# Geotechnical Assessment

Cashmere Oaks Drive, Masterton



# **Geotechnical Assessment Proposed Plan Change** Cashmere Oaks Drive, Masterton

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Copies to: Welhom Developments Limited Electronic copy

> Riley Consultants Ltd Electronic copy

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# Geotechnical Assessment Proposed Plan Change Cashmere Oaks Drive, Masterton

# 1.0 Introduction

The following report has been prepared by Riley Consultants Ltd (Riley) at the request of Welhom Developments Limited. It presents the findings of a geotechnical investigation at the site, and includes comment on geology, geomorphology, natural hazards and considerations with respect to future development of the site. This report has been prepared to support a private plan change request to be submitted to Masterton District Council (MDC).

# 2.0 Summary

The site is generally considered suitable for residential development from a geotechnical perspective with the considerations summarised below:

- The site is underlain by alluvial deposits consisting of clayey silts within the near surface (up to approximately 1.0m below ground level (bgl)) layer which is underlain by silty gravels to depths greater than 15m bgl. Regional groundwater is understood to be between 0.9m and 1.2m bgl across the site.
- There is generally a low risk of instability given the flat nature of the site. The liquefaction susceptibility of the site has been assessed to be negligible based on analysis of cone penetrometer test (CPT) data and general characteristics of the soils.
- The underlaying materials generally provide favourable bearing capacity for future development to adopt shallow foundations.
- Earthworks are anticipated to be minor given the site profile, however, design of final levels across the site will need to consider the relatively significant topsoil layer across the site.
- Soakage is considered to be poor within the near surface clayey silt layer across the site, however, on-site soakage is achievable within the underlying gravel layers sing standard drainage design measures.
- Road pavements will require specific design and a preliminary testing considers a
   California bearing ratio (CBR) value between 3% and 5% is likely available.



# 3.0 Background

# 3.1 Site Description

The site is located on the northern outskirts of Masterton and includes the following lots:

- Lot 1 DP 69308
- Lot 3 DP 516269, Lot 36 DP 429991, Part Lot 9 DP 65445

The site has a total approximate area of 14.7ha. It is presently being subdivided into two lots of 10.4ha and 4.3ha, respectively (site). The lots are currently accessed from the end of Roger Renal Avenue. The site is zoned Rural (Primary Production) and consists of greenfield space which also borders the site to the north. The site is bordered by the rail corridor to the west and rural lifestyle properties to the east. The gradients across the site are predominantly flat to very gently sloping and from aerial imagery appears to be used as pastoral land.

It is proposed to change the zoning of the site from the current Rural (Primary Production) to Residential zoning with provision for a retirement village. We understand that the site may yield up to approximately 254 residential houses at current Residential Zone District Plan density standards. The intention of the assessments to support the rezoning is to provide certainty regarding key requirements for any future residential activity on the site.

# 3.2 Desktop Study

Information available from the infrastructure report prepared for the Cashmere Oaks Subdivision Stage 2, to the south of the site, indicated silty clayey deposits that graded to gravels at approximately 0.8m to 1.2m below the surface. Testing indicated groundwater levels were in the order of 0.9m below the surface and more favourable soakage was apparent within the gravel layers.

Existing information on the single structure to the east of the site shows it was relocated to the site circa 2006 and founded on a shallow foundation system.

Existing information available on the New Zealand Geotechnical Database (NZGD) from nearby investigations, indicated the presence of silty gravels between 0.6m and 1.5m depth. These were typically overlain by cohesive clayey silts. A summary of other geotechnical information is summarised further below.



# 3.3 Geology

Based on our knowledge of the immediate area and a review of IGNS Geological Map Sheet 11 'Wairarapa', the site is inferred to be underlain by Late Pleistocene-age alluvial deposits comprising of a mix of gravel, sand, and silt horizons. Holocene-age alluvium is noted along the Waipoua River channel approximately 500m to the west of the site.

# 4.0 Geotechnical Investigation

Riley has undertaken a subsurface investigation and testing on-site between 22 and 24 September 2021 and the 21 and 22 October 2021 which comprised the following:

- Two machine boreholes (BH1 and BH2) were drilled by ProDrill Ltd to depths of 15.2m, with supervision and logging by Riley. Standard penetration testing (SPT) was undertaken at 1.5m intervals within the machine boreholes to determine in-situ strength.
- Ten hand auger boreholes (HA1 to HA10) were drilled by Riley to depths between 0.7m and 1.4m bgl, where refusal was encountered. Where material encountered was primarily non-cohesive, Scala penetrometer (Scala) testing was undertaken to determine in-situ strength. Similarly, where material was cohesive in nature shear vane testing was undertaken.
- Seven Scala testing (SC01 to SC07) was extended from the surface to 1.0m bgl in order to estimate CBR values for pavement design.
- Six CPTs were carried out by ProDrill Ltd to depths between 1.3m and 1.5m bgl where refusal was encountered.
- Nine falling head soakage tests within HA3, HA5, HA9, BH2, and SP1 through SP5.

Results of all in-situ soil tests, together with detailed descriptions and depths of strata encountered during drilling of the boreholes are appended in the investigation logs. Test locations are presented on the site plan, Riley Dwg: 210422-2 (appended).

# 4.1 Summary of Ground Conditions

The subsoil conditions across the site consisted of a layer of topsoil (200mm to 300mm) generally underlain by a clayey silt layer that is between 0.7m and 1.3m thick. The clayey silts were generally of a stiff to very stiff consistency (65kPa to 126kPa) and were considered to have a low plasticity. Varying amounts of fine to course gravels were encountered within the clayey silt matrix from approximately 0.5m bgl.



Below the clayey silt layer, the material graded to gravels and cobbles that were infilled with silts as well as interbedded bands of finer gravelly silt material. The gravels were generally sub-rounded and graded from medium to course. This layer was generally very dense with Scala tests generally encountering effective refusal (three 10+ counts per 50mm of penetration) and SPTs with the machine holes encountered N-values of 50+. The layer was encountered through to the termination depth of the machine boreholes at 15.2m bgl.

Groundwater was generally encountered across the Site at a depth of approximately 0.8m to 0.9m bgl in the hand augered boreholes. Following completion of the machine boreholes, groundwater was measured at approximately 0.9m bgl, indicating this is likely the approximately level of the regional groundwater. Groundwater was not encountered in the hand augers on the southern portion of the site to a depth of 1.2m although given the ground levels across the site, groundwater is not expected to be significantly deeper than this depth. As previously outlined, similar groundwater levels were encountered in the investigation within the residential subdivision to the south.

#### 5.0 Geotechnical Hazards

# 5.1 Stability and Settlement

The stiff nature of surficial clayey silt layer and the characteristics of the underlying silty gravel layer derived from in-situ testing, combined with the flat profile of the site, mean instability is unlikely.

The soils have low compressibility and are unlikely to result in significant static settlement under development surcharge loading. Specific considerations for building structures are outlined further in this report in Section 5.1.

# 5.2 Seismic Design Considerations

The structural design code requires buildings to be designed for two seismic criteria, Serviceability Limit State (SLS) and Ultimate Limit State (ULS). SLS considers a return period less than the structures design life and requires the designed structure to remain fit for its intended use in the event of an earthquake. ULS considers the highest reasonable return period for the structures use where the design is to ensure that life is protected in the event of a major earthquake.

The Ministry of Business, Innovation and employment (MBIE) and the New Zealand Geotechnical Society (NZGS) have recently reissued several modules for the guidelines titled Earthquake Geotechnical Engineering Practice.



The MBIE and NZGS Module 1 Guidelines provide interim recommendations for the derivation of ground motion parameters. The methods presented in this report are interim and the detailed design should account for these guidelines or the revised method.

Method 1 is used to derive the ground motion parameters. These are summarised in Table 1 for an importance Level 3 (IL3) and IL2 type structure.

Table 1: Seismicity Parameters used for Preliminary Liquefaction Analysis

Limit State	Return Period (years)	PGA (g)	M <sub>w</sub>
ULS (IL3)	1000	0.91	7.7
SLS	25	0.13	6.5

# 5.3 Liquefaction

Liquefaction typically occurs in recent (i.e., typically less than 10,000-years old), normally consolidated silt and sand beneath the groundwater table. It is dependent on soil density, grain size, and soil composition. Liquefaction analysis was undertaken using the CPT data collected, seismic parameters in Table 1, and a groundwater level of 0.8m, which is considered to be appropriate for the site.

The method by Boulanger & Idriss 2014 has been used in assessing liquefaction settlement. Liquefaction analysis of the CPTs, using the parameters outlined in Table 1 with CLiq software, indicated that liquefaction induced settlements for both design earthquake scenarios are likely to be less than minor (<15mm) and are consistent with Technical Category 1 (TC1) levels of settlement as outlined in the Ministry of Business, Innovation and Employment Christchurch Earthquake Guidelines.

Note that the liquefaction analysis has only considered the near surface soil layer (up to approximately 1.4m bgl) due to refusal at the gravel layer. The in-situ tests indicate the gravel layer is generally dense to very dense and the infilled silt and clay material indicate there is low potential for liquefaction in this layer. Detailed CPT results and calculations are appended.



#### 5.4 Faults

Based on information provided in the GNS New Zealand Geology Webmap, the Masterton Fault is approximately lkm south of the site with an east-to-west trajectory. The fault is known to be active with dextral movement (northern side of the fault effectively moving laterally to the east). As the fault does not pass in proximity of the site, it is not expected that significant differential ground movement will occur as a result of fault movement.

# 6.0 Site Development Suitability

# 6.1 Building Foundations

Shear strengths in the near surface soils indicate that there is suitable bearing capacity for one to two-storey timber structures to be founded on conventional shallow foundations designed in general accordance with NZS 3604:2011. A soil expansivity class of Class M (moderately reactive clays and silts) would be recommended with respect to AS 2870.

Therefore, subsurface material is suitable to facilitate structures consistent with those typically proposed within Residential zoning subject to future resource consent assessments and detailed design. Where structures fall outside the scope of NZS 3604 specific design will be required, however, subsurface conditions are favourable for shallow foundation designs.

# 6.2 Roading

Surficial Scala testing up to 1m bgl returned CBR values for preliminary pavement design in the order of 3% to 5%. If greater values are required, subgrade improvement via either undercutting and replacement, cement/lime stabilisation or dynamic compaction may be required. Further investigation should be undertaken once road layout and pavement depths have been further developed.

# 6.3 Soakage Assessment

From review of the soakage tests done within the neighbouring Cashmere Oaks Subdivision to the south of our site, it appears a soakage rate of 334mm/hour was adopted for their design.

The on-site soakage testing conducted by Riley indicates that soakage rates are poor within the near surface clays and silts. However, soakage within the underlying gravel has been tested to be approximately 300mm/hour and onsite soakage can be achieved using standard draining design measures.



#### 6.4 Earthworks

The generally flat nature of the Site indicates only minor cut and fill earthworks would likely be required for any future development of the Site, primarily for roading construction and stormwater flow path purposes. Given fill is likely to be limited and subsurface conditions indicate generally stiff material, consolidation settlement is considered unlikely.

Further assessment should be undertaken at resource consent stage to determine what mitigation measures such as preloading (if any) is required and what appropriate engineering solutions should be incorporated into detail design. It is considered that standard engineering solutions can be applied to manage any site geotechnical matters with future development.

### 7.0 Limitation

This report has been prepared solely for the benefit of Welhom Developments Limited as our client and Masterton District Council in processing the plan change. 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 report 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.





# Appendix A **Investigation Logs**





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# GEOTECHNICAL AND **GEOLOGICAL INFORMATION**

#### SOIL TYPES AND SYMBOLS



FILL





**TOPSOIL** 

SILT SAND

**GRAVEL** 

CLAY

**PEAT** 

GROUNDWATER LEVEL

10,11,10

SCALA PENETROMETER LAST 3 NUMBER OF BLOWS PER 50mm INCREMENT

## **ROCK TYPES AND SYMBOLS**



SANDSTONE



**BASALT** 



SILTSTONE



TUFF



MUDSTONE



**IGNIMBRITE** 



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	Л	FIELD IDENTIFICATION	UNCONFINED UNIAXIAL COMPRESSIVE STRENGTH (MPa)
Extremely weak	(EW)	Indented by thumbnail.	< 1
Very weak	(VW)	Crumbles under firm blows wit point of geological hammer. Can be peeled with pocket kni	
Weak	(W)	Difficult to peel with pocket kr	nife. 5 – 20
Moderately strong	(MS)	Cannot be scraped or peeled with pocket knife.	20 - 50
Strong	(S)	More than one blow of geologi hammer to fracture.	ical 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



DISTURBED

HAND AUGER DISTURBED

(solid cone)



STANDARD PENETRATION TEST



STANDARD PENETRATION TEST (hollow cone)

#### DRILLING METHOD

OB OPEN BARREL TT TRIPLE TUBE WB WASH BORE UNDISTURBED SH SHELBY TUBE RC ROCK CORE

STANDARD

PENETRATION TEST

SPT

#### FIELD TESTS

V SHEAR VANE (corrected to BS:1377) R REMOULDED STRENGTH Ρ 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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soil)

CONSULTANTS LTD,

RILEY

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22 Moorhouse Avenue Addington CHRISTCHURCH 8011 Ph: 03.379.4402

MACHINE HOLE LOG E: riley.co.nz Email: rileychch.co.nz Project No.: **Project Name: Project Location:** No.: 210422 Masterton Due Diligence Roger Rennal Drive, Lansdowne, Masterton **BH01** Client: Start Date: 20 Sep 2021 Hole Location: Refer to site plan Welhom Development Ltd End Date: 20 Sep 2021 Ground Level (NZVD 2016): Hole Depth: Inclination: Azimuth: Sheet: Co-ordinates (NZTM): E 1824517, N 5465706 15.20 m 90° N/A 1 of 2 123 m **Geological Description** Groundwater Core Elevation (m NZVD 2016 In-Situ Depth (m) Method Field Strength Loss Legend Run Geological Testing Sample / Laboratory Testing (%) In accordance with NZGS Guidelines (2005) Data / Refer to "Geotechnical and Geological Information" sheet Soil Rock Results for explanation of legend and abbreviations 25 50 75 SILT (TS SI), with minor sand, with trace rootlets and clay; brown. Firm; low plasticity; moist; sand, fine to medium; [TOPSOIL]. × Clayey SILT (CL SI), with trace sand; light orange brown with grey mottling.

Firm to stiff; low plasticity; moist to wet; sand, fine to medium; [Q2A ALLUVIUM]. \$\langle \cdot \cd Silty GRAVEL (CL SI), with minor clay and sand and cobbles; bedded. Very dense; low plasticity; wet to saturated; gravel, medium to coarse, subround to rounded, slightly weathered; sand, fine to medium; Predominantly clast supported, greywacke. ¥ 1.50 SPT 1.50 m ог і і.50 m 8, 18 / 19, 16, 15 medium; Predominantly clasts supported, groyndams:

INTERBEDDED WITH Gravelly SILT (GR SI), with minor clay and sand; bedded.

Very stiff; low plasticity; wet to saturated; gravel, medium to coarse, subround to rounded, slightly weathered; sand, fine to Nc=50 for 125 1.25m: Greyish brown to yellowish brown. 2.00m - 3.00m: Grades to yellowish brown; gravelly SILT. 2.60 126 SPT 3.00 m 3, 6 / 11, 19, 21, 10 for 40mm Nc=50 for 265mm core drilling 127 Sonic 4.50 SPT 4.50 m 4.50m: Grades to orange brown. 8, 8 / 8, 11, 21, 10 for 35mm Nc=50 for 128 129 SPT 6.00 m 6.10 5, 11 / 19, 15, 13, 3 for 5mm Nc=50 for 6.10m: Grades orange brown to yellowish brown. 230mm 130 SPT 7.50 m 9, 13 / 13, 14, 13, 10 for 7.60 50mm Remarks **Explanations:** Backfill: Co-ordinates and elevation are approximate and subject to survey confirmation.
 Strength terms are based on SPT testing where appropriate, otherwise based on ▼ Standing Water Level Standard Penetration Test (SPT)
Filled = Solid cone (C) Topsoil Clav **Bentonite** ← Out flow Peat Silt Grout/concrete No Fill = Split spoon (S) In flow Moisture: Vane Shear Strength (kPa) Fill Sand Drill arisings M = moist W = wet V=Peak, R=Residual UTP=Unable to penetrate Core Loss Gravel Filter sand S = saturated Driller: Logged By: Checked By: Drilling Rig ID: **Drilling Contractor:** All dimensions in metres **NOT TO SCALE** PRO-DRILL Sonic Dual Head Keith AvD SRO



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22 Moorhouse Avenue Addington

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MACHINE HOLE LOG E: riley.co.nz Email: rileychch.co.nz Project No.: **Project Name: Project Location:** No.: 210422 Masterton Due Diligence Roger Rennal Drive, Lansdowne, Masterton **BH02** Client: Start Date: 17 Sep 2021 Hole Location: Welhom Development Ltd End Date: 17 Sep 2021 Refer to site plan Ground Level (NZVD 2016): Hole Depth: Inclination: Azimuth: Sheet: Co-ordinates (NZTM): E 1824613, N 5465658 15.20 m 90° N/A 1 of 2 125 m Groundwater Core **Geological Description** In-Situ Elevation NZVD 201 Depth (m) Method Field Strength Loss Legend Run Geological Testing Sample / Laboratory Testing (%) In accordance with NZGS Guidelines (2005) Data / Refer to "Geotechnical and Geological Information" sheet Soil Rock Results Ξ for explanation of legend and abbreviations 25 50 75 SILT, with minor sand, with trace rootlets and clay; brown. Firm; low plasticity; moist; sand, fine to medium; [TOPSOIL]. TS ×× Clayey SILT, with trace sand; light orange brown with grey mottling.
Firm to stiff; low plasticity; moist to wet; sand, fine to medium; × × × × × [Q2A ALLUVIUM]. ¥ 126 Silty GRAVEL (GR SI), with minor clay and sand and cobbles; bedded. Very stiff; low plasticity; wet to saturated; gravel, medium to SPT 1.50 m 8, 10 / 18, 14, 12, 6 for 50mm 1.50 SPT Rec: ~200 mm coarse, subround to rounded, slightly weathered; sand, fine to medium; Predominantly clast supported, greywacke.
- INTERBEDDED WITH -N=50 for Gravelly SILT, with minor clay and sand; bedded.
Very stiff; low plasticity; wet to saturated; gravel, medium to coarse, subround to rounded, slightly weathered; sand, fine to 127 medium: Lenses. 1.25m: Greyish brown. 1.50m - 3.90m: "claybound". 128 -SPT 3.00 m SPT Rec: ~250 mm 3, 10 / 21, 22, 18, 10 for 50mm N=50 for core drilling Q2A ALLUVIUM 3.90 129 Sonic SPT 4.50 m 4.50m: Grades to orange brown. 4.60 10, 15 / 21, 20, 9 for 40mm Nc=50 for 130 5.50m: Grades to yellowish brown; gravelly SILT. 131 6.10 SPT 6.10 m 6.10m: Grades to bluish grey. 8, 17 / 20, 20, 10 for 30mm Nc=50 for 180mm 132 7.60 SPT 7.60 m 8, 25 / 40, 10 for 25mm Remarks **Explanations:** Backfill: Co-ordinates and elevation are approximate and subject to survey confirmation.
 Strength terms are based on SPT testing where appropriate, otherwise based on ▼ Standing Water Level Standard Penetration Test (SPT)
Filled = Solid cone (C) Topsoil Clav **Bentonite** field description

3. Undertaken during period of persistent rain. Out flow Peat Silt Grout/concrete No Fill = Split spoon (S) In flow Moisture: Vane Shear Strength (kPa) Fill Sand Drill arisings M = moist W = wet V=Peak, R=Residual UTP=Unable to penetrate Core Loss Gravel Filter sand S = saturated Driller: Logged By: Checked By: Drilling Rig ID: **Drilling Contractor:** All dimensions in metres **NOT TO SCALE** PRO-DRILL Sonic Dual Head Keith AvD SRO



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15.20				х <i>О</i> с	END OF I	HOLE: 15.20m							SPT 15.20 r 9, 23 / 20, 1 12 for 50mn Nc=50 for 200mm	8,			
Explanation Standing Water Leve Out flow In flow Moisture: M = moist W = wet S = saturated		fer to "Ge Standai (SPT) Filled = No Fill: /ane Sh /=Peak, JTP=Un	Solid of Solid of Solit of Solit of Solid	etration cone (C spoon rength ( sidual	n Test	Information" she	Cla	nd 2	Backfill Bentonite Grout/cor Drill arisir	ncrete	1. Co 2. St field	marks o-ordinates and ele trength terms are b description ndertaken during p	ased on SPT	testing whe			
All dimens	sione	in me	tres	Drilli	ing Cont	ractor:			Drillin	g Rig II	<u>—</u> D:		Driller:		Logged By	: Checked	Bv:
NOT			63		D-DRILL					Dual H		l	Keith		AvD	SRO	



All dimensions in metres NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622 Ph: 09.489.7872 22 Moorhouse Avenue Addington CHRISTCHURCH 8011 Ph: 03.379.4402 Email: rileychch.co.nz

# HAND AUGER LOG

	COI	NSUI	TAN	Ph: 09.489.7872 Ph: 03.379.44 E: riley.co.nz Email: riley.chd	TIAND AGGEN EGG											
<b>Proje</b> 21042	ct No.	:	l l	oject: asterton Due Diligence		Project Location: Roger Rennal Drive, Lansdowne, Masterton						No.:				
	Auger	ed:	IVIC	Client:			le Loc		<u> </u>	viasicii		HA01				
	p 202			Welhom Development Ltd	T =		fer to									
130 m		/el (m	NZVI	Co-ordinates (NZTM): E 1824440, N 5465847	pth	:	Refu	son Terminated: sal		l	Shed 1 of					
		<u>a</u>	1	Geological Description		Water / Moisture			Soil Shear		Scala					
Elevation NZVD 2016	Depth (m)	Geological Unit	Legend	In accordance with NZGS Guidelines	rdance with NZGS Guidelines (2005)			ples	Strength (kPa)					itu ing a	II / Ins	
n NZ	Dep	Geo Geo	Le	Refer to "Geotechnical and Geological Information" sheet for explanation of legend and abbreviations					△ Residual ● Peak 50 100 150 200	5		In Situ   Figure   Fi			Backfi	
			TS W	SILT, trace clay and organics; brown with white s low plasticity.	pecks. Moist;	Ĺ									SC.	
		JIL	т т.	1				_					0, 1, 0 1, 1, 1			
†	-	TOPSOIL	TS w					0m, 1_0.1		•			2, 1, 1 1, 2, 1			
		·	T.										1, 2, 2 3, 3, 3		Ş	
129.80	0.20		××××	SILT, with minor clay; light brown with orange mo	ttles. Stiff;	1							19, 8			
			× × × × × ×	moist, low plasticity.						•					800	
+	-		× × × ××. ×							•						
			× × × ×												)C	
+	-		× × ×			М				•						
			^x							•					12	
130.5	- 0.5	M	×××				■ 0.5	50m, 1_0.5	Δ	•			~ <u>}</u>	V=65 R=26	_\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	
		LLUVII	×× × × × ×					0.0					'	. 20		
1	-	Q4A ALLUVIUM	× × ×												- 次	
			× × × ×	0.60m - 0.90m: Grades to clayey.												
	_		××												Ž	
			× × ×												6	
			$\frac{\times}{\times} \frac{\times}{\times}$													
1	-		× × ×	0.80m: Grades to include fine gravel; wet.										•	100	
129.10	0.90		- <u>×</u> -×			l w				1						
			× ×	0.90m: Grades to hard; saturated.					•	1		·		UTP		
				END OF HOLE: 0.90m								<b>~</b>				
131.0	<b>-</b> 1.0										•	1	*	1.0-	1	
†	•														-	
+	-														1	
+	-														1	
+	-														-	
		_					<u></u>				-					
Ctor	ndina			regical and Geotechnical Information" sheet for further deta					ordinates and elevation	are appro	oximate	and su	ıbject to sur	vey		
▼ Wat	er Level flow	110	w data in	trometer Tests blows per 50mm  Strongth (kDs)		tonite		confirm 2. Stre	nation. ength terms are based or	ı shear v	ane test	S.				
├─ In-flo Moistu	re:	V =	= Peak, R	Strength (kPa) Peat Silt R = Residual Dole To Penetrate Fill Sand	×	ut/cor arisir	ncrete     nas	3. Site	testing undertaken durir	ng period	or pers	istent r	rain.			
M = mo W = we S = sate	t	UI	r - Unai	ole To Penetrate Sand Core Loss Grave		er san	· II									
		ons i	n metro		Instrun	nent	Detail	s:	Shea	r Vane	No.:   I	_ogge	ed By: CI	hecked	By:	

Hand Auger 70mm



NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622 Ph: 09.489.7872 22 Moorhouse Avenue Addington CHRISTCHURCH 8011 Ph: 03.379.4402

# HAND AUGER LOG

Project No.: 210422  Project:  Masterton Due Diligence  Roger Rennal Drive, Lansdowne, Masterton  Project Location: Roger Rennal Drive, Lansdowne, Masterton  Refer to site plan    Hole Location:   Refer to site plan	D2 ta go (m)
Date Augered: 15 Sep 2021   Welhom Development Ltd   Welhom Development Ltd   Refer to site plan	하는 전 보다 한 전 보다 (m) Populi (m) Backfill / Install
Sep 2021   Welhom Development Ltd   Refer to site plan	하는 전 보다 한 전 보다 (m) Populi (m) Backfill / Install
Table 1	
Geological Description  Geological Description  In accordance with NZGS Guidelines (2005) Refer to "Geotechnical and Geological Information" sheet for explanation of legend and abbreviations  Samples  Soil Shear Strength (kPa)  Residual Peak 50 100 150 200 5 10 15  Data/Residual Signature  Stamples  Soil Shear Strength (kPa)  Penetrometer (blows/50mm) Data/Residual Signature  Signature  Stamples  Soil Shear Strength (kPa)  Soil Shear Strength (kPa) Soil Sh	
E SULT. minor to some clay, trace organics: brown, Moist.	
E SULT. minor to some clay, trace organics: brown, Moist.	
SILT. minor to some clay, trace organics: brown, Moist.	
TS ogdinos, rootets.	
T   TS \\\   TS \\\\   TS \\\\\   TS \\\\\   TS \\\\\   TS \\\\\   TS \\\\\   TS \\\\\\   TS \\\\\\   TS \\\\\\\\\   TS \\\\\\\\\\	
	Ş
	-52
TS_W TS_W TS_W TS_W TS_W TS_W TS_W TS_W	Ş
129.70 0.30 W TS	
X X X   Clayey SILT; light yellowish brown with orange mottles. Very   Stiff; moist; low plasticity.	200
1905—0.5   X X X X X X X X X X X X X X X X X X	/-126 (74) (-126 (97)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	/=126 <sub>0.5</sub> R=40
	Q
The second secon	70
0.60m: Grades to cream and orange.	ŞŞ
+   \delta \delta \times \tin \times \times \times \times \times \times \times \times \times	-02 -02
	200
	- 02 - 03
X X X   0.80m: Grades to include trace fine to coarse gravel. Wet.   W   W	
1	174 175 176
0.90m: Grades to minor to some gravel. Saturated.	
129.00 × × × × × × × × × × × × × × × × × ×	Ç
END OF HOLE: 1.00m	
	1 1
	1 1
	-
	-
Explanations: Refer to "Geological and Geotechnical Information" sheet for further details.  Standing Code Department of Table 1	/ey
✓ Water Level       Scala Penetrometer Lests       Topsoil       Clay       Bentonite       confirmation.         2- Out-flow       2. Stength terms are based on shear vane tests.	
In-flow	
M = moist W = wet	
All dimensions in metres   Contractor (if applicable):   Instrument Details:   Shear Vane No.:   Logged By:   Ch	seeked By

Hand Auger 70mm



All dimensions in metres NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622 Ph: 09.489.7872

Contractor (if applicable):

22 Moorhouse Avenue Addington CHRISTCHURCH 8011 Ph: 03.379.4402 Email: rilevchch.co.nz

# **HAND AUGER LOG**

C	COI	NSU	LTAN	TS Ph: 09.489.7872 Ph: 03.379.4 E: riley.co.nz Email: riley.co								70	OL					
	ct No.	:	1	oject:			oject L						No.:					
21042	22 Auger	od:	Ma	asterton Due Diligence Client:		Roger Rennal Drive, Lansdowne, Masterton  Hole Location:									HA03			
	p 202			Welhom Development Ltd		Refer to site plan							IIAUS					
Grou	nd Lev	vel (m	NZVI		Hole De	pth	ı:	Reas	on Tern	ninated:		Sheet:						
130 n	n			E 1824531, N 5465771	1.15 m			Refu	sal				1 0	f 1				
Elevation m NZVD 2016	Œ	<u>a</u>	D	Geological Description	1	Water / Moisture				Shear			Scala In S			Depth (m) Backfill / Install		
evati ZVD	Depth (m)	Geological Unit	Legend	In accordance with NZGS Guideline Refer to "Geotechnical and Geological	s (2005) Information"	r/Mo	Sam	oles		gth (kPa)	(b	enetron ows/50		Te	esting	£ =		
ii izi	De	Ge		sheet for explanation of legend and ab	breviations	Wate			△ Residua 50 10	ıl ● Pea 0 150 20		5 1 <sub>0</sub>	15	Data	/Results	Back		
			் L2 ்ா	SILT, minor to some clay, trace organics; brown plasticity; organics, rootlets.	n. Moist; low											37		
			ホポ TS ホポ エS ホ LS ホ											0, 1, 0 1, 1, 0				
+	_		LS TA				0.1 HA3	0m, _0.1			•			1, 0, 1		$+$ $^{\prime}$ $^{\prime}$		
		TOPSOIL	TS T	1										1, 2, 1 2, 1, 1				
		힏	™_T.											2, 1, 1 1, 1				
			⊥2 	1														
			Th Th								1							
129.70	0.30		$\times$ $\times$ $\times$	Clavey SILT: light brown with orange mottles. V	ery stiff; moist;	М										-63		
			<u>* * * * * </u>	iow plasticity.							•							
4	_		× × ×													-03		
			× × ×															
			× × ×				_ 0.5	0m,							V=110			
130.5	- 0.5		× × ×				HA3	0.5	Δ	•	Ì				∨ V=119 <sub>0</sub> R=29			
			××××								•					Og		
4	-	× × × × ×				_	-				•					-33		
																Qq		
		<u>⊠</u>	× × ×			ļ.,,												
1	_	ILUV	× × × × × ×			w												
		Q4A ALLUVIUM	× × ×								•							
+	-		× × ×	0.00 Cdttd			-				•					-03		
			× × × ×	1														
			×××			4												
			× × × × × ×	0.90m: Grades to trace fine to medium gravel.	Saturated.	`												
			×××			s					•					Qq		
131.0	<b>-</b> 1.0		× × ×	1.00m: Grades to minor gravel, fine to coarse.				0m, i_1.0	Δ	•	ŀ			▼	V=123 <sub>1</sub> R=19			
			××××													(S)		
4	_		×××								•			1007				
128.85	1.15		× × ×										<u> </u>	2, 3, 7 12, 17		Q2		
				END OF HOLE: 1.15m							)							
1	-											•				1		
												`						
+	-												•	ļ!		+		
Explai	nations	: Refe	r to "Geol	pgical and Geotechnical Information" sheet for further d	etails.		<del>'  </del>	Rema	arks			. :	-	<u> </u>		艹		
-	nding ter Level			etrometer Tests	888888	tonite			ordinates a	nd elevation	on are ap	proxima	te and s	subject to	survey			
◆ Out	-flow	110		r Strength (kPa)				2. Stre	ngth terms testing un					rain				
├─ In-fl Moistu	re:	V	= Peak, F	R = Residual ble To Penetrate  Fill  San	22.3	arisir			ng head te						this hole.			
M = mo W = we	et	5	0114	IN Core Loss Gra	N-C	r san	· II											
S = sat	urated			CAL	4 . 4 . 4		- 11											

Instrument Details:

Hand Auger 70mm

AvD

Shear Vane No.: Logged By: Checked By:

RJF



All dimensions in metres NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622 Ph: 09.489.7872 22 Moorhouse Avenue Addington CHRISTCHURCH 8011 Ph: 03.379.4402 Email: rileychch.co.nz

# **HAND AUGER LOG**

	CON	NSUL	TAN	TS Ph: 09.489.7872 Ph: 03.379 E: riley.co.nz Email: riley						•	17	.171	<i>,</i>	10	OL	·		
Project		:		oject:		I	oject Lo									N	o.:	
210422 Date A		ed:	Ma	asterton Due Diligence Client:			ger Rer			Lans	down	e, M	aster	ton	-	Н	۹04	
15 Sep	2021	1		Welhom Development Ltd		Re	fer to si									1 17	10+	
Ground 130 m	d Lev	/el (m	NZVI	Co-ordinates (NZTM): E 1824637, N 5465759	1.00 m	epth	I	Reas Refu	son Te	ermin	ated	•			She 1 of			
		_	<u>_</u>	Geological Descriptio	1	<u>e</u>		T								•		=
ation D 20	Depth (m)	ogica nit	Legend	In accordance with NZGS Guidelin		Moistu	Samp	عما		Soil SI rength		)		Scala netron	neter		Situ	/ Inst
Elevation NZVD 2016	Dept	Geological Unit	Leg	Refer to "Geotechnical and Geological sheet for explanation of legend and a	Information"	Water / Moisture	Camp		△ Res					ws/50			Results	Depth (m) Backfill / Install
E			TS <sub>W</sub> W	SILT, some clay, trace organics; brown. Moist;		>			50	100	150 20	00	5 :	10	15			
		_	Ts										. :			0, 0, 1		
+		TOPSOIL	LS TR TS TR TR TR				0.10 HA4_									0, 0, 1 1, 1, 0		
		70	TS				_						•			2, 0, 1 2, 2, 1		(V)
129.80	0.20		™_T.Z													3, 4, 3 4, 6		
			<u> </u>	Silt, some clay, trace organics; brown with oral Moist; low plasticity; organics, rootlets.	nge mottles.													Q2
			× × × ×															
Ť			× × ×			M							1					
			× × ×										•					
+			× × ×	0.40m: Grades to no organics; light brown with	orange streaks.				Δ	•			<b>,</b>			ļ	V=110 R=23	-03
			× × ×															8
130.5	).5		<u>× × ×</u>				0.50 HA4	m, 0.5					<b>)</b>				0	5-85 5-85
		Σ	<u> </u>				""	_0.0					/					
		רחאוח	× × × ×															200
T		Q4A ALLUVIUM	× × ×	0.60m: Grades to clayey; wet.														
		ď	× × ×			W												77
†			× × ×	0.70m: Grades to saturated.									<b>†</b> :					
			× × ×										<b>\</b>					
+			× × ×										•					
			× × × × × ×			s							•					
1			<u>×</u> ××	-								•	4				√ UTP	<u>_</u> @
			× × ×	0.90m: Grades to include trace fine gravel.									\					
129.00 131.01	1.00		× × ×				1.00	ım,					À			<b>*</b>	4	Ş
131.0				END OF HOLE: 1.00m			HA4_	_1.0								•		
															•	13, 7, 3 4, 3, 12		
†													1	•		6, 15, 16		-
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•		: Refer	to "Geolo	ogical and Geotechnical Information" sheet for further	details.		- 11	Rema			-1							
▼ Stand Water	Level			etrometer Tests  n blows per 50mm	ay Ber	itonite	·    c	confirn	ordinate nation. ngth te							ubject to s	survey	
Out-flow	v	∨Va	ne Shea	r Strength (kPa)	d Gro	ut/cor									rsistent	rain.		
Moisture M = mois W = wet				ble To Penetrate Fill Sa	×-0	arisir	·											
W = wet S = satura	ated			Core Loss Gra	avel Filte	er san	d											
All dim	ensi	ons ii	n metr	es Contractor (if applicable):	Instrun	nent	Details	:			Sł	near '	Vane	No.:	Logg	ed By:	Checked	d By:

Hand Auger 70mm

AvD

BCF



All dimensions in metres NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622 Ph: 09.489.7872 22 Moorhouse Avenue Addington CHRISTCHURCH 8011 Ph: 03.379.4402

# **HAND AUGER LOG**

CC	USNC	LTAN	TS Ph: 09.489.7872 Ph: 03.37 E: riley.co.nz Email: rile	9.4402 eychch.co.nz								IN LOO	
Project N	o.:	l l	roject:		I	oject L						No.:	
210422 <b>Date Aug</b>	ered:	Ma	asterton Due Diligence Client:			ger Re		Orive, Lans	downe, N	lasterto	on	HA05	
15 Sep 20			Welhom Development Ltd		I	fer to s						IIAUJ	
Ground L	.evel (n	n NZVI	<b>Co-ordinates (NZTM):</b> E 1824442, N 5465657	Hole D	epth	Ī	Reas Refus	on Termin	ated:		<b>She</b> 1 o		
130 m		<u> </u>			Φ.		Reius	Sai		1	10	1	
Elevation NZVD 2016 Depth (m)	Geological	pue	Geological Description		Water / Moisture			Soil Sh Strength			Scala etrometer	In Situ	Depth (m) Backfill / Install
Elevation NZVD 207 Depth (m)		Legend	In accordance with NZGS Guideli Refer to "Geotechnical and Geological and Geologi	al Information"	iter / N	Samp	- 1	△ Residual			/s/50mm)	Testing Data/Results	Depth (m) Backfill /
<u> </u>	+	TS	sheet for explanation of legend and SILT, minor to some clay, trace organics; bro		Wa			50 100	150 200	5 :	10 15		Ba
		TS TS	plasticity.	wii. Wolst, low								0, 1, 0	
1		™TS				0.10						1, 2, 0 1, 1, 0	200
	TOPSOIL	TS TS				HA5	_0.1					1, 1, 1 1, 1, 1	
	-	™ TS										2, 2, 4 5, 6	200
†		TS *								•			
129.75 0	).25	× × ×	Clayey SILT, trace organics; yellowish brown	. Stiff; moist; low	1					<b> </b>			
+		× × ×	plasticity, organiss, resticts.										-03
		× × ×								•			20
1		× × ×			м					•			- Q
		× × ×	0.40m: Grades to no organics.										
130.5 0.5		<u>× × ×</u>				0.50	)m,	Δ				V=90	
130.3 0.3		× × ×				HA5	_0.5					* R=24 *	
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†	≥	× × ×								•			-12
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1		× × ×	-1										
		× × ×		9.	w								
		×××											00
T		× × ×	0.90m: Grades to white / orange / brown; sat	urated.	7					Ţ			
		× × ×				4.00	_			•			ģ
131.0 1.0		<u>× × ×</u>			S	1.00 HA5	_1.0			•		1	
		<u>× × ×</u>	1 3 -										Ş
128.90 1	1.10	× × ×	END OF HOLE: 1.10m		+							20	50
+													+
1													
T													
Explanatio	ns: Refe	er to "Geolo	ogical and Geotechnical Information" sheet for further	r details.	-	- 11	Rema			<u> </u>		1	
Standing Water Lev	vei		etrometer Tests n blows per 50mm	lay Ber	ntonite	•    •	confirm	nation.				subject to survey	
Out-flow In-flow	∨V:	ane Shea	r Strength (kPa)	ilt Gro	ut/cor			ngth terms are testing under				t rain.	
Moisture: M = moist			Sis 10 1 chickets	and Dril	l arisir	ngs							
W = wet S = saturated	t		CAL Core Loss G	Filt	er san	d							
All dimen	sions i	n metr	es Contractor (if applicable):	Instrur	nent	Details	:		Shear	Vane N	No.: Logg	ged By: Checke	d By:

Hand Auger 70mm

AvD

RJF



All dimensions in metres NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622

22 Moorhouse Avenue Addington CHRISTCHURCH 8011

# **HAND AUGER LOG**

	COI	NSU	LTAN	TS Ph: 09.4 E: riley.c		Ph: 03.379.4402 Email: rileychch						_			-					
<b>Proje</b> 21042		:	I	oject: asterton Due [	Diligence				<b>oject Lo</b> ger Ren			Lanso	downe	, Ma	ster	ton			o.:	
Date A			•	Client:	ralammant I td				le Loca								1	HA	<b>406</b>	
16 Se			NZVI		elopment Ltd		Hole De		fer to sit			rmin	ated:				She	et.		
130 m				E 1824615, I			0.90 m	<b>P</b>		Refus			utou.				1 of			
116		<u></u>			Geological De	scription	•	inre				Soil Sh	near .			Scala				tall
atior D 20	m) h	ngić.	Legend		dance with NZGS		2005)	Moist	Sampl	ا ود			ieai (kPa)		Pen	etrom	eter		Situ sting	/ Ins
Elevation NZVD 2016	Depth (m)	Geological Unit	Leg	Refer to "Ge	eotechnical and ( xplanation of leg	Geological Info	rmation"	Water / Moisture	Cumpi	- 1	Resid	dual	• Pea	k	(blo	ws/50	mm)		Results	Depth (m) Backfill / Install
Ε		-	TS Ч⊻		y, trace organics; br			⋛		+	50	100 1	50 20	)	5 :	10	15			
			TS.	OIL1, SOME CIA	y, trace organics, bi	own. Moist, low	plasticity.													
			™TS						0.10r	n,				l				0, 1, 1 1, 1, 0		856
Ī	-	1	TS T						HA6_	0.1								1, 0, 1 0, 1, 1		
		TOPSOIL	T.S.											•				1, 1, 1 1, 1, 3		Ç
+	-	-	Ψ TS											•				3, 3		
			TS T																	Ş
129.70	0.30		ጥ LS ጥ ጥ																	2
	• · · · · · · · · · · · · · · · · · · ·		× × ×	Clayey SILT; ta	n with orange mottle	es. Stiff; moist; lo	ow plasticity.											İ		
			×××											•						
+	-		× × ×					м										į		-03
			×××															İ		
400.5	0.5		<u>×××</u>	,					- 0.50r	n,	Δ								V=87 0.	Qi
130.5	- 0.5		×××						HA6_	0.5	-								R=23	
		24A ALLUVIUM	× × ×											•						Ş
+	•	ALLU	× × ×											•						\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
		Q4A,	××××																	Ç.
			××××	1																
Ī	-		$\times$ $\times$ $\times$																	
			××××	0.75m: Grades	to trace to minor fin	e gravel.								ļ.						
+	-		× × ×	0.80m: Grades	to wet.			Н						•				ļ		
			×××	1				w						Į.						
129.10	0.90		×××						0.90r					•	\ <u> </u>		<u>.</u>	ļ	⊬-(-)TP	
				ļ	to hard; saturated.			1	HA6_	0.9										
				END OF HOLE:	0.90m															
131.0	<b>-</b> 1.0														•			*	1.0	۱ ۲
															•			6, 5, 20		
1															•					11
Ť	•																			11
+	-																			- 1
	_																			
1																				
Evola	nation	. p-f	r to "C'	onical and Co-f'	ical Informatica " - '	at for further date."		<u>Ш</u>		Remar	: rks	-	<u>: i</u>		-	:	:			
Star	nding	Sc		ogical and Geotechn strometer Tests	ical Information" shee			onit.	1	Co-or	rdinate	s and	elevatio	n are	appr	oximat	e and s	ubject to s	urvey	
<b>√</b> Out-		Ra	aw data ir	n blows per 50mm	Topsoil	Clay		tonite	2		igth ter		based					roin		
├─ In-flo Moistu		V	= Peak, F	r Strength (kPa) R = Residual	Peat	Silt	× >			Site t	esting	unaert	aken d	uring p	erio	а от ре	rsistent	rain.		
M = mo W = we	ist	UT	IP = Una	ble To Penetrate	Fill Core Loss	Sand		arisin r sand												
S = sati	urated			Γ-	- UL	[++]]	** * **		IL				T -							
All di	mensi	ions i	n metr	es   Contract	or (if applicable	ie):	Instrum	ent	Details:				Sh	ear V	ane	NO.:	Logg	ea By:	Checked	By:

Hand Auger 70mm

AvD

RJF



All dimensions in metres NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622 Ph: 09.489.7872

Contractor (if applicable):

22 Moorhouse Avenue Addington CHRISTCHURCH 8011 Ph: 03.379.4402 Email: rilevchch.co.nz

# **HAND AUGER LOG**

CON	ISUL	TAN	Ph: 09.489.7872 Ph: 03.379. E: riley.co.nz Email: riley.					'			<b>~</b> O`	OL.	IV EOO	
Project No.:		1	oject:			oject L							No.:	
210422		Ma	asterton Due Diligence			-		Orive, Lans	downe, N	/laste	erton	4	11407	
Date Augere 16 Sep 2021			Client: Welhom Development Ltd			ole Loc efer to s							HA07	
Ground Lev		NZVI	Co-ordinates (NZTM):	Hole De				on Termi	nated:			She		
130 m			E 1824502, N 5465597	0.70 m	_		Refus	sal				1 of	3	
on 2016 (m)	cal	g	Geological Description	n	isture			Soil S		l _	Scala		In Situ	nstall
Elevation NZVD 2016 Depth (m)	Geological Unit	Legend	In accordance with NZGS Guideline Refer to "Geotechnical and Geological	Information"	Water / Moisture	Sam		Strengtl  A Residual	, ,		enetrom ows/50		Testing Data/Results	Depth (m) Backfill / Install
_ E		LS <sup>TT</sup> TA	sheet for explanation of legend and al SILT, trace to minor clay, trace organics. Moist		×			50 100	150 200	-	5 10	15		Ba Ba
		™TS ™	organics, rootlets.	, low plasticity,						,			0, 1, 0	
		TS					0m,						2, 1, 1 1, 1, 0	Š
	SOIL	™TS TS TS				HA7	7_0.1						1, 2, 1 1, 16, 21	
	0	ጥ <sub>ጥ</sub> LS ጥ ጥ											.,,	92
†	ŀ	TSΨ								•				
		TS								•				
129.70 0.30		× × ×	SILT, some clay; light brown with orange mottle	es Stiff: moist:	м					•				-02
		× × ×	low plasticity.	,						•				
1		<u> </u>						Δ •		•			V=87	-03
		<u> </u>											* R=26	
	UNU.	<u> </u>				0.5	i0m,							Ç.
130.5 0.5	4	× × ×				HA7	7_0.5			1				).—))
		× × ×	0.55m: Grades to include trace fine gravel. Gra	vel, subangular.						<b> </b>				ÇĞ
†		× × × × × ×	0.60m: Grades to clayey; wet.			1				•				-12
	2	<u> </u>	0.65m: Grades to hard.		w			Δ	•	•			∨ V=187 R=32	800
129.30 0.70	-	<u>×</u> ×××	END OF HOLE: 0.70m		-					<del> </del>		•		
			2.15 6. 1.022. 6.1.6.11									\	¥	
1										,			5, 15, 24	4
													10, 10, 24	
131.0 1.0													1	1.0—
+														+
+														41
ļ														]
†														1
Explanations	Refer	to "Geolo	gical and Geotechnical Information" sheet for further o	letails.		<u> </u>	Rema	ırks	1 1		: :	:	<u> </u>	
Standing Water Level	Sca	ala Pene	trometer Tests		tonite			ordinates and	elevation a	ire app	oroximat	e and s	subject to survey	
Out-flow			n blows per 50mm rStrength (kPa)				2. Sten	igth terms are testing unde					rain.	
Moisture:	V =	Peak, F	R = Residual   Fill   Sar	× ×	arisi			~		-				
M = moist W = wet S = saturated			Core Loss Gra	avel Filte	r san	nd								

Instrument Details:

Hand Auger 70mm

AvD

Shear Vane No.: Logged By: Checked By:

BCF



NOT TO SCALE

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# HAND AUGER LOG

CON	NSUL'	TANT	Ph: 09.489.7872 Ph: 03.379.4402 E: riley.co.nz Email: rileychch.						,,,	_	`		
Project No. 210422	:	I I	<b>Dject:</b> Isterton Due Diligence			oject Locat	ion: Drive, Lansdo	owne M	acterton		N	0.:	
Date Auger		' I	Client:		Но	le Location	າ:	JWITE, IVI	asterton	$\dagger$	HA	80	
16 Sep 202 <sup>2</sup> Ground Lev			Welhom Development Ltd  Co-ordinates (NZTM):	Hole De		fer to site p	lan son Termina	tod:		She			
130 m	rei (iii	INZ V L	E 1824475, N 5465502	0.95 m	pui.	Refu		teu.		1 of			
Elevation 1 NZVD 2016 Depth (m)	Geological Unit	Legend	Geological Description  In accordance with NZGS Guidelines (2 Refer to "Geotechnical and Geological Info sheet for explanation of legend and abbre	rmation"	Water / Moisture	Samples	Soil She Strength (I	kPa) ▶ Peak	Scal Penetror (blows/5	meter Omm)	Te	Situ sting Results	Backfill / Install
129.70 0.30	TOPSOIL					0.10m, HA8_0.1	50 100 15	0 200	5 10	15	0, 1, 0 1, 0, 1 1, 1, 1 1, 1, 1 1, 1, 1 1, 4, 7 3, 5	· ·	1 40 NO NO NO NO NO NO NO NO NO NO NO NO NO
130.5 0.5	Q4A ALLUVIUM				М	0.50m, HA8_0.5	<b>A</b>	**************************************			`	, V=75 0.5 R=23	
129.05 0.95	× × × × ×	× × × × × × × × × × × × × × × × × × ×	0.80m: Grades to trace to minor gravel. Gravel, fine subangular to subrounded.  END OF HOLE: 0.95m	to medium,								V=129 R=32	
131.0										,	4, 5, 6 10, 17, 18	1.0	-
+													
Standing Water Level Out-flow In-flow Moisture: M = moist W = wet S = saturated	Sca Raw Van V = UTF	la Penet v data in e Shear Peak, R P = Unab	gical and Geotechnical Information" sheet for further details trometer Tests blows per 50mm  Strength (kPa) Peat Silt Silt Pill Sand  Office Core Loss Gravel	Bent Grou	arisin r sand	confir 2. Ste 3. Site	arks -ordinates and el mation. ength terms are b e testing undertal	ased on sl ken during	near vane te	ests. ersistent	rain.		By
All dimensi	JIIO III	cut	20   ( abbang.o).	1						128			-2.

Hand Auger 70mm



All dimensions in metres NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622 Ph: 09.489.7872

Contractor (if applicable):

22 Moorhouse Avenue Addington CHRISTCHURCH 8011 Ph: 03.379.4402 Email: rileychch.co.nz

# HAND AUGER LOG

	COI	NSU	LTAN	TS Ph: 09.489.7872 Ph: 03.379.44 E: riley.co.nz Email: rileych						_ , ,			
-	ct No.	:	l l	oject:			oject L			loct: ···	,	No.:	
21042 Date	22 Auger	ed:	Ma	asterton Due Diligence Client:			oger Re		Orive, Lansdowne, N	iasterto	ות	HA09	
15 Se	p 2021	1		Welhom Development Ltd			efer to					117403	
		vel (m	n NZVI	Co-ordinates (NZTM): E 1824572, N 5465511	Hole De	pth	1:	Reas	on Terminated:		<b>Sh</b> 1 o	eet:	
130 m		_		ı	1.00 111	e.	 T	Iveius	<b>7</b> 61	I	110		 T=1
Elevation NZVD 2016	Depth (m)	Geological Unit	pué	Geological Description In accordance with NZGS Guidelines	(2005)	Water / Moisture			Soil Shear Strength (kPa)		Scala etrometer	In Situ	Deptin (m)
Eleva NZVI	)epth	Seolo L	Legend	Refer to "Geotechnical and Geological Ir sheet for explanation of legend and abb	nformation"	Iter / N	Sam	· I	△ Residual ● Peak	(blow	/s/50mm)	Testing 7	Deptin (m) Backfill /
Ε		<del> </del>	TS W	SILT, trace clay and organics: dark brown. Moist		×			50 100 150 200	5	10 15		
	ı		TS TS	plasticity.	to wot, low							0, 1, 0	00 00 00 00 00 00 00 00 00 00 00 00 00
	-		₩Ţ.TS					0m,		•		1, 1, 0 1, 1, 1	100
	ı	TOPSOIL	TS T			М	_ HAS	0_0.1				1, 1, 1 2, 2, 2	
	ı	TOP	™™TS			W						2, 1, 2 3, 5	
			TS T										
129.70	0.30		ホ π LS - LS							ľ			
128.70	0.30		× × ×	Clayey SILT; dark brown with orange mottles. St	iff; moist; low		†						
			× × ×	plasticity.						•			
+	-		× × ×	0.40m: Grades to yellowish brown.						•			-03
			× × ×							•			
130.5	<b>-</b> 0.5		× × ×				0.5 HAS	0m, 0_0.5		•		0.5	-83
			<u>×</u> ×××							•			
	-	Σ	× × ×										-53
		LUVIL	<u>× × ×</u>			м							
	L	Q4A ALLUVIUM	× × ×						Δ			V=97	
	ı		× × ×									R=24	Q
			× × ×										
1	-		× × ×	0.80m: Grades to include trace fine to coarse gra	avel.					<b> </b>			
			× × ×										
+	-		× × ×	0.90m: Grades to minor gravel.									-Ki
			× × ×	1						•			
129.00 <b>131.0</b>	- 1.00 1.0		×××	END OF HOLE: 1.00m		-		0m, 0_1.0				1.0	\$59
										•		7, 14, 12	
+	_										$\rightarrow$	20	4
	<u>-</u>											$\downarrow$	
	-												]
	ļ												
	L												
1	- 												1
	ļ												
Explai	nations	: Refe	er to "Geolo	gical and Geotechnical Information" sheet for further det	tails.			Remai	rks	<u>. : </u>	: :	1	$\dashv$
Stor	nding ter Level	So	cala Pene	etrometer Tests		tonite	,	1. Co-o	rdinates and elevation a ation.	re appro	ximate and	subject to survey	
Out-	-flow			r Strength (kPa)				2. Steng	gth terms are based on testing undertaken durin			nt rain.	
Moistu M = mo	re:			R = Residual   Fill   Sand	× ×	arisir							
W = we S = sat	et			CRI Core Loss Grave	el Filte	r san	nd						

Instrument Details:

Hand Auger 70mm

AvD

Shear Vane No.: Logged By: Checked By:

RJF



All dimensions in metres NOT TO SCALE

4 Fred Thomas Drive Takapuna AUCKLAND 0622

22 Moorhouse Avenue Addington CHRISTCHURCH 8011

# **HAND AUGER LOG**

	COI	NSU	LTAN	TS Ph: 09.489.7872 Ph: 03.379.44 Ex riley.co.nz Email: rileycho												
<b>Proje</b> 21042	22			oject: asterton Due Diligence			<b>oject Lo</b> ger Rer			ansdo	owne, M	lasterton			0.:	
Date 1 16 Se				Client: Welhom Development Ltd			<b>le Loca</b> fer to si		n					HA	110	
			NZVI	'	Hole De				on Terr	mina	ted:		She	eet:		$\dashv$
130 m	)			E 1824643, N 5465474	1.40 m			Refus	al				1 0	f 1		
Elevation NZVD 2016	Depth (m)	Geological Unit	Legend	Geological Description  In accordance with NZGS Guidelines Refer to "Geotechnical and Geological In sheet for explanation of legend and abb	formation"	Water / Moisture	Sampl	- 1	Stren Residu	ıal •	kPa) Peak	Sca Penetro (blows/5	meter 0mm)	Te	Situ sting a Results	Backfill / Install
٤				1		>			50 10	0 15	200	5 10 : :	15			, <u>P</u>
129.75	0.25	TOPSOIL	TS	SILT, some clay; light brown with orange mottles. moist; low plasticity.	Very stiff;	М	0.10i	m, _0.1						0, 1, 0 1, 1, 1 1, 1, 1 2, 1, 2 2, 1, 2 1, 2, 5 2, 2		MONTON MONTON MONTON
130.5	- 0.5	MU	X X X X X X X X X X X X X X X X X X X	0.60m: Grades to clayey. Wet.		w	0.50 HA10	m, _0.5	Δ	•					V=116 R=36	NO KON YOUNG NO KON YOUNG
131.0-	- 1.0 1.10	Q4A ALLUVIUM	X	0.90m: Grades to trace fine gravel; saturated.	rated; low	8	1.00i HA10_	m, _1.0	Δ		•			2, 1, 4 4, 4, 5 8, 9, 12	/ V=177 <sub>1.0-</sub> R=36	10 10 10 10 10 10 10 10 10 10 10 10 10 1
Star Wate Out- In-flo Moistur M = mo W = we	nding er Level flow ow re: ist t	Sc Ra ✓ Va V :	r to "Geolo cala Pene aw data ir ane Sheai = Peak, F	END OF HOLE: 1.40m  cogical and Geotechnical Information" sheet for further details and blows per 50mm r Strength (kPa) R = Residual ble To Penetrate  Gut Core Loss Grave	Ben Grou	tonite ut/cor arisir	ncrete 3	onfirma . Stenç	rdinates a ation. gth terms	are b	ased on s	re approxim shear vane t g period of p	ests.	·	urvey	2000 2000 2000 2000 2000 2000 2000 200
S = satu		ons i	n metr	un Esse	Instrum			<u> </u>			Shear	Vane No.:	Logo	ged By:	Checked	By:

Hand Auger 70mm

AvD

BCF



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# **SCALA PENETROMETER TESTS**

Project No.: Project Location: Sheet: Project Name: 210422 Masterton Due Diligence 1 of 1 Roger Rennal Drive, Lansdowne, Masterton Client: Co-ordinate System: Elevation (m NZVD 2016): Welhom Development Ltd NZTM 130m (SC01)

Test   Date   16   Sep 2021		Development Ltd			INZTIVI			0111 (	SC01)						
Converted By   BCF	Test ID:	SC01												Test	t ID:
Co-ordinates   Co-o		16 Sep 202	21											Da	ite
Converting   Con	Logged By: Checked By:	BCF	AvD											1	
Second   S	Co-ordinates (NZTM):	E 1824552, N 54	165458		,				,			,		Co-ord (NZ	inates ΓM):
10.11 10.11 1.1,11 13.4.0 3.10 4 10.11 1.1,11 1.4,10 1.5,1	evation ZVD 2016 spth (m)	Scala Penetrometer (blows/50mm)	Data (blows/	egend	Penetrometer	Data (blows/	epth (m)	puege.	Penetrometer	Data (blows/	puege.	Penetrometer	Data (blows/	epth (m)	evation ZVD 2016
10.11 10.11 1.1.11 1.4.0 1.5.1			50mm)	٦ _		50mm)	۵			50mm)			50mm)	ے	n Ei
	131.0 1.0		1, 1, 1 0, 0, 1 1, 0, 1 1, 1, 1 3, 4, 9											-	

Explanations:

Scala Penetrometer Tests Raw data in blows per 50mm

Remarks

- RILEY CONSULTANTS LTD, REPORT: RILEY SC (multi). Co-ordinates and elevation are approximate and subject to survey confirmation.
   Stength terms are based on shear vane tests.
   Site testing undertaken during period of persistent rain.

**LOCATION PLAN** 





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# **SCALA PENETROMETER TESTS**

Project No.: Project Location: Sheet: Project Name: 210422 Masterton Due Diligence 1 of 1 Roger Rennal Drive, Lansdowne, Masterton Client: Co-ordinate System: Elevation (m NZVD 2016): Welhom Development Ltd NZTM 130m (SC02)

vveinom i	Development Ltd		NZIM		1.	30m (	SC02)						
Test ID:	SC02											Tes	t ID:
Date:	16 Sep 2021	1										Da	ite
Logged By: Checked By:	BCF /	AvD										Logge	
Co-ordinates	E 1824428, N 546	65615	,				,			,		Co-ord (NZ	inates ΓM):
Elevation n NZVD 2016	Scala Penetrometer (blows/50mm)	Raw pue bush bush bush bush bush bush bush bush	Scala Penetrometer (blows/50mm)	Raw Data (blows/	Depth (m)	Legend	Scala Penetrometer (blows/50mm)	Raw Data (blows/	Legend	Scala Penetrometer (blows/50mm)	Raw Data (blows/		Elevation NZVD 2016
⊞ Ž ŏ	5 1,0 1,5	50mm)	5 10 15	50mm)	۵		5 10 15	50mm)	7	5 10 15	50mm)	۵	n N
130.5 0.5		0, 1, 1 1, 1, 1 0, 1, 2 1, 0, 1 0, 1, 0 1, 0, 3 2, 3										-	- - - - - - - -
Explanat	ions:					LOC	ATION PLAN	100	110	HA03			

**Explanations:** 

Scala Penetrometer Tests Raw data in blows per 50mm

Remarks

- RILEY CONSULTANTS LTD, REPORT: RILEY SC ( Co-ordinates and elevation are approximate and subject to survey confirmation.
   Stength terms are based on shear vane tests.
   Site testing undertaken during period of persistent rain. tests.





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# **SCALA PENETROMETER TESTS**

Project No.: Project Location: Sheet: Project Name: 210422 Masterton Due Diligence Roger Rennal Drive, Lansdowne, Masterton 1 of 1 Client: Co-ordinate System: Elevation (m NZVD 2016): Welhom Development Ltd NZTM 130m (SC03)

vveinom L	Development Ltd		NZIM		13	30m (	SC03)						
Test ID:	SC03											Test	t ID:
Date:	16 Sep 202	1										Da	ite
Logged By: Checked By:	BCF	AvD										Logge	
Co-ordinates	E 1824555, N 54	65578	i				j			,		Co-ordi (NZT	inates ΓM):
Elevation n NZVD 2016 Depth (m)	Scala Penetrometer (blows/50mm)	Raw Data (blows/ 50mm)	Scala Penetrometer (blows/50mm)	Raw Data (blows/	Depth (m)	Legend	Scala Penetrometer (blows/50mm)	Raw Data (blows/	Legend	Scala Penetrometer (blows/50mm)	Raw Data (blows/		Elevation NZVD 2016
	5 10 15	50mm)	\$ 1,0 1,5	50mm)	۵	٦	, 5 10 15	50mm)		, 5 10 15	50mm)	۵	E N W
130.5 0.5 130.5 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0		0, 1, 1 1, 0, 1 0, 0, 1 2, 0, 1 2, 1, 3 6, 3, 5 5, 4										0.5	- - - - -

**Explanations:** 

Scala Penetrometer Tests Raw data in blows per 50mm

Remarks

- RILEY CONSULTANTS LTD, REPORT: RILEY SC ( Co-ordinates and elevation are approximate and subject to survey confirmation.
   Stength terms are based on shear vane tests.
   Site testing undertaken during period of persistent rain.





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# **SCALA PENETROMETER TESTS**

	· · · · · · · · · · · · · · · · · · ·	, , , , , , , , , , , , , , , , , , ,				
Project No.:	Project Name:		Project Location:		Sheet:	
210422	Masterton Due Diligence		Roger Rennal Drive, Lansdov	ne, Masterton	1 of 1	
Client:		Co-ordinate System	Elevation (m NZVD 2016):			
Welhom Developmen	it Ltd	NZTM	130m (SC04)			

Date:    September   Paul		Developme				NZTW			30111 (	SC04)		_			_	
Rule   AUD	Test ID:		SC04												-	
Explanations:  Explan	Date:				<u> </u>										_	
Significantions:  Significant Stories  Significant		-			<u> </u>											
Xplanations:  ✓ Cacal Pennisorate Tatas  A condrises and elevation are approximate and subject to survey confirmalism.  Shorp in this are based on sheer varie elasts.  Chardinates and elevation are approximate and subject to survey confirmalism.					$\vdash$										(NZ	TM):
Xplanations:  Scala Pennitroneia Tatas  Rary data in blows per 50mm  Co-ordinates and elevation are approximate and subject to survey confirmation.  Shorp in hims are based on below per 50mm	n NZVD 2016 Depth (m)		netrometer ws/50mm)	Data (blows/	Legend	Penetrometer (blows/50mm)	Data (blows/	Depth (m)	Legend	Penetrometer (blows/50mm)	Data (blows/	Legend	Penetrometer (blows/50mm)	Data (blows/	Depth (m)	Elevation
Scala Penetrometer Tests Raw data in blows per 50mm  Remarks  Co-ordinates and elevation are approximate and subject to survey confirmation. Stength terms are based on shear vane tests. Site testing undertaken during period of persistent rain.	130.5— 0.5			1, 1, 1 1, 0, 1 0, 1, 1 1, 1, 2 2, 2, 2											-	
. Co-ordinates and elevation are approximate and subject to survey confirmation Stength terms are based on shear vane tests Site testing undertaken during period of persistent rain.	▼ Scala Raw d	Penetrometer lata in blows p	Tests er 50mm							ATION PLAN	HA03  SC09  BH01	BH02 SC				
NOT TO SCALI	1. Co-ordin 2. Stength	ates and elev terms are bas	ed on shear v	ane tests.	-	•	ation.				HA09	♦ HA10	UNZ Basemap	NOT	TO 00	ΛΙ.

- Co-ordinates and elevation are approximate and subject to survey confirmation.
   Stength terms are based on shear vane tests.
   Site testing undertaken during period of persistent rain.





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# **SCALA PENETROMETER TESTS**

Project No.: Project Location: Sheet: Project Name: 210422 Masterton Due Diligence 1 of 1 Roger Rennal Drive, Lansdowne, Masterton Client: Co-ordinate System: Elevation (m NZVD 2016): Welhom Development Ltd NZTM 130m (SC05)

Test   Disc.   16 Sep 2021	VVCIIIOIII L	Development			_	INZ				70111 (	SC05)						_	
Constraint By   Constraint B	Test ID:	S	C05														Test	t ID:
Co-ordinate (Continue)   Continue (Continu		16 S	ep 202	1													Da	ite
Co-ordinate (Continue)   Continue (Continu	Logged By: Checked By:	RJF		AvD													1	
Scale   Penetrometer   Penetromete	Co-ordinates (NZTM):	E 182458	6, N 54	65727			,					,			,		Co-ord (NZ	inates ГМ):
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	131.0 1.0			2, 1, 0 1, 1, 2 1, 2, 1 2, 1, 2 4, 7, 5													-	-

Explanations:

Scala Penetrometer Tests Raw data in blows per 50mm

Remarks

- RILEY CONSULTANTS LTD, REPORT: RILEY SC ( Co-ordinates and elevation are approximate and subject to survey confirmation.
   Stength terms are based on shear vane tests.
   Site testing undertaken during period of persistent rain. tests.

**LOCATION PLAN** 





22 Moorhouse Avenue Addington
CHRISTCHURCH 8011
Ph: 03.379.4402
Email: rileychch.co.nz

# **SCALA PENETROMETER TESTS**

Project No.: Project Location: Sheet: Project Name: 210422 Masterton Due Diligence 1 of 1 Roger Rennal Drive, Lansdowne, Masterton Client: Co-ordinate System: Elevation (m NZVD 2016): Welhom Development Ltd NZTM 130m (SC06)

xplanations: Scala Penetro Remarks		INZTIVI		30111 (3					
Explanations:  Semarks  Semarks									Test ID
A VIZAD Sold (III) A VIZAD Sold	16 Sep 2021								Date
(w) photo of the property of t									Logged By
ixplanations: Scala Penetro Remarks		,			,		,		Co-ordinate (NZTM):
ixplanations: Scala Penetro Remarks	Scala Raw Data Penetrometer (blows/50mm) (blows/50mm)  5 10 15	Scala Penetrometer (blows/50mm)  5 10 15	Depth (m)	Legend	Scala Penetrometer (blows/50mm) 5 10 15	Raw Data (blows/ 50mm)	Scala Penetrometer (blows/50mm) 5 10 15	Raw Data (blows/ 50mm)	Depth (m) Elevation
Scala Penetro Raw data in b									1.0 131
	ations: a Penetrometer Tests data in blows per 50mm		<u> </u>	LOCA	ATION PLAN	Begree S	HA01 SC07 HA02 HA03 HA03 SC00 SC00 SC00 SC00 SC00 SC00 SC00 SC		
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Stength terms a	inates and elevation are approximate and n terms are based on shear vane tests. sting undertaken during period of persister						HA05 SC02 MA07_INZ_Enreshap		
						ACT STATE DAMES	100 m 🛇	NOT	TO SCAL

#### Remarks

- Co-ordinates and elevation are approximate and subject to survey confirmation.
   Stength terms are based on shear vane tests.
   Site testing undertaken during period of persistent rain.





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# **SCALA PENETROMETER TESTS**

		Zinaii iloyonomoomiz					
Project No.:	Project Name:			Project Location:		Sheet:	
210422	Masterton Due Diligence			Roger Rennal Drive, Lansdow	ne, Masterton	1 of 1	
Client:		Co-ordinate System	n:	Elevation (m NZVD 2016):			
Welhom Developmer	NZTM		130m (SC07)				

vveind	_	Jeve						INZ	. I IVI			30111 (	(SC07)		_			_	
Test II				SC														Tes	
Date				Sep														-	ate
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- Co-ordinates and elevation are approximate and subject to survey confirmation.
   Stength terms are based on shear vane tests.
   Site testing undertaken during period of persistent rain.











Client / Project:	WELHOM DEVELOPMENTS LTD GEOTECHNICAL ASSESSMENT DUE DILIGENCE	Hole ID:	BH01		
i roject.	BOREHOLE CORE PHOTOS	Date:		Sep 2021	
Notes:	Drill sampling method: Rotary Sonic (approx. 78mm sample diameter).	Box No(s).	1 and 2 of 7		
	<ol> <li>Markers: start/end of run in metres; "CL" indicates core loss in metres; brack- ets indicate run split between boxes</li> </ol>	Depth from (	m):	0.00m	
		Depth To (m)	):	4.70m	
Project No.	210422	Interval (m):		4.70m	







Client / Project:	WELHOM DEVELOPMENTS LTD GEOTECHNICAL ASSESSMENT DUE DILIGENCE BOREHOLE CORE PHOTOS	Hole ID:	BH01		
		Date:	Sep 2021		
Notes:	Drill sampling method: Rotary Sonic (approx. 78mm sample diameter).     Markers: start/end of run in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes	Box No(s).	3 and 4 of 7		
		Depth from (	<b>Depth from (m):</b> 4.70m		
		Depth To (m):		9.90m	
Project No.	210422	Interval (m):		5.20m	







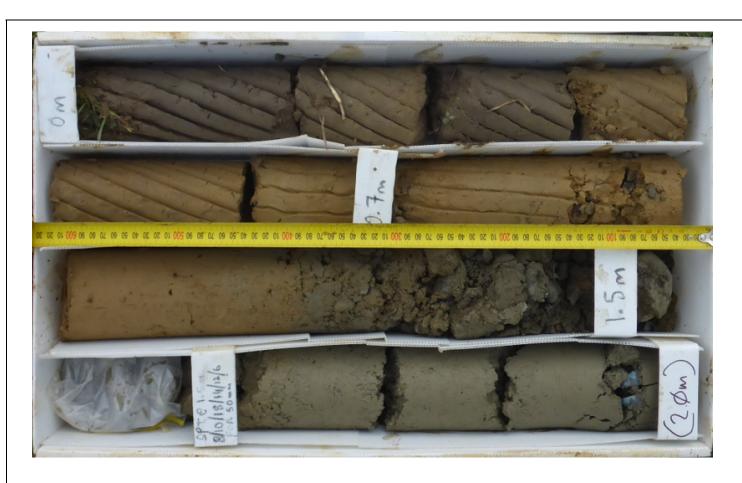
Client / Project:	WELHOM DEVELOPMENTS LTD GEOTECHNICAL ASSESSMENT DUE DILIGENCE	Hole ID:	BH01		
i roject.	BOREHOLE CORE PHOTOS	Date:	;	Sep 2021	
Notes:	Drill sampling method: Rotary Sonic (approx. 78mm sample diameter).	Box No(s).	5 and 6 of 7		
	Markers: start/end of run in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes	Depth from (	m):	9.90m	
		Depth To (m)	:	14.60m	
Project No.	210422	Interval (m):		4.70m	





Client / Project:	WELHOM DEVELOPMENTS LTD GEOTECHNICAL ASSESSMENT DUE DILIGENCE BOREHOLE CORE PHOTOS	Hole ID:	BH01		
		Date:	Sep 2021		
Notes:	Drill sampling method: Rotary Sonic (approx. 78mm sample diameter).     Markers: start/end of run in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes	Box No(s).	7 of 7		
		<b>Depth from (m):</b> 14.60m		14.60m	
		Depth To (m):		15.20m	
Project No.	210422	Interval (m):	•	0.80m	

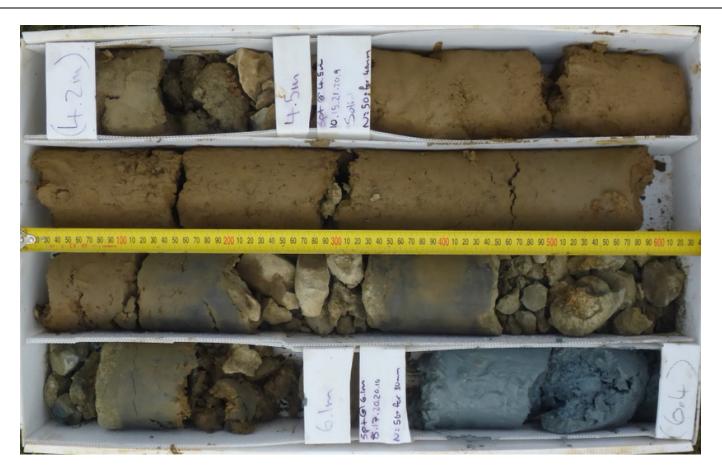


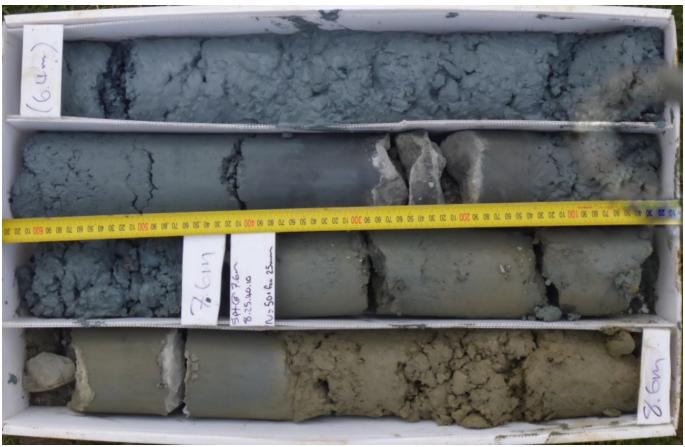




Client / Project:	WELHOM DEVELOPMENTS LTD GEOTECHNICAL ASSESSMENT DUE DILIGENCE	Hole ID:		BH02	
i roject.	BOREHOLE CORE PHOTOS	Date:	;	Sep 2021	
Notes:	Drill sampling method: Rotary Sonic (approx. 78mm sample diameter).	Box No(s).	1 and 2 of 7		
	Markers: start/end of run in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes	Depth from (	m):	0.00m	
		Depth To (m)	):	4.20m	
Project No.	210422	Interval (m):		4.20m	







				and the same		
Client / Project:	WELHOM DEVELOPMENTS LTD GEOTECHNICAL ASSESSMENT DUE DILIGENCE BOREHOLE CORE PHOTOS	Hole ID:		BH02		
		Date:	Sep 2021			
Notes:	Drill sampling method: Rotary Sonic (approx. 78mm sample diameter).     Markers: start/end of run in metres: "CL" indicates core loss in metres: brack-	Box No(s).	3 and 4 of 7			
	Markers: startrend of run in metres; CL indicates core loss in metres; brackets indicate run split between boxes	Depth from (	m):	4.44m		
		Depth To (m)	epth To (m):			
Project No.	210422	Interval (m):		4.36m		







Client / Project:	WELHOM DEVELOPMENTS LTD GEOTECHNICAL ASSESSMENT DUE DILIGENCE	Hole ID:		BH02	
i roject.	BOREHOLE CORE PHOTOS	Date:	;	Sep 2021	
Notes:	Drill sampling method: Rotary Sonic (approx. 78mm sample diameter).	Box No(s).	5 and 6 of 7		
	Markers: start/end of run in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes	Depth from (	m):	8.60m	
		Depth To (m	):	12.90m	
Project No.	210422	Interval (m):		4.30m	





Client / Project:	WELHOM DEVELOPMENTS LTD GEOTECHNICAL ASSESSMENT DUE DILIGENCE BOREHOLE CORE PHOTOS	Hole ID:	BH02		
		Date:	Sep 2021		
Notes:	Drill sampling method: Rotary Sonic (approx. 78mm sample diameter).     Markers: start/end of run in metres; "CL" indicates core loss in metres; brackets indicate run split between boxes	Box No(s).	7 of 7		
		<b>Depth from (m):</b> 12.90m		12.90m	
		Depth To (m):		15.20m	
Project No.	210422	Interval (m):		2.30m	



# Appendix C

Liquefaction Analysis and Soakage Results

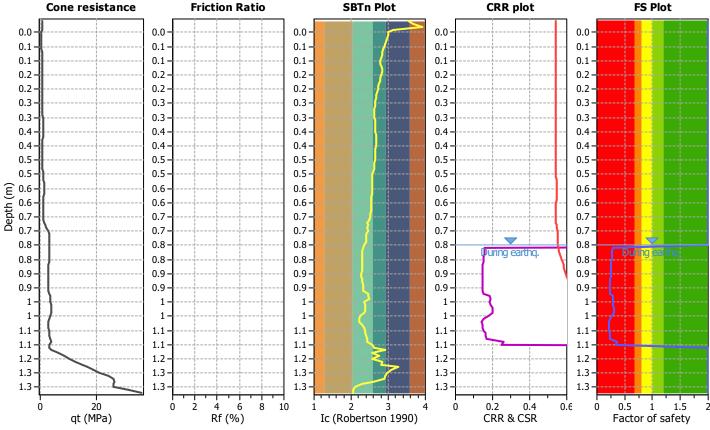


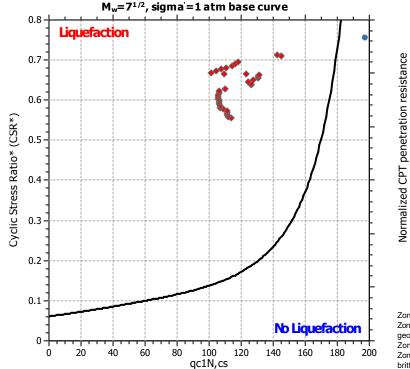
Project title: 210422 Masterton Plan Change Location: Cashmere Oaks Drive, Masterton

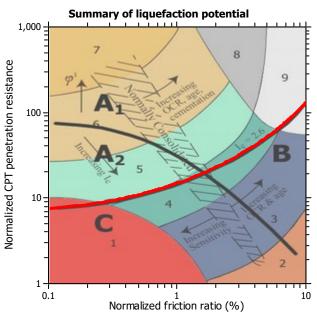
CPT file: 16-CPT01

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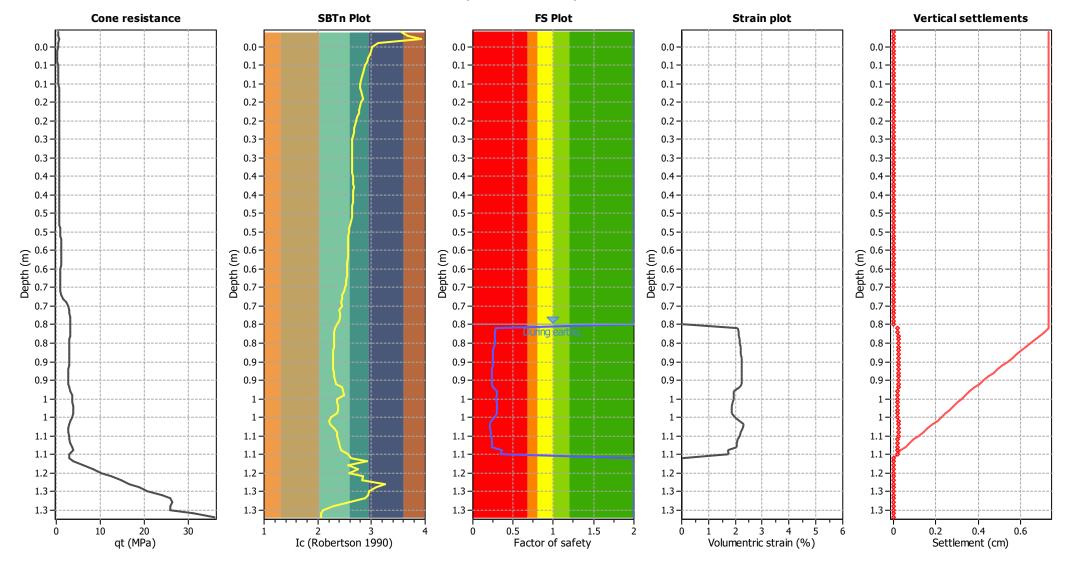
B&I (2014) 0.80 m A naly sis method: G.W.T. (in-situ): Use fill: Nο Clay like behavior Fines correction method: Fill height: B&I (2014) G.W.T. (earthq.): 0.80 m N/A applied: Sands only Points to test: Based on Ic value Average results interval: 3 Fill weight: N/A Limit depth applied: Yes Earthquake magnitude M<sub>w</sub>: Ic cut-off value: 2.60 Trans. detect. applied: No Limit depth: 10.00 m Peak ground acceleration: 0.91 Unit weight calculation: Based on SBT  $K_{\sigma}$  applied: Yes MSF method: Method based







Zone  $A_1$ : Cyclic liquefaction likely depending on size and duration of cyclic loading Zone  $A_2$ : Cyclic liquefaction and strength loss likely depending on loading and ground geometry



#### **Abbreviations**

Total cone resistance (cone resistance q<sub>c</sub> corrected for pore water effects) q<sub>t</sub>: I<sub>c</sub>:

Soil Behaviour Type Index

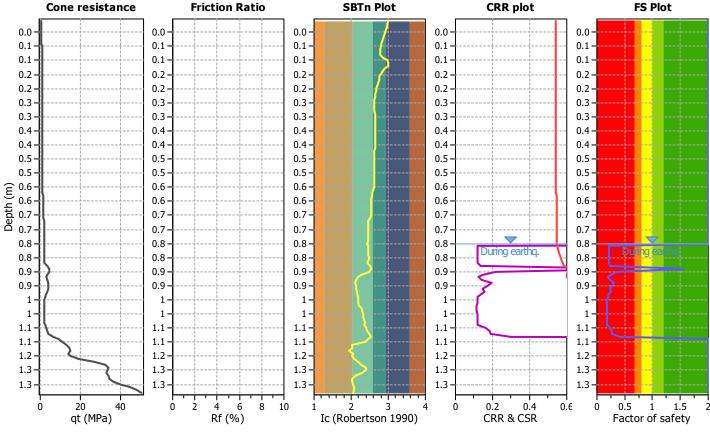
FS: Calculated Factor of Safety against liquefaction

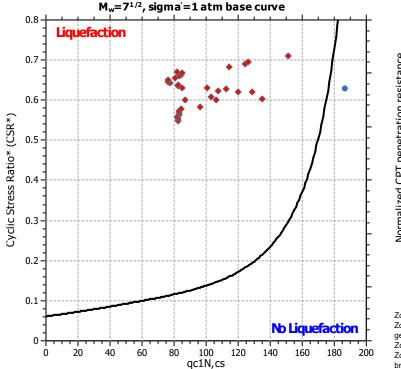
Project title: 210422 Masterton Plan Change Location: Cashmere Oaks Drive, Masterton

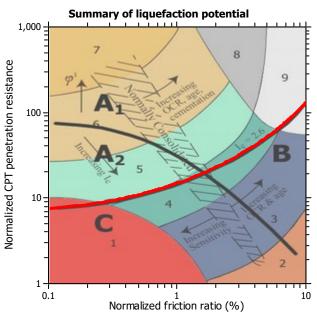
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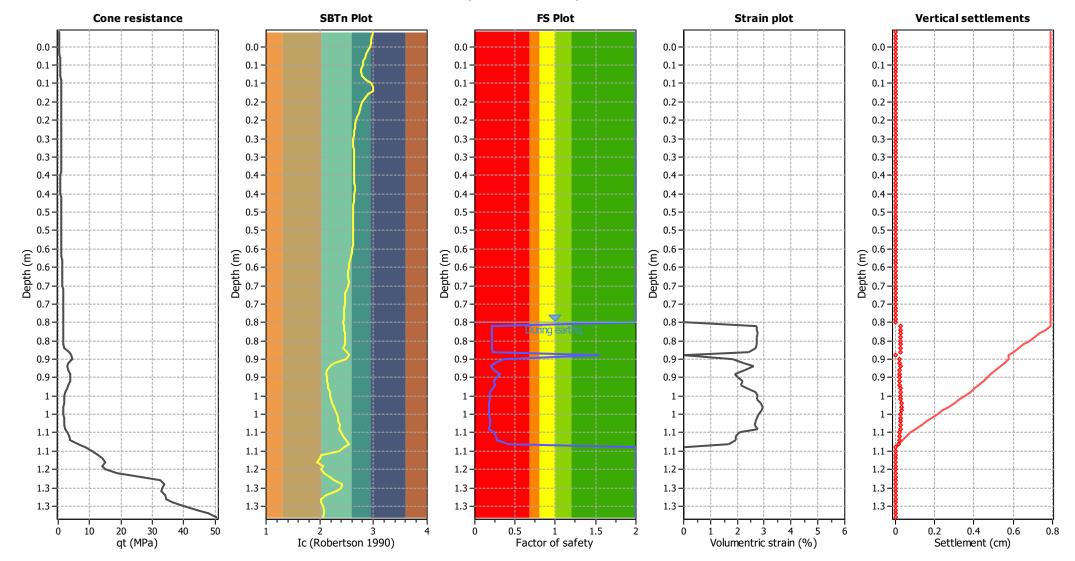
B&I (2014) 0.80 m A naly sis method: G.W.T. (in-situ): Use fill: Nο Clay like behavior Fill height: Fines correction method: B&I (2014) G.W.T. (earthq.): 0.80 m N/A applied: Sands only Points to test: Based on Ic value Average results interval: 3 Fill weight: N/A Limit depth applied: Yes Earthquake magnitude M<sub>w</sub>: 7.70 Ic cut-off value: 2.60 Trans. detect. applied: No Limit depth: 10.00 m Peak ground acceleration: 0.91 Unit weight calculation: Based on SBT  $K_{\sigma}$  applied: Yes MSF method: Method based







Zone A<sub>1</sub>: Cyclic liquefaction likely depending on size and duration of cyclic loading Zone A<sub>2</sub>: Cyclic liquefaction and strength loss likely depending on loading and ground



#### **Abbreviations**

Total cone resistance (cone resistance q<sub>c</sub> corrected for pore water effects) q<sub>t</sub>: I<sub>c</sub>:

Soil Behaviour Type Index

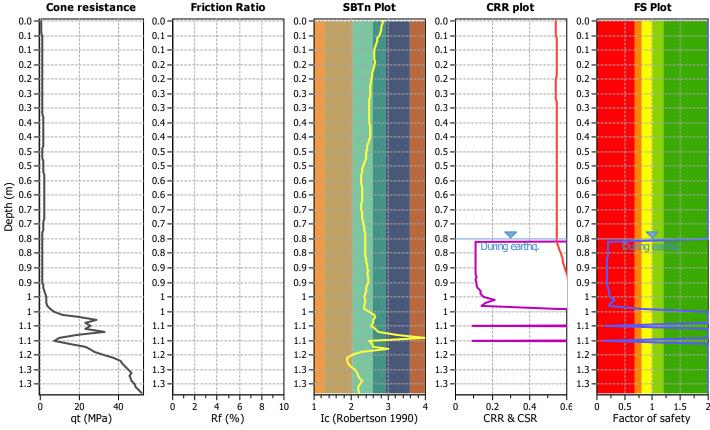
FS: Calculated Factor of Safety against liquefaction

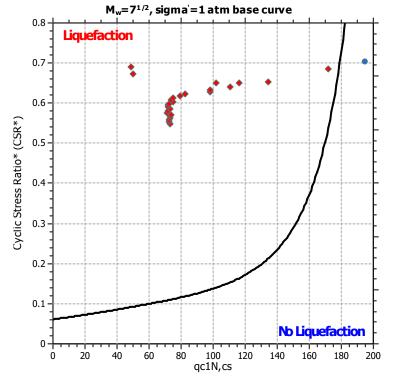
Project title: 210422 Masterton Plan Change Location: Cashmere Oaks Drive, Masterton

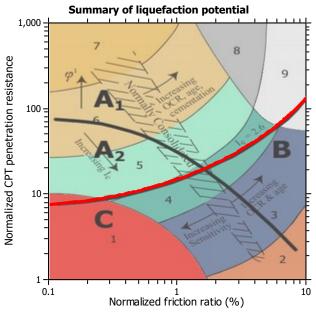
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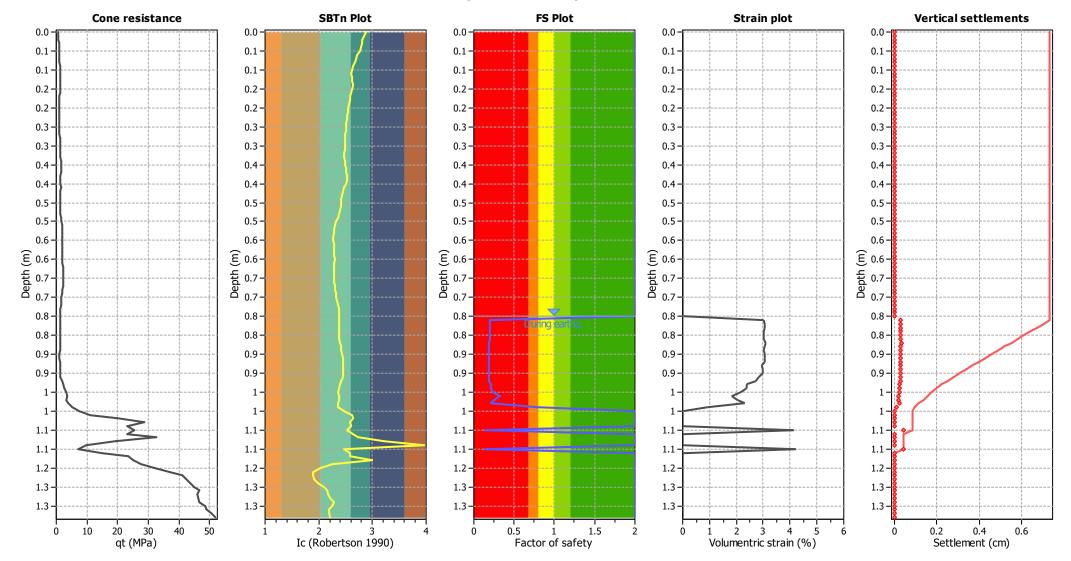
B&I (2014) 0.80 m A naly sis method: G.W.T. (in-situ): Use fill: Nο Clay like behavior Fill height: Fines correction method: B&I (2014) G.W.T. (earthq.): 0.80 m N/A applied: Sands only Points to test: Based on Ic value Average results interval: 3 Fill weight: N/A Limit depth applied: Yes Earthquake magnitude M<sub>w</sub>: Ic cut-off value: 2.60 Trans. detect. applied: No Limit depth: 10.00 m Peak ground acceleration: 0.91 Unit weight calculation: Based on SBT  $K_{\sigma}$  applied: Yes MSF method: Method based







Zone A<sub>1</sub>: Cyclic liquefaction likely depending on size and duration of cyclic loading Zone A<sub>2</sub>: Cyclic liquefaction and strength loss likely depending on loading and ground



#### **Abbreviations**

Total cone resistance (cone resistance q<sub>c</sub> corrected for pore water effects) q<sub>t</sub>: I<sub>c</sub>:

Soil Behaviour Type Index

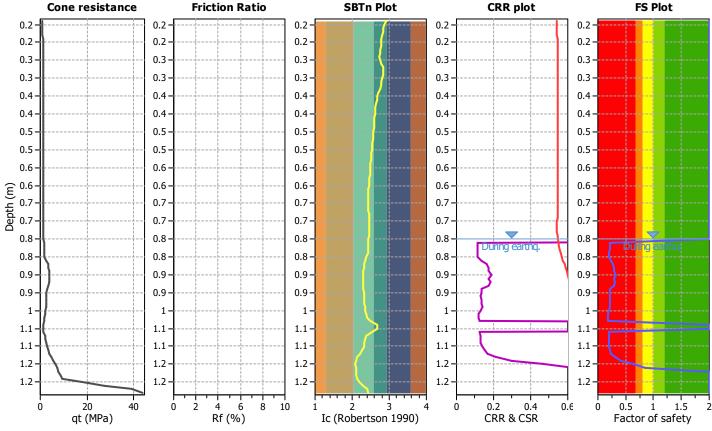
FS: Calculated Factor of Safety against liquefaction

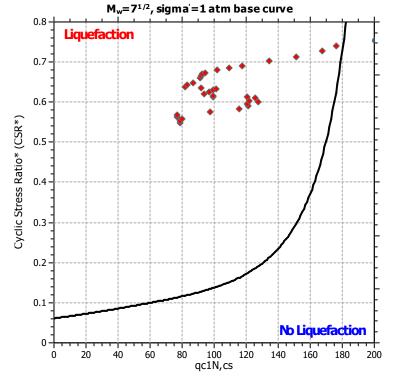
Project title: 210422 Masterton Plan Change Location: Cashmere Oaks Drive, Masterton

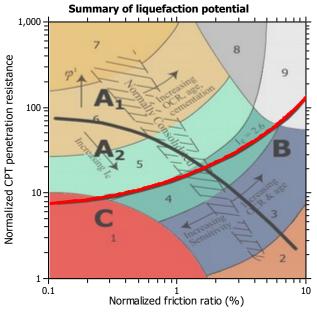
CPT file: 16-CPT04

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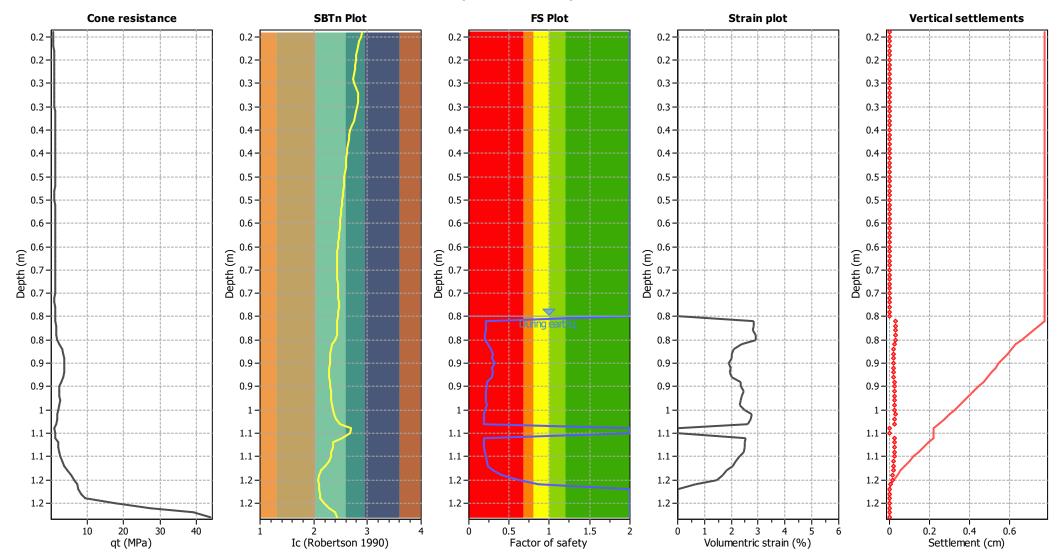
B&I (2014) 0.80 m A naly sis method: G.W.T. (in-situ): Use fill: Nο Clay like behavior Fines correction method: Fill height: B&I (2014) G.W.T. (earthq.): 0.80 m N/A applied: Sands only Points to test: Based on Ic value Average results interval: 3 Fill weight: N/A Limit depth applied: Yes Earthquake magnitude M<sub>w</sub>: 7.70 Ic cut-off value: 2.60 Trans. detect. applied: No Limit depth: 10.00 m Peak ground acceleration: 0.91 Unit weight calculation: Based on SBT  $K_{\sigma}$  applied: Yes MSF method: Method based







Zone A<sub>1</sub>: Cyclic liquefaction likely depending on size and duration of cyclic loading Zone A<sub>2</sub>: Cyclic liquefaction and strength loss likely depending on loading and ground



#### **Abbreviations**

Total cone resistance (cone resistance q<sub>c</sub> corrected for pore water effects) q<sub>t</sub>: I<sub>c</sub>:

Soil Behaviour Type Index

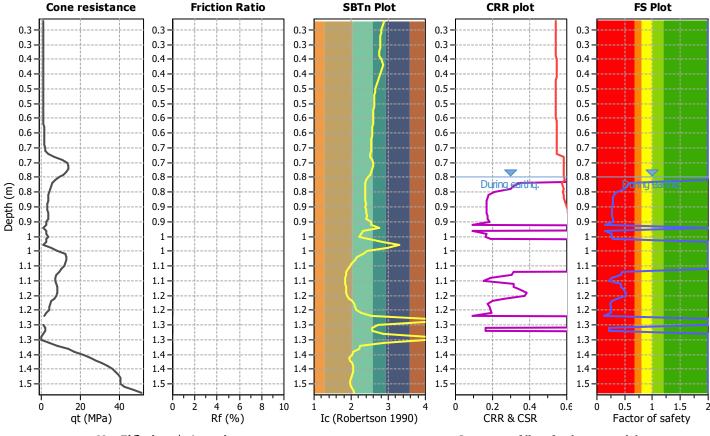
FS: Calculated Factor of Safety against liquefaction

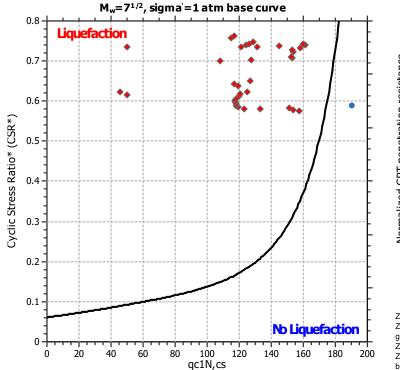
Project title: 210422 Masterton Plan Change Location: Cashmere Oaks Drive, Masterton

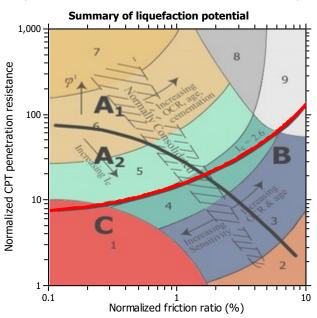
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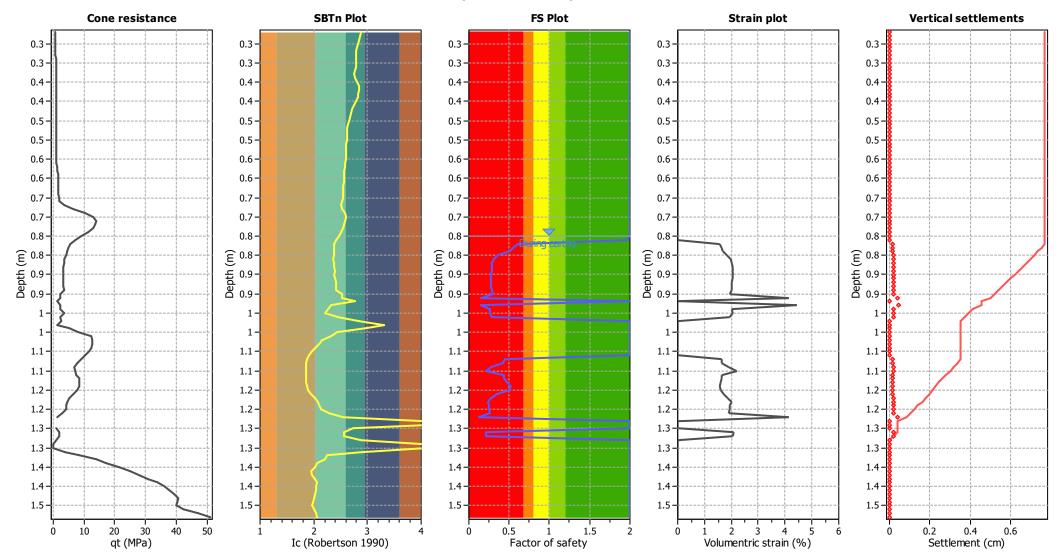
B&I (2014) 0.80 m A naly sis method: G.W.T. (in-situ): Use fill: Nο Clay like behavior Fines correction method: Fill height: B&I (2014) G.W.T. (earthq.): 0.80 m N/A applied: Sands only Points to test: Based on Ic value Average results interval: 3 Fill weight: N/A Limit depth applied: Yes Earthquake magnitude M<sub>w</sub>: 7.70 Ic cut-off value: 2.60 Trans. detect. applied: No Limit depth: 10.00 m  $K_{\sigma}$  applied: Peak ground acceleration: 0.91 Unit weight calculation: Based on SBT Yes MSF method: Method based







Zone A<sub>1</sub>: Cyclic liquefaction likely depending on size and duration of cyclic loading Zone A<sub>2</sub>: Cyclic liquefaction and strength loss likely depending on loading and ground



#### **Abbreviations**

Total cone resistance (cone resistance q<sub>c</sub> corrected for pore water effects) q<sub>t</sub>: I<sub>c</sub>:

Soil Behaviour Type Index

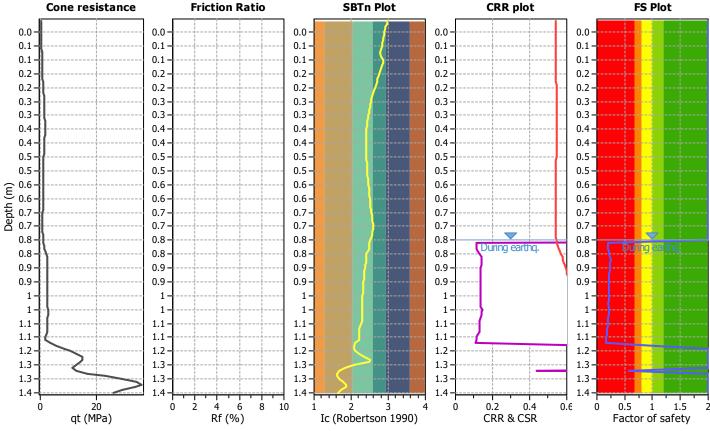
FS: Calculated Factor of Safety against liquefaction

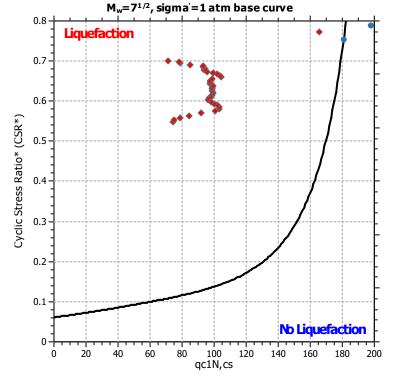
Project title: 210422 Masterton Plan Change Location: Cashmere Oaks Drive, Masterton

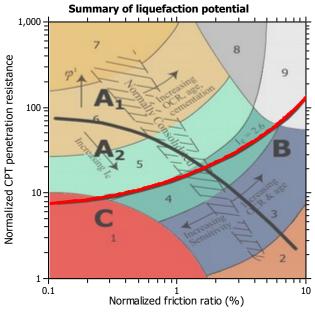
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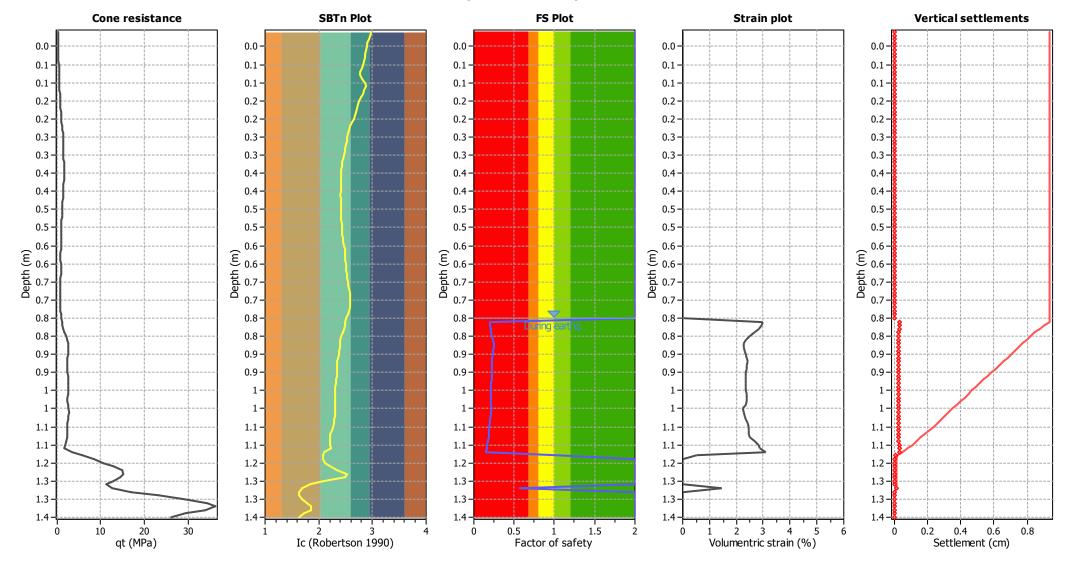
B&I (2014) 0.80 m A naly sis method: G.W.T. (in-situ): Use fill: Nο Clay like behavior Fines correction method: Fill height: B&I (2014) G.W.T. (earthq.): 0.80 m N/A applied: Sands only Points to test: Based on Ic value Average results interval: 3 Fill weight: N/A Limit depth applied: Yes Earthquake magnitude M<sub>w</sub>: 7.70 Ic cut-off value: 2.60 Trans. detect. applied: No Limit depth: 10.00 m  $K_{\sigma}$  applied: Peak ground acceleration: 0.91 Unit weight calculation: Based on SBT Yes MSF method: Method based







Zone  $A_1$ : Cyclic liquefaction likely depending on size and duration of cyclic loading Zone  $A_2$ : Cyclic liquefaction and strength loss likely depending on loading and ground geometry



#### **Abbreviations**

Total cone resistance (cone resistance q<sub>c</sub> corrected for pore water effects) q<sub>t</sub>: I<sub>c</sub>:

Soil Behaviour Type Index

FS: Calculated Factor of Safety against liquefaction

Figure 1: Falling head soakage test results within hand auger boreholes

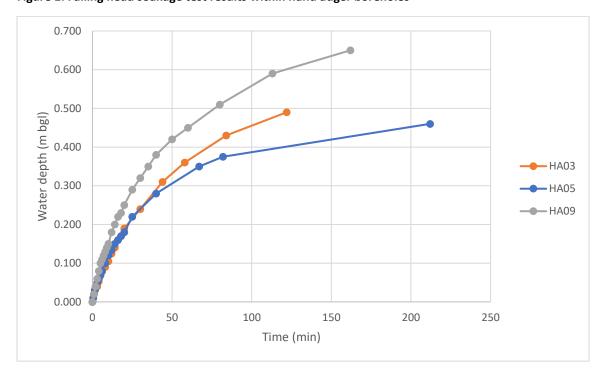


Figure 2: Falling head soakage test results with machine hole (BH02)

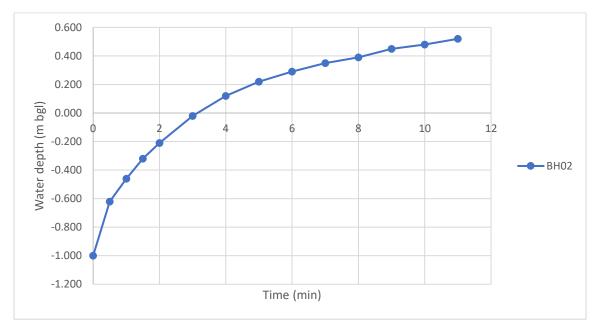
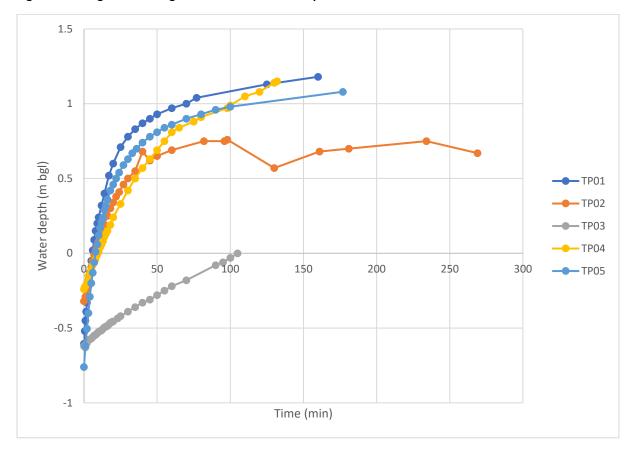


Figure 3: Falling head soakage test results within test pits



# Appendix D

Riley Dwg: 210422-2



