

Appendix E

Geotechnical Assessment



Geotechnical Report for Proposed Plan Change

Wilfield Subdivision Proposed Southern Extension

Issue Date: 20 November 2020

Miyamoto Ref: **200509-RP-001[A]**

Prepared for: **GW Wilfield**

Report Tracking

Revision	Status	Date	Date Prepared by	
А	FINAL	20 November 2020	C. Gibbens	C. McDermott

Authorisation

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A. Geotechnical Investigation Results

1. Introduction

Miyamoto International NZ Limited (MINZ) has been engaged by GW Wilfield to undertake a geotechnical investigation, evaluation and land suitability assessment as part of the proposed land reclassification and plan change required for the proposed extension of the Wilfield residential subdivision.

Our assessment comprised the following scope of works:

- Research of available information; including historic reports, the New Zealand Geotechnical Database (NZGD), Selwyn District Council (SDC) and Environment Canterbury (ECan);
- Site walkover inspection of the land;
- Shallow field investigation comprising:
 - Machine excavated trial pits (TP);
 - o Hand-augered boreholes (HA)
 - Dynamic cone penetrometer (DCP) testing.
- Geotechnical Assessment including high-level assessment of the site with regard to the Resource Management Act (RMA) Section 106.

This report presents the findings of our investigation and assessment which were carried out considering the Ministry of Business, Innovation & Employment (MBIE) Guidance documents "Planning and engineering guidance for potentially liquefaction-prone land" - Version 1, dated September 2017, "Repairing and rebuilding houses affected by the Canterbury earthquakes" - Version 3, dated December 2012, and "Earthquake geotechnical engineering practice - Modules 2 & 3".

It is noted that contaminated land assessment does not form part of our scope of works.

2. Site Description

The site (approximately 32 hectares in area) is located in a rural setting in West Melton, Selwyn, directly south of the existing Wilfield residential subdivision, and encompasses the following land parcels (as shown in Figure 1):

- Lot 163 DP 508829;
- Lot 707 DP 508829;
- Lot 708 DP 531293;
- Lot 709 DP 531293;
- Rural Sec 10802 Blk XI.

The site is predominantly flat with a global elevation difference of 3.0 m to 4.0 m (increasing to the west) and a step up (probable terrace feature) in the topography approximately through the middle of the site running northwest-southeast. The land is predominantly grass covered farmland with two existing residential dwellings, a pump station and a chicken farm currently located on the site.



Figure 1: Site Location / Layout Plan

3. Data Sources

The following sources of third-party information were considered and are referenced in this report:

- Davie Lovell Smith (2014). Geotechnical Appraisal Wilfield Subdivision;
- GNS Science Geological Maps;
- New Zealand Geotechnical Database (NZGD);
- Environment Canterbury (ECan);
- Selwyn District Council (SDC);
- Canterbury Maps.

4. Geotechnical Assessment

Geological Setting

The geological map of the area (GNS 1:250,000 QMap) indicates that a geological boundary dissects the site approximately through the middle running northwest-southeast approximately along the line of a step-up in elevation (probable terrace feature). The geology is described as 'modern (Quaternary) river floodplain/low-level degradation terraces of unweathered, variably sorted gravel/sand/silt/clay' to the northeast and 'dunes of unweathered, wind-deposited river sand' to the southwest.

Field Investigations

Miyamoto undertook a site-specific ground investigation on 9 November 2020, comprising:

• 9No. machine excavated trial pits (referenced TP001 to TP009);

- 5No. hand-augered boreholes (referenced HA001 to HA005) with in-situ shear vane testing;
- 14No. Dynamic Cone Penetrometer (DCP) tests associated with the above exploratory holes.

As part of the Wilfield subdivision, directly north of the site, Davie Lovell Smith undertook a ground investigation comprising 32No. Trial Pits, the data collected from which has been used in our assessment. Additionally, a number of ECan well bore logs available for the surrounding area have been referenced in our assessment.

The test locations are shown in Figure 2, the general details of the ground investigations are summarised in Table 1, and the engineering and well bore logs are presented in Appendix A.



Figure 2: Ground Investigation Location Plan

Table 1: Summary of Ground Investigations

Test Ref.	Source	Source Ref.	Test Type	Depth (mbgl)
TP001 to TP009	MINZ	200509	TP / DCP	0.7 to 1.8
HA001 to HA005	MINZ	200509	HA / DCP	0.3 to 2.3
TP001 to TP032	Davis Lovell S	Davis Lovell Smith (2014)		0.1 to 2.7
ECan Well Bores	ECan	Various	Rotary / Percussion / Cable Tool	Max. 200+

Ground Conditions

The ground conditions over the majority of the site interpreted from the on-site shallow ground investigation, correlated with the available existing data, comprise a layer of topsoil

(0.2 m to 0.4 m in thickness), overlying low plasticity, firm to stiff Sandy SILT to between 0.3 m and 0.8 mbgl, below which dense to very dense Sandy fine to coarse GRAVEL is encountered to depth. An exception to the above is the ground profile identified at HA001, which encountered a layer of fine to medium SAND to 2.2 mbgl.

Groundwater

Standing groundwater was not encountered during our site-specific investigation. Groundwater level monitoring information available for a number of the ECan well bores indicate the groundwater table to average around ~20 mbgl with seasonal fluctuations reaching a highest level of ~12 mbgl.

It is noted that saturated soil was encountered at 2.2 mbgl in HA001 and water was noted at 3.5 mbgl in Davis Lovell Smith TP021.

Liquefaction Assessment

The site is located within an area of 'low geotechnical risk' as defined by Selwyn District Council (McCahon, 2013). The site is also located within an area identified as 'Liquefaction damage is unlikely' (2012), and a 'Zone of low liquefaction potential' (2006) as presented on the Canterbury Maps Viewer.

Based on our assessment (including the site-specific ground conditions and groundwater regime) we concur that the risk of damaging effects from liquefaction at the site is low with the seismic performance expected to be equivalent to MBIE Technical Category (TC) 1 as per the MBIE Guidance (2012).

Sloping Ground

The likely terrace feature running northwest-southeast through the middle of the site presents the most significant sloping ground on-site. No signs of instability were observed during our site visit and considering the ground conditions and slope geometry the slope is considered to be stable.

Any earthworks or development proposed in proximity to the sloping ground should carefully consider the effects of the works on the stability of the slope.

NZS1170.5 Site Sub-soil Class

Based on our geotechnical assessment, geological maps and other available information, NZS1170.5 Site Sub-soil Class D (deep or soft soil site) is considered appropriate for the site.

Flood Hazard

The site is not currently located within one of the Flood Zones identified by Selwyn District Council, however, restrictions around building floor levels must be checked at building consent stage.

5. Development Considerations

At this stage in the project, the future development plans are not defined. However, considering likely residential subdivision similar to the Wilfield subdivision to the north, the following preliminary guidance is provided:

- Earthworks should be undertaken in general accordance with the requirements of NZS 4431:1989. All unsuitable materials should be stripped from the work areas and stockpiled clear of the operations or removed from site;
- The stability of the sloping ground (terrace feature) should be assessed considering any proposed developments or earthworks;
- Preliminarily, NZS3604 foundations are considered suitable for NZS3604 compliant structures, subject to building-specific geotechnical investigations to assess the available bearing capacity.

It is noted that this report is limited to geotechnical assessment and advice related to other development requirements (such as roading infrastructure, pavements, services, stormwater management and contaminated land) should be sought from appropriately qualified personal.

6. Assessment Against RMA Section 106

As per the requirements of Section 106 of the Resource Management Act (RMA) (2017), we have undertaken a high-level assessment of the significant geotechnical hazards that may affect the site. These hazards include, but are not limited to:

- Erosion;
- Falling debris;
- Slippage;
- Subsidence
- Inundation.

At the time of our site visit, there was no evidence of erosion or erosional features on site. The shallow soils could be vulnerable to erosion if the topsoil layer is removed and left unprotected for prolonged periods of time. This can be easily mitigated with appropriate design measures during construction.

Given the proximity of the site to any source, rockfall (falling debris) is not considered a risk to the site.

The likely terrace feature running northwest-southeast through the middle of the site presents the most significant sloping ground on-site. No signs of instability were observed during our site visit and considering the ground conditions and slope geometry the slope is considered to be stable. Any earthworks or development proposed in proximity to the sloping ground should carefully consider the effects of cutting and / or filling works and loading on the stability of the slope.

On the basis of our geotechnical assessment herein, we do not consider subsidence (under either static or seismic loading) to be a significant hazard for normal construction (i.e. NZS3604 compliant buildings).

The site is not currently located within one of the Flood Zones identified by Selwyn District Council, however, restrictions around building floor levels must be checked at building consent stage.

Based on our assessment, we consider that the geotechnical hazards may be mitigated to an acceptable standard, provided that the geotechnical recommendations given in this report are followed, and the appropriate engineering measures implemented, we consider that the development is unlikely to be affected nor worsen, accelerate or result in material damage.

7. Limitations

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- Miyamoto's professional services are performed using a degree of care and skill reasonably exercised by reputable consultants providing the same or similar services as at the date of this report.
- The sub surface information has been obtained from investigation carried out at discrete locations, which by their nature only provide information about a relatively small volume of subsoils. While Miyamoto has taken reasonable skill and care in carrying out the investigation to determine the subsoil condition, the subsoil condition could differ substantially from the results of any sampling investigation. Miyamoto is not responsible for and does not accept any liability in respect of any difference between the actual subsoil conditions and the results of our investigation.
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If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact Miyamoto International (NZ) Ltd.

References

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- New Zealand Standard NZS1170.5 (2004). Structural Design Actions, Part 5: Earthquake Actions New Zealand Standard, NZS 2004.
- Selwyn District Council District Plan Online Maps, https://eplan.selwyn.govt.nz/eplan/#/Property/7941662.

Appendices

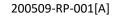


A. Geotechnical Investigation Results

MINZ site-specific investigation logs

ECan well bore logs

Davis Lovell Smith investigation location plan and logs (nearby only)

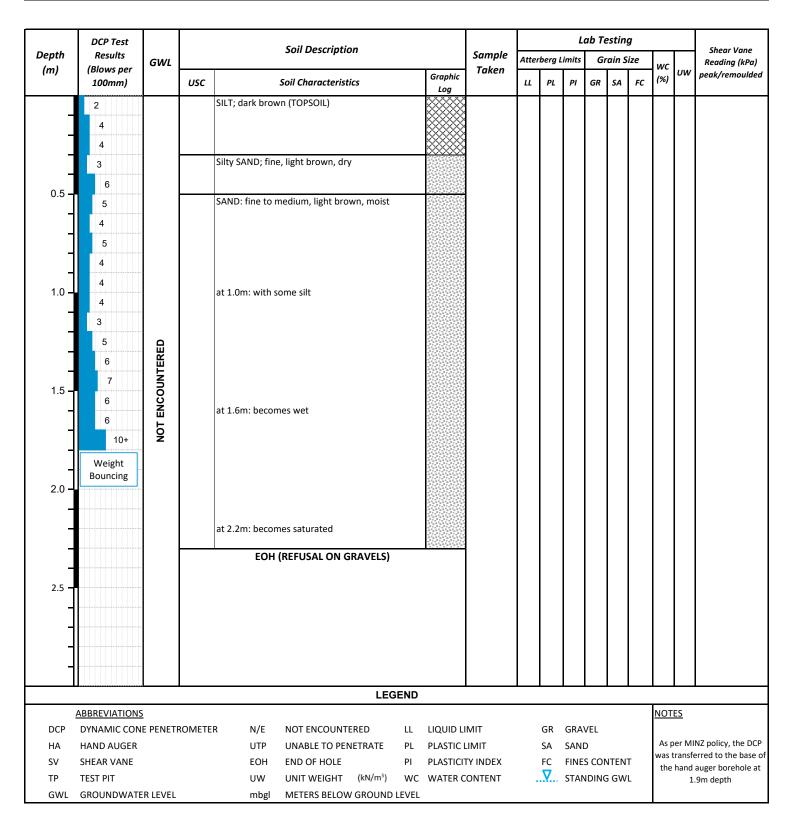




200509 GW Wilfield 9 November 2020

SHALLOW GROUND INVESTIGATION LOG

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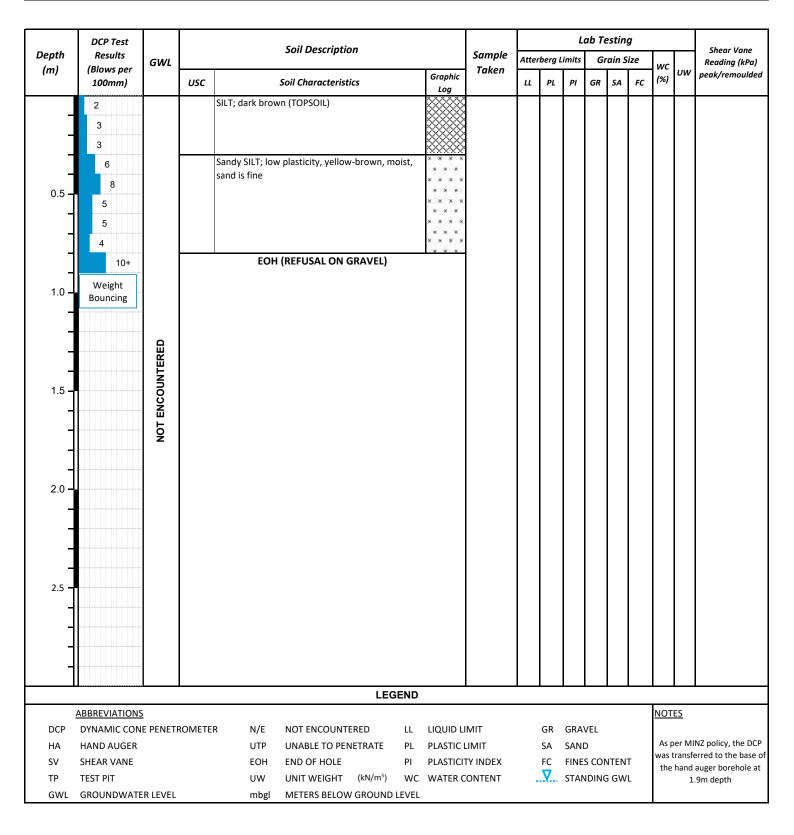




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SHALLOW GROUND INVESTIGATION LOG

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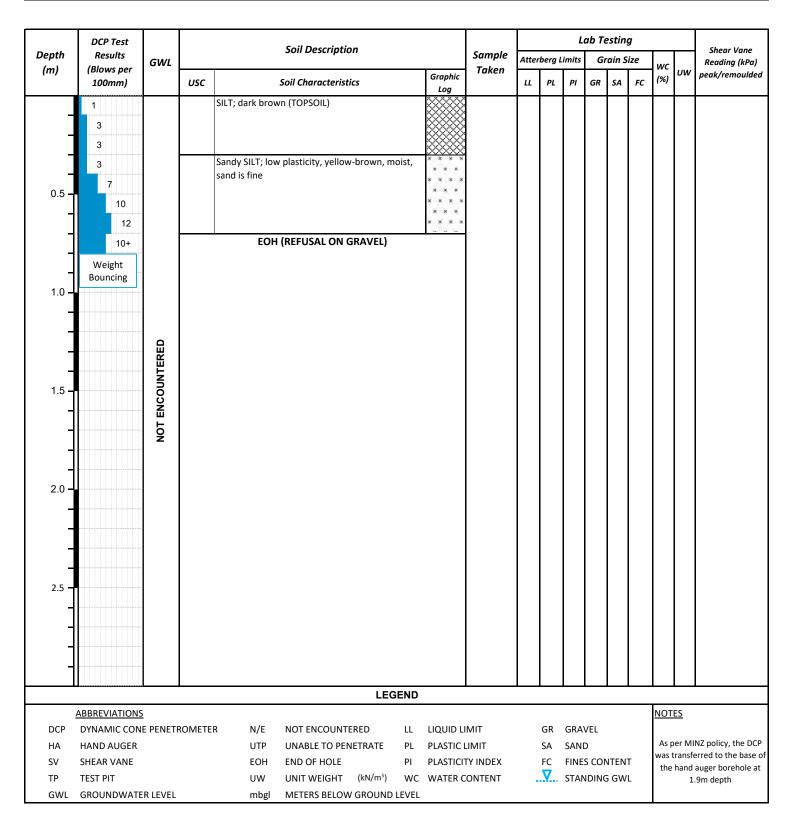




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SHALLOW GROUND INVESTIGATION LOG

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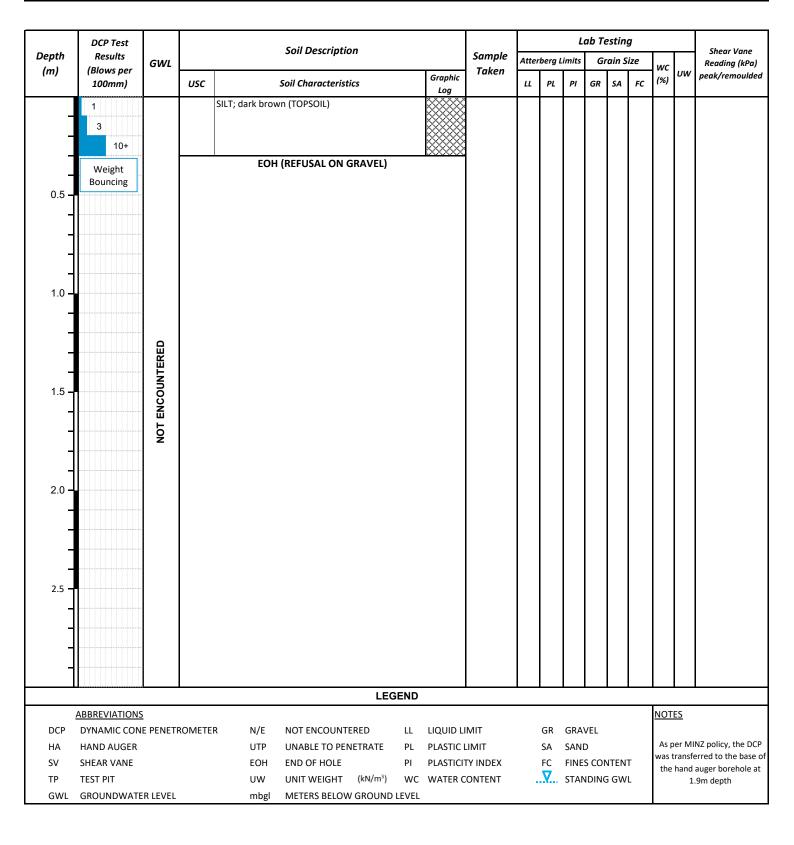




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SHALLOW GROUND INVESTIGATION LOG

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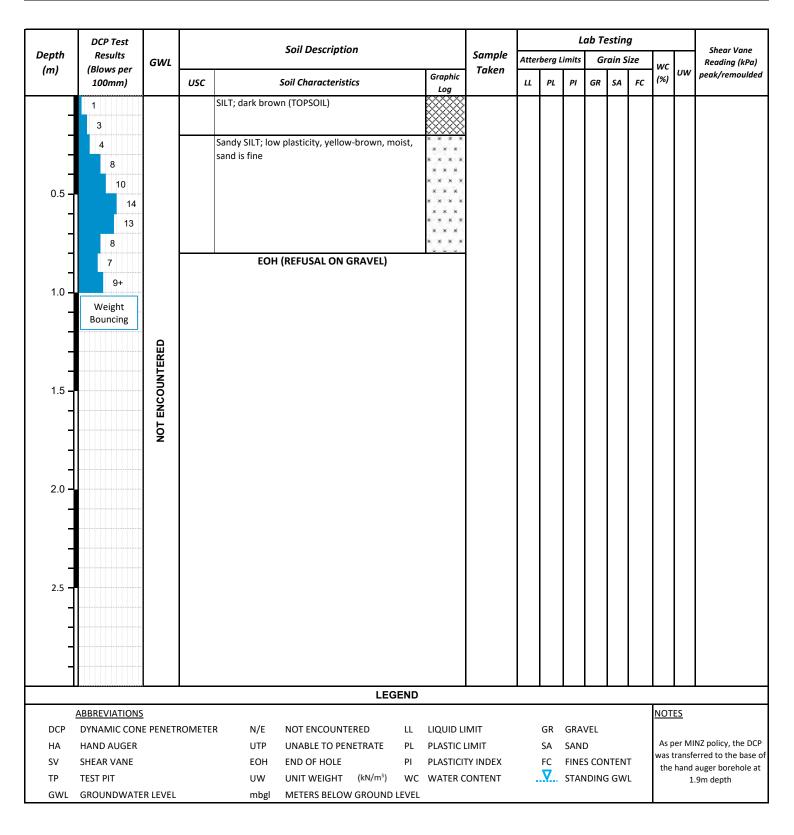




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SHALLOW GROUND INVESTIGATION LOG

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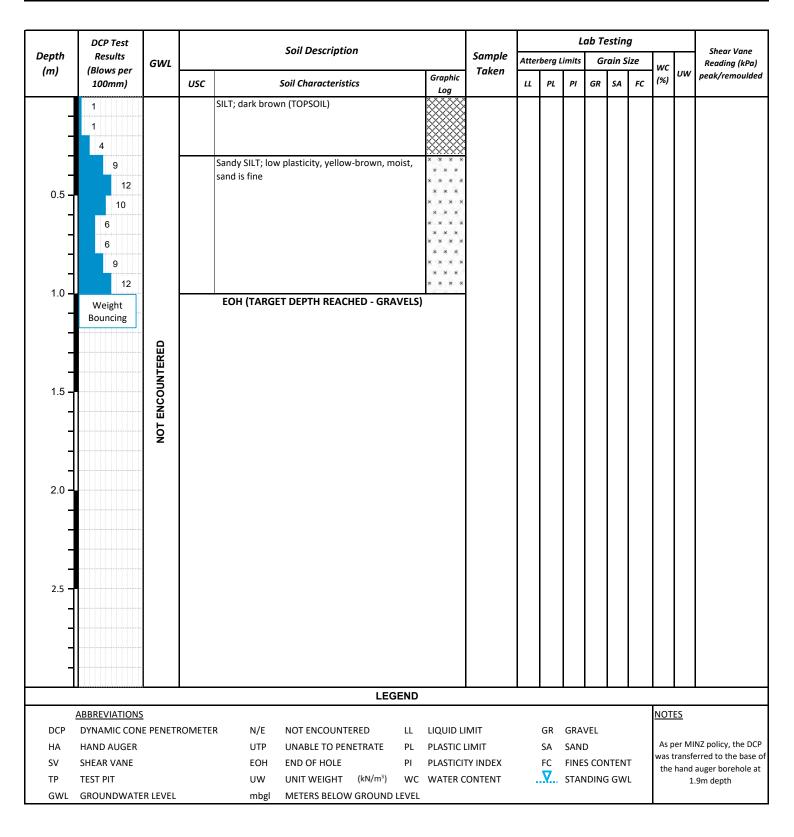




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SHALLOW GROUND INVESTIGATION LOG

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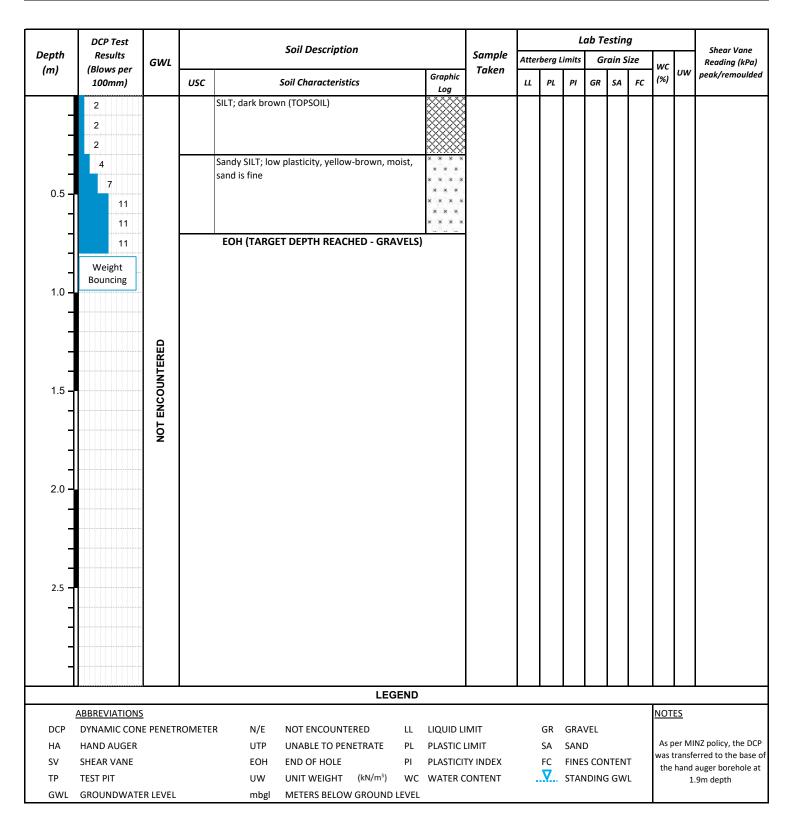




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SHALLOW GROUND INVESTIGATION LOG

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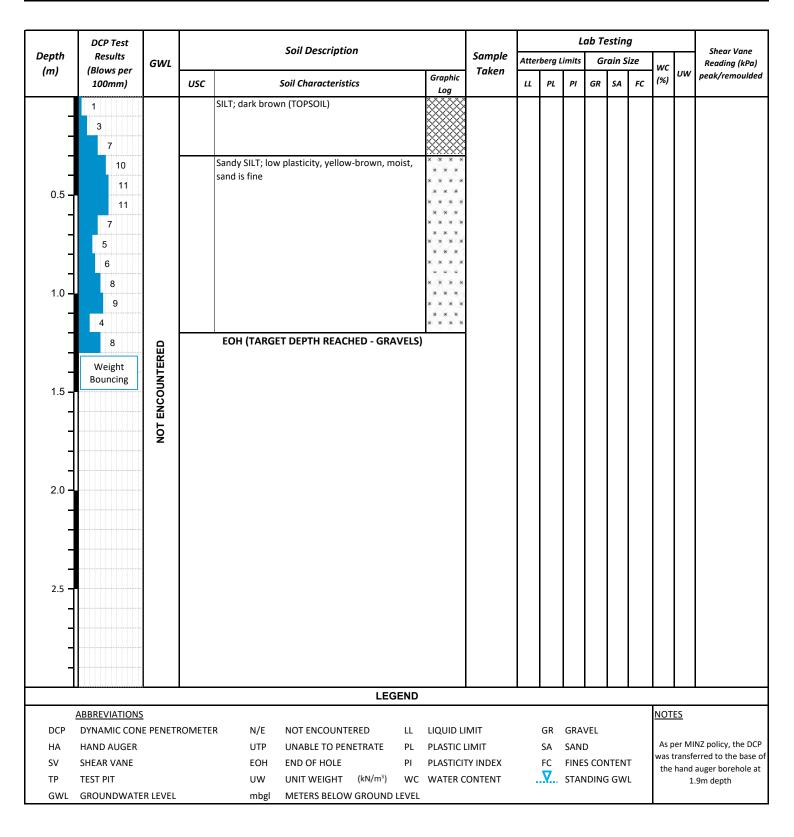




200509 GW Wilfield 9 November 2020

SHALLOW GROUND INVESTIGATION LOG

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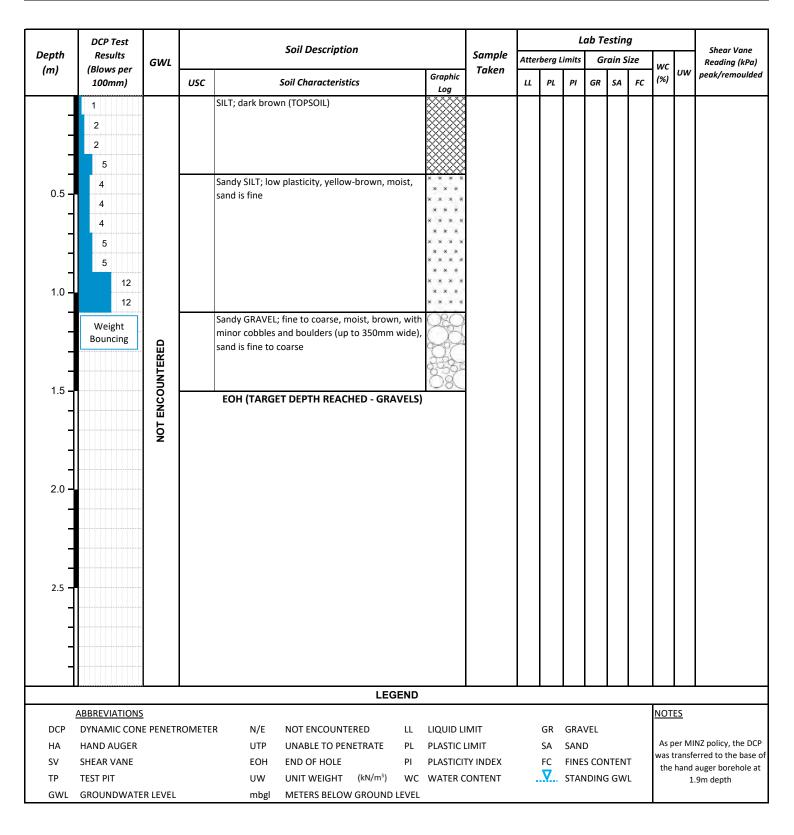




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SHALLOW GROUND INVESTIGATION LOG

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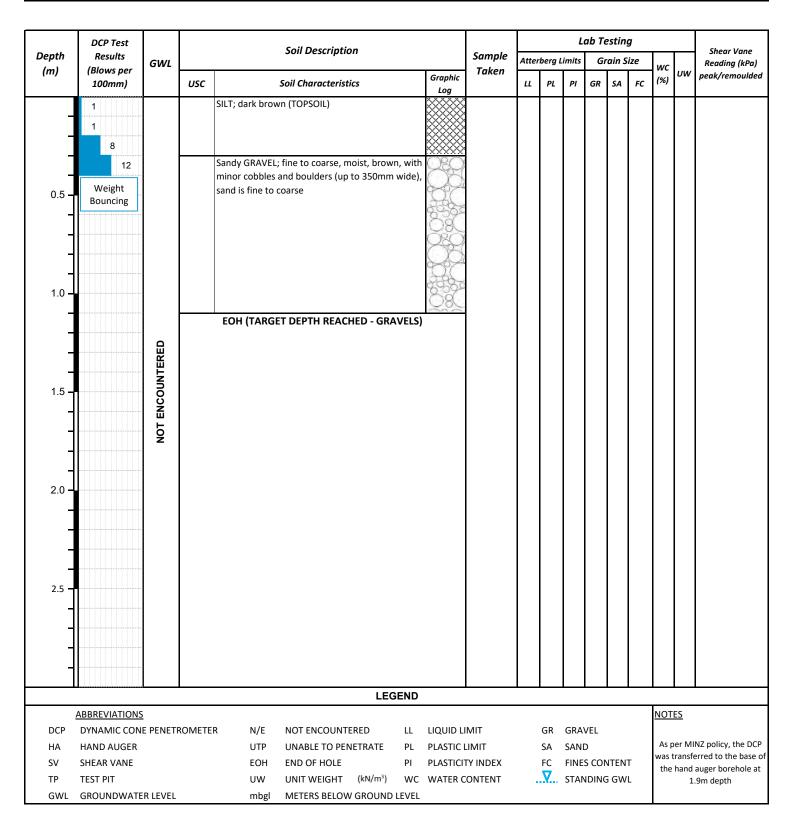




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SHALLOW GROUND INVESTIGATION LOG

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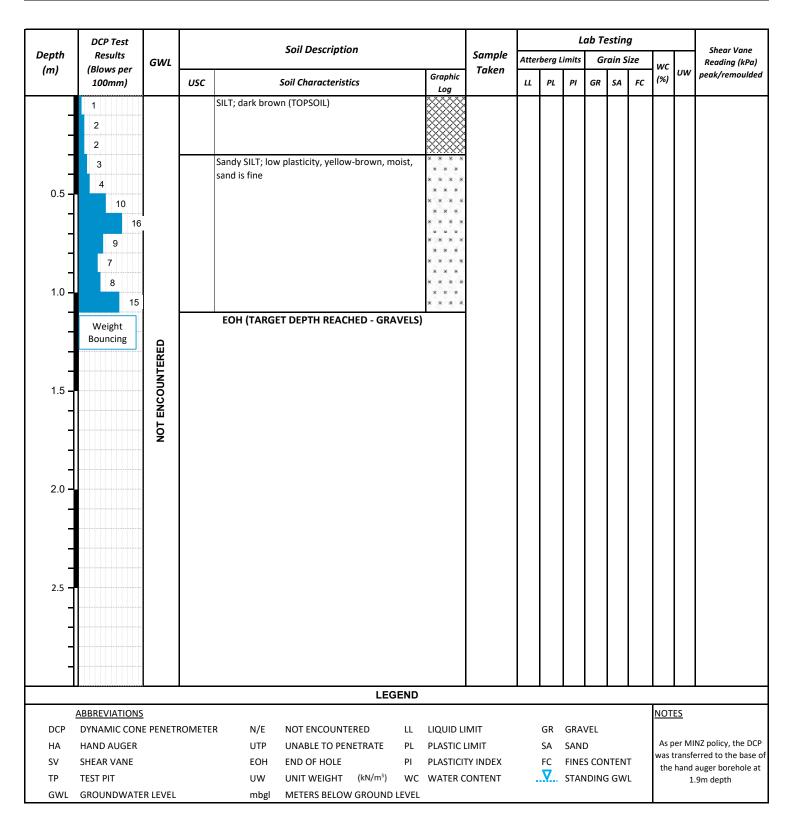




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SHALLOW GROUND INVESTIGATION LOG

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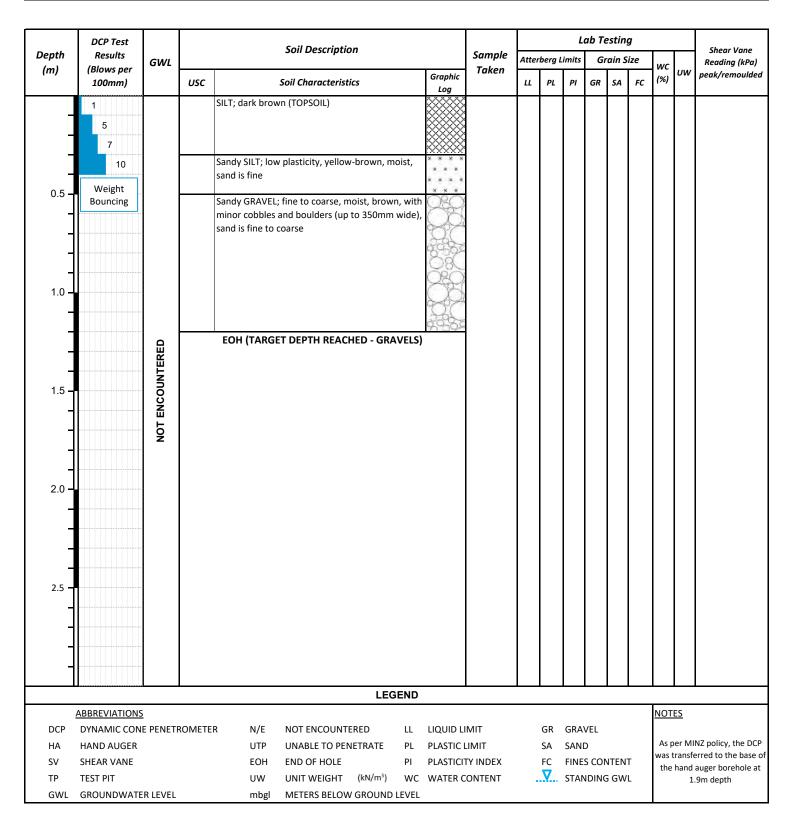




200509 GW Wilfield 9 November 2020

SHALLOW GROUND INVESTIGATION LOG

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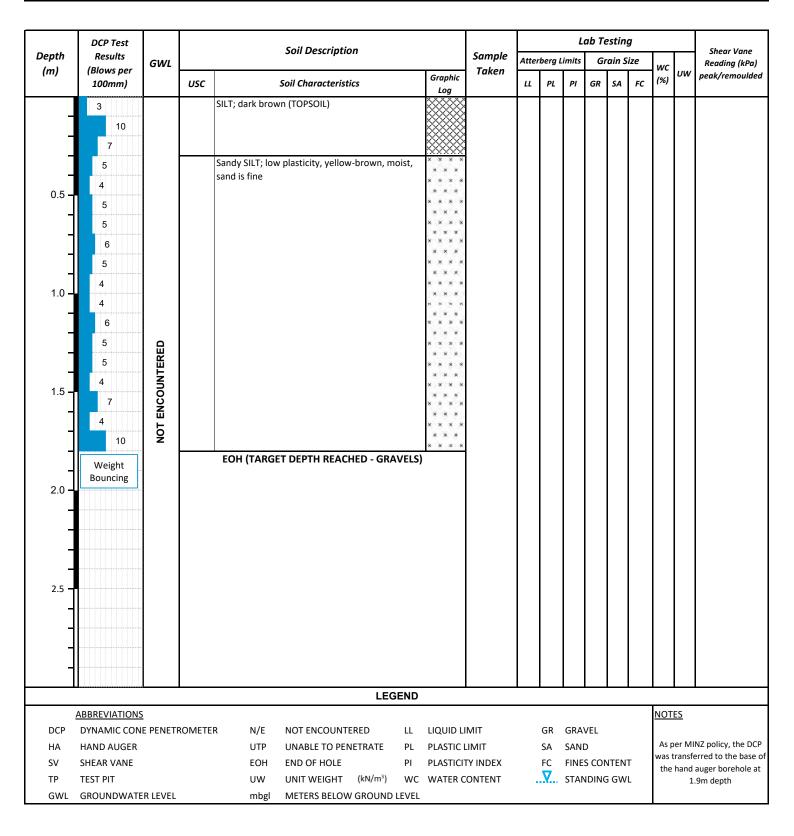




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SHALLOW GROUND INVESTIGATION LOG

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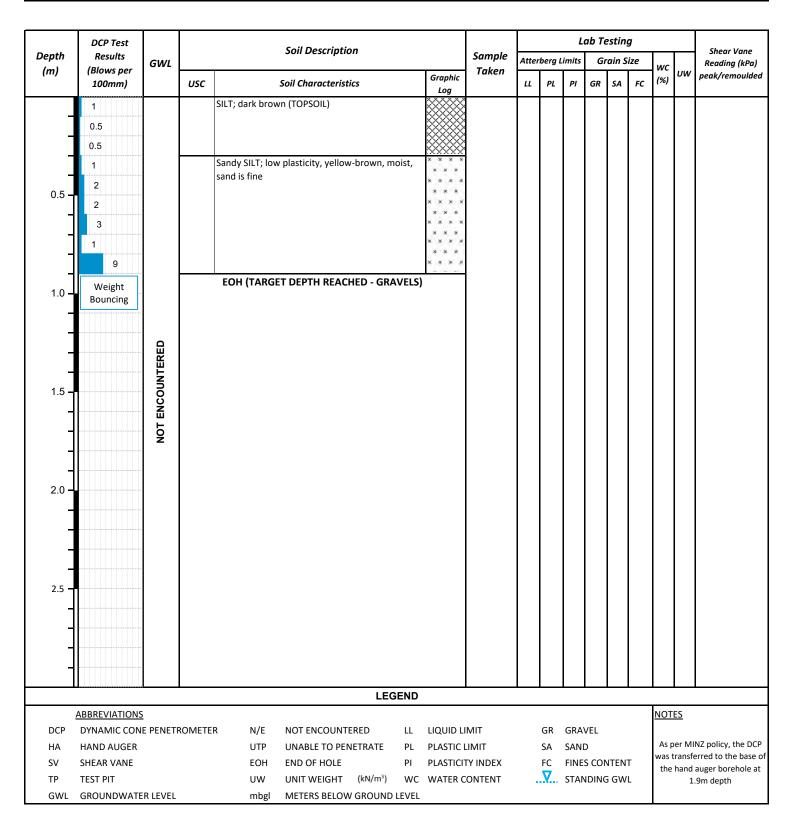




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SHALLOW GROUND INVESTIGATION LOG

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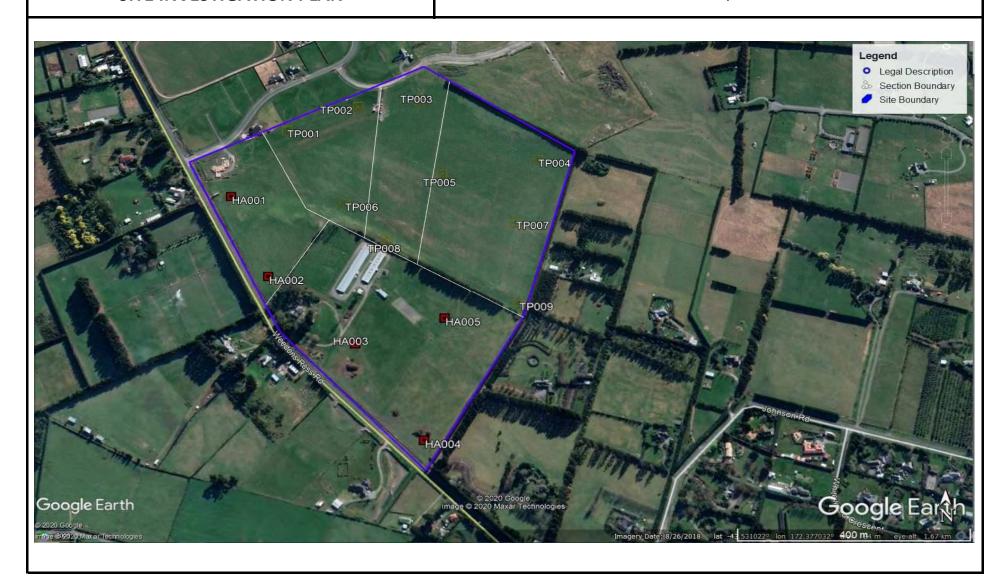


PROJECT NUMBER:

200509 **Yoursection Ltd** 9 November 2020

SITE INVESTIGATION PLAN

Wilfield Subdivision, West Melton



Borelog for well BX23/0829

Grid Reference (NZTM): 1549894 mE . 5180029 mN

Location Accuracy: 10 - 50m Ground Level Attitude: m +MSD Accuracy:

Driller: McMillian Drilling Ltd Drill Method: Rotary/Percussion

Borelog Depth. 202.0 m. Drill Date: 01-Sep-2018



Stable (m)	Water Level	Deproint		Full Drillers Description	Formation Gode
Ha		0.40m -		Not Logged TOPSOIL, Not Recorded. Not Logged CLAY, Not Recorded.	
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1 2				MM/, Not Recorded.	
411					
1115		4.00m	5.0.0		
Н.		100-201	0::0::0	Not Logged sendy (SRAVEL (2 - 50	
Thi .				MM), with some optibles. Not Recorded	
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11 -		T 00m	7.0.0		
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2.7			- 12- 6-		
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31	30.00		D C	Figt Looged sendy CRAVEL (2 - 50	

Borelog for well M35/0976

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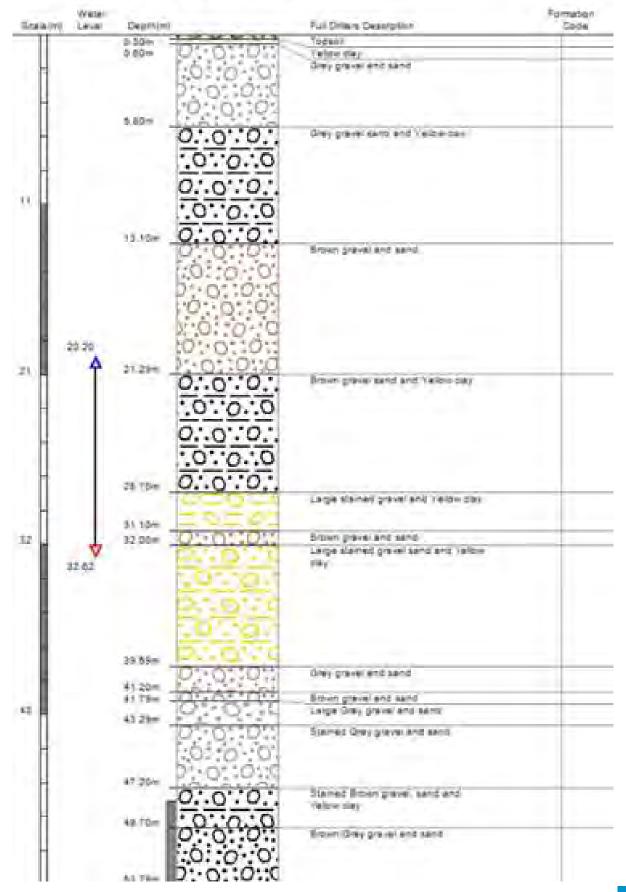
Location Accuracy 2 - 15m

Ground Level Allitude: 82.7 m +MSD Acouracy < 0.1 m

Driller: A M Bisley & Co Drill Method: Cable Tool

Boxelog Depth 533 m Dnill Date 30-Jun-1971





Borelog for well M35/11167

Grid Reference (NZTM): 1549957 mE, 5179666 mN

Location Accuracy 10 - 50m

Ground Level Allitude: 82 7 m +MSD Accuracy = 0.5 m

Driller Dynes Road Drilling Drill Method, Cable Tool

Barelog Depth: 58.0 m Drill Date: 01-Feb-2006



##(m) 1	Level Depthins		Full Drivers Destrotion	De64
		00000C 00000C 00000C 00000C	med erge graves dean	
	4.00m	200000		
	4 00m	:0::0::0:	arrail med gravels sandy	
	5,60m	0==0==0==	smail med graves sensy	
			email med gravels mass elt	
11		::0::0::0		
H	225.20	0==0==0==		
	16-60m 16-60m	02000	small med gravels traces sit	
ļ	1900	0=0=0=0	Small trees are selected that	
	16 00m	== O == O == O		
	18.00m	0=0=0=0	small med graves without one dear-	
		0::0::0::0		
	24 00m	0::0::0::0		
	24 95m	20 = 0 ± 0	small med gravels wet altimore pleam. First visiter med large grave is well yallow sit.	

Borelog for well M35/11169

Grid Reference (NZTM) 1550203 mE 5778439 mN

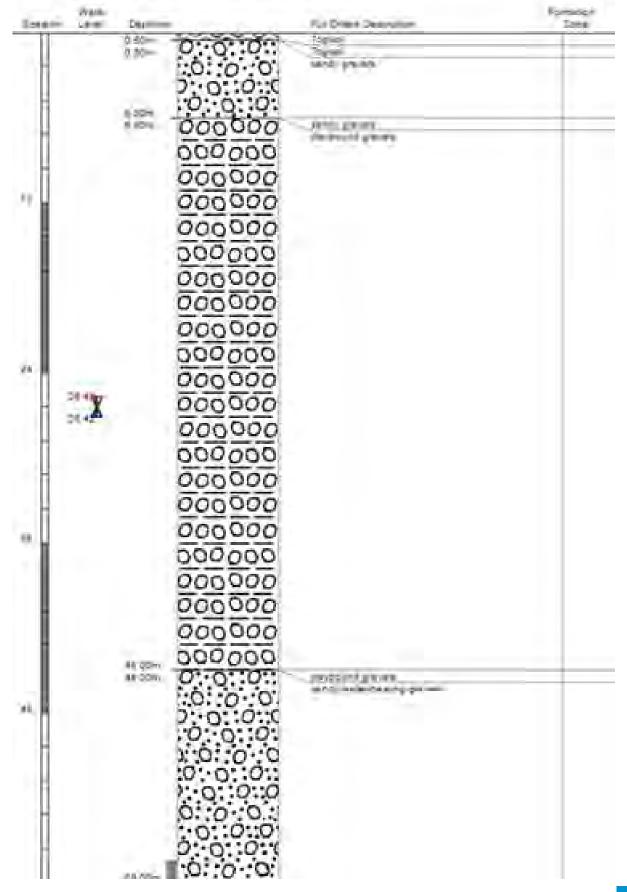
Location Accuracy: 2 - 15m

Bround Lavel Althora 81 4 m • MSD Accoracy = 0.5 m

Driller East Coast Drilling Drill Metrics Rotary/Percussion

Borelog Depth 60 0 m Drill Date 15-Feb-2006





Borelog for well BX23/0525

Grid Reference (NZTM): 1550000 mE, 5179207 mN

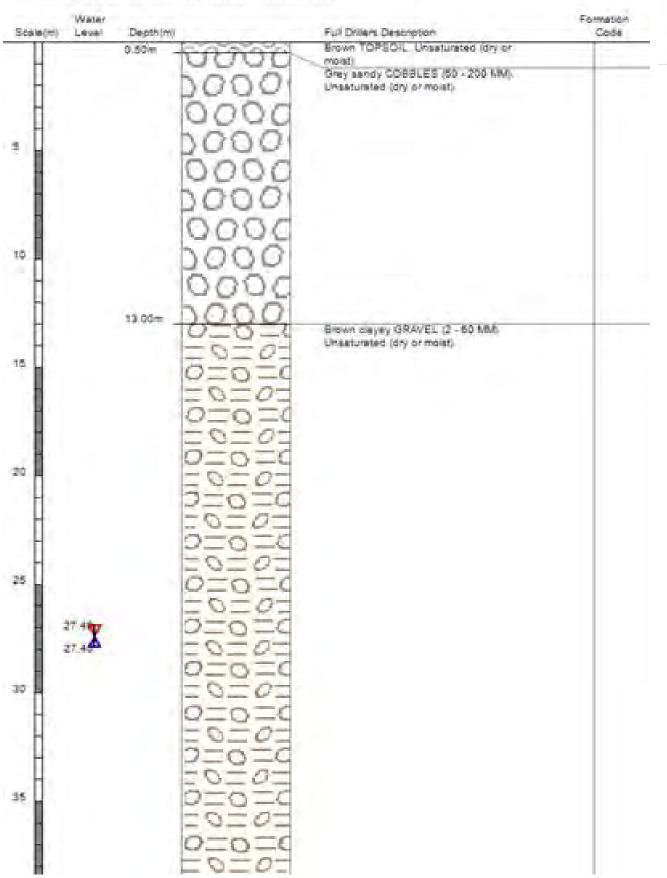
Location Accuracy 10 - 50m

Ground Level Altitude: m •MSD Accuracy

Driller East Coast Drilling Drill Method: Air Rotary

Borelog Depth: 42.0 m Drill Date: 14-Sep-2015







AMENDMENT	S:	
AMENDMENT	DATE	DESCRIPTION

NOTE

- Areas and dimensions are approximate only and are subject to final survey and deposit of plans.
- 2) Service easements to be created as required.
- This plan has been prepared for subdivision consent purposes only. No liability is accepted if the plan is used for any other purposes.



PLANNING SURVEYING ENGINEERING

79 Cambridge Terrace P 0 Box 679 Christchurch 8140. New Zealand Telephone; 03 379-0793 Fax; 03 379-5664 E-mall; office@dis.co.nz

JOB TITLE:

G W Wilfield Limited Gillman Wheelans

SHEET TITLE:

Test Pit Locations

DRAWING STATU

For Approval

CALE: 1:2500@A1 DATE: June 2014

CAD FILE: J:\18130\ENG\Geotech Report\C18130.TPL.01

DRAWING No: SHEET No:

C.18130 TPL.01

R1

1	Scala Po	enetrome	ter Log		Job No: 18	130	
	Project: Lot 862				SPT No: TF	P026	
Client: Gillma							
Date: 27/06/2				vel	S	er	Soil Strength to NZS3604:1999 (kPa)
	Ifeild Sub Devision	<u>:</u>	<u>E</u>	, Le	No.	ows o ov	engt 04:1
Logged By: N		Graphic	Depth (m)	Water Level	SPT Blows	T Blo	l Str S36('a)
Description o	f Soils.	Gr		×	SP	SPT Blows Average over 300mm	Soi NZ (RP
	-		0.00				
					1	1.50	112.50
	Topsoil				2	2.00	150.00
End of D	lana lan (Craval hit)		1		3	2.50	187.50
Ena oi B	ore log (Gravel hit)		0.50				
			1.00				
			1.50				
			2.00				
			2.00				
			2.50				
			3.00				
			3.50				
			3.50				
			4.00				
			<u> </u>		J		

1	Scala Pe	enetrome	ter Log		Job No: 18	130	
DAVIE LOVELL-SNITH	Project: Lot 862				SPT No: TI	P027	
Client: Gillma							
Date: 27/06/2	014			le le		_	to 10
Location: Wil	feild Sub Devision	U	E)	Le) N	ws	ngth 4:19
Logged By: N	lic Brooker	phi	th	ter	Blc	Blo age nm	Stre 360.
Description o		Graphic	Depth (m)	Water Level	SPT Blows	SPT Blows Average over 300mm	Soil Strength to NZS3604:1999 (KPa)
			0.00		, , , , , , , , , , , , , , , , , , ,	0, ()	0, 2 0
					1	1.00	75.00
					1		75.00
	Topsoil				1		100.00
					2		100.00
End of	Bore log (Gravel hit)		0.50		1		275.00
Liid Oi	bore log (Graver Ilit)						
					8	4.50	337.50
			1.00				
			1.00				
			1.50				
			2.00				
			2.50				
			3.00				
			0.50				
			3.50				
			4.00				
		l					

1	Scala Penetr	ometer L	og		Job No: 18	130	
Project: Lot					SPT No: TF	P028	
Client: Gillman Wheelar	ns						
Date: 27/06/2014			_	_ -	S	Ē	Soil Strength to NZS3604:1999 (KPa)
Location: Wilfeild Sub [Devision	<u> </u>	E	Le	ow.	ws 0 0	engtl
Logged By: Nic Brooker		hde :	Depth (m)	iter	F Bl	- Blc rage mm	Stre 3360 a)
Description of Soils.	(Graphic	Del	Water Level	SPT Blows	SPT Blows Average over 300mm	Soil NZS (KPa
		0.00					
Topsoil		0.50			1 1 2	1.00 1.33 1.50	75.00 100.00 112.50
Sandy Grav	el	1.00					
		1.50					
		2.00					
		2.50					
		3.00					
		3.50					
		4.00					

1	Scala Penetrometer Log				Job No: 18130			
Project: Lot 862					SPT No: TF	P029		
Client: Gillmar	n Wheelans							
Date: 27/06/20	014			vel	S	-e	Soil Strength to NZS3604:1999 (kPa)	
Location: Wilf	eild Sub Devision	ي	Œ	Le	šwc	ws ove	angtl	
Logged By: Nic Brooker		hdı	oth	ter	. Ble	· Blo rage nm	Stre 3360 1)	
Description of		Graphic	Depth (m)	Water Level	SPT Blows	SPT Blows Average over 300mm	Soil NZS (KPa	
			0.00			77 77	.,	
	-				1	1.00	75.00	
	Topsoil				1	1.33	100.00	
					2	1.33	100.00	
						1.67	125.00	
			0.50		2	2.00	150.00	
					3	3.00	225.00	
						3.00	225.00	
					4			
					2	2.67	200.00	
		-	1.00		2	3.00	225.00	
			1.00		5	4.00	300.00	
					5	5.00	375.00	
	Sandy Gravel							
		and the second	1.50					
			2.00					
		7777						
		and and are						
			2.50					
			3.00					
			3.00					
			3.50					
			4.00					

Scala Penetrometer Log				Job No: 18130			
Project: Lot 862	Project: Lot 862			SPT No: TP030			
Client: Gillman Wheelans							
Date: 27/06/2014	1	_	<u>e</u>		<u>.</u>	Soil Strength to NZS3604:1999 (KPa)	
Location: Wilfeild Sub Devision	J	(E)	Lev	SW(ws ove	ngth 4:19	
Logged By: Nic Brooker	phi	ţ	ter	Blc	Blov age nm	Stre 360.)	
Description of Soils.	Graphic	Depth (m)	Water Level	SPT Blows	SPT Blows Average over 300mm	Soil VZS KPa	
		0.00		Ţ,	0, (0)	0, 2 0	
				1	1.00	75.00	
Topsoil				1		75.00	
End of Bore log (Gravel hit)]					
		0.50					
		1.00					
		1.50					
		2.00					
		2.50					
		3.00					
		3.50					
		4.00					

1	Scala Penetrometer Log				Job No: 18130			
Project: Lot 862			<u>~</u>		SPT No: TF			
Client: Gillma	n Wheelans							
Date: 27/06/2			_	le/		_	Soil Strength to NZS3604:1999 (KPa)	
Location: Wi	Ifeild Sub Devision	. <u>.</u>	Depth (m)	Water Level	SPT Blows	ws ove	angth 4:19	
Logged By: Nic Brooker		Graphic	oth	ter) 	SPT Blows Average ov 300mm	Stre 3360 a)	
Description of	of Soils.			Ma	SPT	SPT Blows Average over 300mm	Soil NZS (kP	
			0.00					
					1	1.00	75.00	
	Topsoil	<u> </u>			1	1.00	75.00	
	ropoon	<u> </u>			1	1.67	125.00	
					3	4.33	325.00	
			0.50		9	8.00	600.00	
					12	10.50	787.50	
		マグナハ						
			4.00					
			1.00					
Sa	ndy Gravel							
		マグチへ						
			1.50					
			1.50					
		- + + + +						
			2.00					
		PARTONIA CONTROL MARK						
			2.50					
			3.00					
			3.50					
							'	

Scala Penetrometer Log				Job No: 18130			
Project: Lot 862			SPT No: TP032				
Client: Gillman Wheelans							
Date: 27/06/2014			/el	(0	٦.	1 to	
Location: Wilfeild Sub Devision	<u>.</u> 2	Œ	Le	šmo	ws ove	angtl	
Logged By: Nic Brooker	phi	oth	ter	. Blc	Blo age	Stre 360 1)	
Description of Soils.	Graphic	Depth (m)	Water Level	SPT Blows	SPT Blows Average over 300mm	Soil Strength to NZS3604:1999 (kPa)	
		0.00					
Tanasii				2	3.00	225.00	
Topsoil				4	4.67	350.00	
Silt				8		725.00	
End of Bore log (Gravel hit)				17		937.50	
,		0.50					
		1.00					
		1.50					
		1.50					
		2.00					
		2.50					
		3.00					
		3.50					
		4.00					