BASELINEGROUP

Appendix 3: Geotechnical Investigations

Geotechnical Report

Hoskyns Road, Kirwee

Proposed Subdivision
Lot 1 DP 350121 (CT 205192)
and
Lot 2 DP 350121 (CT 205193)

Prepared for Bealey Developments Limited

May 2013

Davis Ogilvie
Professionals
Engineers • Surveyors • Planners

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Quality Assurance

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Davis Ogilvie

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Disclaimer

This engineering report has been prepared at the specific instruction of Bealey Developments. It addresses geotechnical conditions onsite, provides estimates of liquefaction induced settlement and lateral spreading for the proposed 45 lot subdivision of Lot 1 DP 350121 and Lot 2 DP 350121 Certificate of Title 205192 and 205193 respectively.

Davis Ogilvie did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. Conditions may exist which were undetectable given the limited investigation of the site. Variations in conditions may occur between investigatory locations, and there may be conditions onsite which have not been revealed by the investigation, which have not been taken into account in the report.

Davis Ogilvie's opinions are based upon information that existed at the time of the production of the document. Assessments made in this report are based on the conditions found onsite and published sources detailing the recommended investigation methodologies described. No warranty is included; either expressed or implied that the actual conditions will conform to the assessments contained in this report.

Davis Ogilvie has provided an opinion based on observations, site investigations, and analysis methodologies current at the time of reporting.

Only Bealey Developments, and the Local and Regional Territorial Authority are entitled to rely upon this engineering report. Davis Ogilvie & Partners Ltd accepts no liability to anyone other than The University of Canterbury and The Project Office in any way in relation to this report and the content of it and any direct or indirect effect this engineering report may have. Davis Ogilvie & Partners Ltd does not contemplate anyone else relying on this report or that it will be used for any other purpose.

Should anyone wish to discuss the content of this report with Davis Ogilvie & Partners Ltd, they are welcome to contact us on (03) 366 1653 or at 186 Hazeldean Road, Addington, Christchurch.

1.0 Introduction

Davis Ogilvie & Partners Ltd has been engaged by Bealey Developments Limited to provide advice on the suitability for subdivision of Lot 1 DP 350121 and Lot 2 DP350121 (CT 205192 and CT 205193) Hoskyns Road, Kirwee, into approximately 45 residential lots.

The purpose of the report is to detail the suitability of the proposed lots, and provide geotechnical constraints and design criteria. Geotechnical considerations for the lots other than those outlined above are not considered in this report.

The scope of works for the investigation included the following works:

- Desktop study
- Site walkover
- Ten Boreholes including Standard Penetration Testing (SPT)
- Geotechnical considerations reporting

2.0 Site Description

The proposed subdivision is located on Hoskyns Road, Kirwee. Legal description of the two lots that encompass the site is; Lot 1 DP 350121 and Lot 2 DP 350121 (CT 205192 and 205193, respectively). The site located approximately 500 metres north east of Kirwee, on rural land which is generally flat and is currently utilised for arable farming. The site is bounded by Hoskyns Road to the north, residential subdivisions to the west and rural land to the south and east.

Aerial photography and current property boundaries on the site are presented in Figure 1, and the proposed 45 residential lot scheme plan is provided in Appendix D.

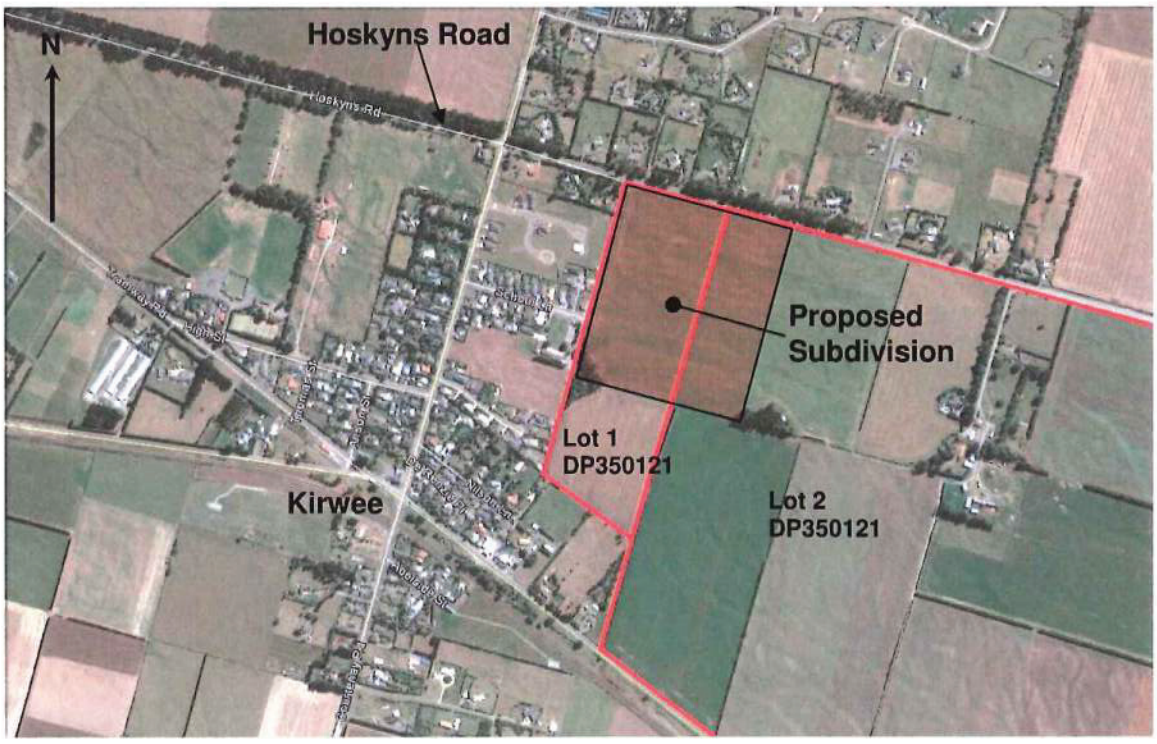

Figure 1 - Aerial Photography of the Proposed Subdivision

3.0 Desk Study

A desk study was conducted to provide background information on the site. This involved research of the published geology, Environment Canterbury (ECan) database, local authority information, groundwater information, and an assessment of recent seismic events in the area.

3.1 Published Geology & Ground Water

Published site geology from Geological and Nuclear Sciences (GNS) (Forsyth *et al* 2008[1]), indicates that the site is underlain by post glacial brownish-grey river alluvium (Q2a), derived from the late quaternary era.

A search of nearby Environment Canterbury (ECan) ground water monitoring wells found two recorded wells within 5 km of the proposed subdivision; L35/0163 and M35/0921, are located approximately 3 km west and 4 km east respectively. Monitoring well M35/0921 was geologically logged from surface and encountered well graded sandy gravel from ground level to a depth of 32.3 m Below Ground Level (BGL), this is underlain by cemented well graded sands and gravels to a target termination depth of 66.4 m BGL.

Well L35/0163 was not logged until 57.9 m BGL, however showed identical lithological units to M35/0921 at this depth; however M35/0921 was advanced to 83.8 m BGL and encountered Conglomerate at 61.3 m until target depth.

The upper lithological description of ECan monitoring well M35/0921, confirms the published geology.

Both wells L35/0163 and M35/0921 have had periodic historical monitoring, the earliest reading was taken during June 1952 from well L35/0163 and periodically monitored until present; groundwater fluctuated between 45.7 to 83.8 m BGL. Monitoring well M35/0921 had its first reading taken during September 1974 until its last reading during April 2004; static water levels fluctuated between 24.87 m to 55.3 m BGL during this period.

[1] Forsyth, P.J., Barrell, D.J.A., Jongens, R. (2008) (compilers), Geology of the Christchurch Area, Institute of Geological and Nuclear Sciences 1:250 000 geological map 16. 1 sheet. Lower Hutt, New Zealand. GNS Science. ISBN 987-0-478-19649-8

3.2 Regional Seismicity

The nearest known active faults listed in the NZS1170.5:2004 which are regarded as *major* are the Alpine, Kakapo and Hope Fault. The recently active Port Hills and the Greendale Faults, as well as a number of smaller reverse and strike-slip faults (the Porters Pass/Amberley Fault Zone, Springbank Fault and the Hororata Fault[2]), were identified. Table 1 summarises the proximities of faults near to the proposed subdivision on Hoskyns Road.

Table 1 Active Faults and Proximity to site

Fault Name	Distance from Fault (km)
Alpine	110
Kakapo	80
Hope	130
Port Hills	35
Greendale	15
Porters Pass	45
Amberley	55
Springbank	25
Hororata	20

As a result of the Christchurch Earthquake series the site has been subject to earthquake loading, with the greatest peak ground acceleration occurred during the September 2010 when the Greendale Fault ruptured at surface. Review of the peak ground acceleration (PGA) data from the GNS monitoring site at the Darfield High School and Rolleston School showed PGAs of 0.65 – 1.29 g during this event.

[2] Environment Canterbury (2009), Earthquake Hazard Assessment for Waimakariri District. Report No. R09/32.

4.0 Site Investigation

The site investigation comprised a site walkover and ten boreholes with Standard Penetration Testing (SPT) carried out at 1.5 m depth intervals. A Geotechnical Site layout plan is presented in Appendix A of this report.

4.1 Site Walkover

An initial site walkover was carried out during the deep ground testing (boreholes investigation) in June 2012. The walkover included inspection of the lots for the surface expression of liquefaction and/or lateral spreading by means of inspection of the ground for bulging, sand ejection, fissuring and cracking.

No surface expression of liquefaction, lateral spreading or other earthquake-induced land damage was observed onsite, nor has it been reported as a result of the recent Canterbury earthquakes.

4.2 Borehole Investigation

Ashburton Contracting Limited (ACL) were contracted to advance ten Boreholes (BH) across the site at locations presented in appended geotechnical site location plan presented in Appendix A of this report. The boreholes were advanced using a sonic drill rig, with continuous sampling capabilities. Standard penetration testing (SPT) was carried out 1.5 m centres during the drilling process to provide relative density of the underlying soils.

The initial target depths for all ten boreholes was 15.0 m Below Ground Level (BGL) however as boreholes BH01, BH02, BH07 and BH09 were advanced to their target depth of 15.0 m BGL it was deemed impractical to advance the remaining boreholes to 15.0 m as it could be concluded with good confidence that the site was underlain by laterally and vertically consistent lithogical units of competent sand and gravel. Therefore the remaining six boreholes had a reduced target depth of 10.0m BGL. The borehole logs are presented in Appendix B of this report, an indicative soil profile is presented in Table 2.

Table 2 Indicative Soil Profile

Depth (m)	Description	N_{50} Values	Relative Density
0.0 – 0.2	TOPSOIL	N/A	N/A
0.2 – 15.0	GRAVEL and SAND	21 - >50	Medium dense – Very dense

4.3 Liquefaction Discussion

The site walkover has confirmed that there is no surface expression of liquefaction observed as a consequence of the Canterbury Earthquake series that commenced during September 2010.

Natural ground water was not encountered during the advancement of the boreholes, this is consistent with ECan ground water monitoring wells in the area, as outlined in Section 3.1 of this report.

The 2012 Environment Canterbury (ECan) technical report on the liquefaction hazard in Canterbury compiled by GNS Science[3] provides useful information on the liquefaction hazard at the proposed subdivision. Figure 3 illustrates the 2012 ECan Liquefaction Hazard map, with a focus on the proposed subdivision area. The ECan Hazard Map generally indicates two distinct zones with regards to Liquefaction Assessment; it is either "needed" or "damage from liquefaction is unlikely," although the proposed subdivision lies approximately 3km west of the western limits of the hazard map it can be concluded that the land beneath the proposed subdivision is "unlikely" to liquefy.

Liquefiable soils are typically deposits of saturated loose sand and silt. The onsite boreholes and SPT testing have identified that the site is underlain by medium dense typically very dense well graded gravels with minor beds of well graded medium dense to very dense sand and therefore not deemed to be susceptible to liquefaction, as the soils are not only dry (natural water level as identified in ECan monitoring well M35/0921 at minimum depth of 24.87 m BGL) but are also too coarse to liquefy, this is consistent with the findings during the site walkover with no surface expression of liquefaction found on site.

[3] Brackley, H.L. (compiler). 2012. Review of liquefaction hazard information in eastern Canterbury, including Christchurch City and parts of Selwyn, Waimakariri and Hurunui Districts, GNS Science Consultancy Report 2012/218. 99p. Environment Canterbury report number R12/83.

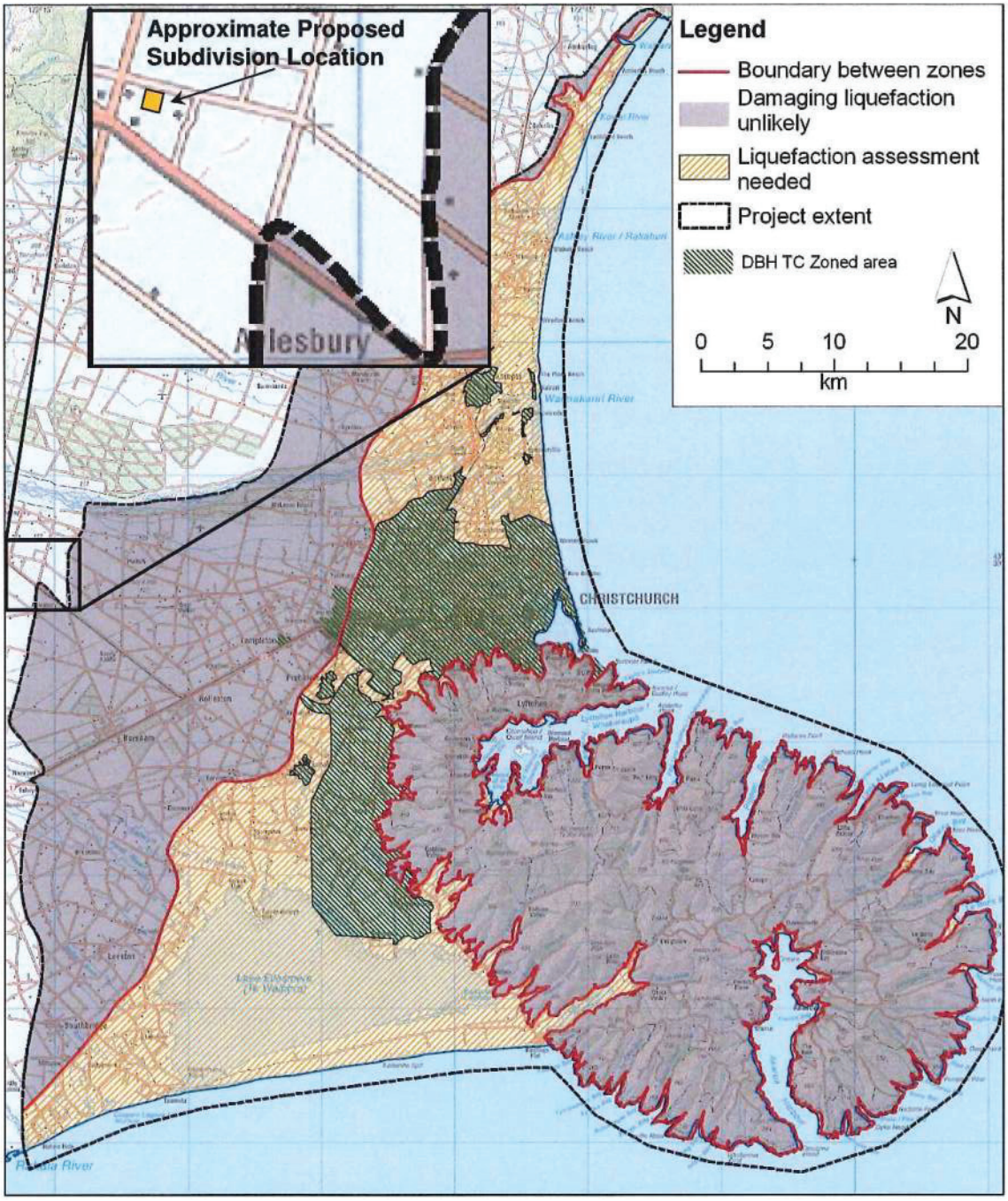

Figure 3 - ECan Liquefaction Assessment Area Map. Brackley, H.L. (compiler), 2012.

5.0 Typical Foundations Investigations

Intrusive site investigations' including Standard Penetration Testing (SPT) has revealed that the site is underlain by medium dense to very dense well graded sands and gravels to a minimum depth of 15.0 m below ground level, surrounding ECan water monitoring wells have concluded that these granular deposits are consistent to considerable depth. It is the professional opinion of Davis Ogilvie that the site can be categorised as equivalent to Technical Category 1. The ground conditions on the site can be defined as "Good Ground" as per NZS3604:2011.

Shallow investigation in accordance with New Zealand Standard NZS3604:2011 is deemed appropriate for house foundation design at building consent stage.

6.0 Section 106 RMA Discussion

Section 106 of the Resource Management Act (RMA) requires a process of addressing the potential for material damage from erosion, falling debris, subsidence, slippage, and inundation for the proposed lots. These aspects are addressed in the following section.

6.1 Erosion

The proposed lots are flat, and are stable against erosion. Erosion was not noted during site visits and is deemed to not be of concern at the site.

6.2 Falling Debris and Slippage

As the proposed lots are located on flat ground with no elevated areas bordering the site elevated. No mechanism for rock falls or land slides exist. Therefore the site has no potential to be affected by falling debris or slippage.

6.3 Subsidence

As the underlying soils are dense and dry sands and gravels the site is deemed to be non-liquefiable where no settlement due to liquefaction is expected during Ultimate Limit State (ULS) and Serviceability Limit State (SLS) seismic events.

It is therefore of our opinion the site is suitable for residential development. Shallow investigation of the building sites at the building consent stage in accordance with the New Zealand standard NZS 3606:2011 is deemed appropriate for foundation design at the proposed lots.

6.4 Inundation

It is believed that the site is not prone to inundation. The site is not located within a flood management area, as specified by the Selwyn District Council. A flood hazard assessment requested from Environment Canterbury indicates that the site is "outside any recorded flood plains", regarded as flood ponding areas. As per the appended letter from Nick Griffiths on behalf of Environment Canterbury.

6.5 Section 106 General Comment

It is believed that the site is generally fit for subdivision and building development under Section 106 of the RMA. Further investigation using Scala Penetrometer testing and hand augers may be required at building consent stage to confirm the underlying geology and appropriate design criteria for the house sites, however it is of our opinion that standard foundation testing requirements as outlined in NZS 3604:2011 shall be appropriate for development of the proposed lots. A statement of professional opinion on the suitability of land for subdivision is presented in Appendix C of this report.

7.0 Conclusions

It is recommended that the site is suitable for residential subdivision. No visual effects of lateral spreading, or liquefaction from the Canterbury earth quake sequence September 2010 earthquake to present have been observed. No liquefaction induced settlement or lateral spreading is expected in ULS or SLS seismic events due to the underlying geology comprising unsaturated well graded, dense arenaceous (sand) and rudaceous (larger than sand) materials.

It is recommended that the lots are typical of Technical Category 1 (TC) classification.

Minimum Ground water levels in the area are in the order of -24.8 m below ground level based on nearby ECan monitoring wells L35/0163 and M35/0921. Ground water levels on site are in excess of 15.0 m below ground level, as no natural ground water was encountered during the drilling of boreholes BH01 – BH10.

It is in the professional opinion of Davis Ogilvie & Partners Ltd (not to be construed as a guarantee) that the aforementioned site is suitable for residential development and construction.

Davis Ogilvie

APPENDIX A

Layout Plan

contractor to locate all existing services & verify all dimensions before commencing work

issue	date	reason	approved
A	08/12	Geotechnical Report Diagram	ED
B	04/13	Geotechnical Report Diagram	ED

CAD ref: 130404.bvb.geotech Test Location Plan

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P.O. Box 589 Christchurch 8140
OFFICES ALSO IN:
Nelson - Timaru - Greymouth

Geotechnical Test Location Plan

Bealey Developments, 1651 - 1737 Hoskyns Road, Kirwee

design	drawn	QA check	dwg	issue
SM	BVB	ED	401	B
scale @ A3	date	file		
1:2500	04/13	29250		

Davis Ogilvie

APPENDIX B

Borehole Logs

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Email: admin@do.co.nz

Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM | **Datum:** -

Hole: BH01
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 15.30
Orientation (°): 0
Inclination (°): 90

MaterialXX	MaterialX	Material	Description	Weathering (SW / MW / HW / CW)	Graphic Log	Depth	TCR (%)	SPT N-value (Uncorrected)	Sample	Backfill & Installation
	M1		Firm dark brown silty CLAY. Moist. Some trace medium gravel.			0.50				
			Soft mottled brown/dark brown silty CLAY.			1.00	87			
			Grey silty slightly sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to medium of greywacke.			1.50				
			Very dense grey brown sandy GRAVEL with some rare cobbles Sand is fine to coarse. Gravel is subrounded fine to medium occasionally coarse.			2.00	90		8, 12 / 27, 32, 34, 15 N = 50 300mm penetration	
			Dense grey brown silty sandy GRAVEL with some rare cobbles Sand is fine to coarse. Gravel is subrounded fine to medium occasionally coarse.			2.50				
			Very dense brown sandy GRAVEL with some rare cobbles. Sand is fine to coarse. Gravel is fine to coarse subrounded of greywacke.			3.00				
			Very dense grey brown slightly sandy GRAVEL with some rare cobbles. Sand is fine to coarse. Gravel is fine to coarse subrounded of greywacke.			3.50	92		8, 12 / 13, 6, 7, 7 N = 33 300mm penetration	
			Very dense brown sandy GRAVEL with some rare cobbles. Sand is fine to coarse. Gravel is fine to medium subrounded of greywacke.			4.00				
						4.50				
						5.00	92		6, 10 / 14, 9, 8, 7 N = 47 300mm penetration	
						5.50				
						6.00				
						6.50	95		4, 15 / 15, 15, 12, 14 N = 50 300mm penetration	
						7.00				
						7.50				
			Dense brown clayey slightly sandy GRAVEL. Sand is fine to coarse. Gravel is fine subrounded of greywacke.			8.00	100		17, 18 / 11, 9, 6, 7 N = 33 300mm penetration	
						8.50				
						9.00				
						9.50	100		8, 15 / 14, 15, 16, 20 N = 50 300mm penetration	
						10.00				
						10.50				
			Very dense grey silty sandy GRAVEL with some rare cobbles. Sand is fine to coarse. Gravel is fine subrounded to subangular fine to coarse of greywacke.			11.00	95		50, 0 / 50 N = 50 75mm penetration	
			Very dense brown clayey GRAVEL. Gravel is fine subangular of greywacke.			11.50				
			Very dense brown sandy GRAVEL. Sand is fine to coarse. Gravel is fine to medium occasionally coarse subrounded of greywacke.			12.00				
			Very dense brown clayey GRAVEL. Gravel is fine to medium subrounded of greywacke.			12.50	96		10, 32 / 31, 26, 25, 45 N = 50 300mm penetration	
						13.00				
						13.50				
			Very dense grey well cemented clayey GRAVEL with some rare cobbles.			14.00				
			Very dense grey clayey GRAVEL with some rare cobbles. Gravel is fine to coarse subrounded of greywacke.			14.50	92		21, 30 / 47, 20, 28, 32 N = 50 300mm penetration	
						15.00			3, 7 / 33, 36, 30, 22 N = 50 300mm penetration	Bentonite

EOH: 15.3 m

Logger	Start Date	Remarks	Hole Depth (m): 15.30
BVB	-		Cluster: -
Driller	End Date		-
-	-		

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Email: admin@do.co.nz

Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM **Datum:** -

Hole: BH02
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 15.73
Orientation (°): 0
Inclination (°): 90

Material	Description	Weathering (SW / MW / HW / CW)	Graphic Log	Depth	TCR (%)	SPT N-value (Uncorrected)	Sample	Backfill & Installation
	Light brown gravelly SILT. with abundant rootlets. Gravel is subrounded fine of greywacke.			0.00				
	Brown silty sandy GRAVEL. Sand is fine to coarse. gravel is subangular fine to medium of greywacke.			0.50	95			
	Very dense grey silty sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			1.00			3, 7 / 23, 50 N = 50 150mm penetration	
	Medium dense grey slightly silty sandy GRAVEL with many cored cobbles. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of greywacke.			1.50	92			
	From 3.5 m - Moist			2.00			6, 7 / 6, 6, 5, 4 N = 21 300mm penetration	
	Dense grey brown silty sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			2.50	98			
	From 5.05 m - Wet			3.00			5, 10 / 10, 10, 12, 10 N = 42 300mm penetration	
	From 5.2 - 6.1 m - Becoming slightly clayey			3.50	97			
	Dense becoming very dense grey silty sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			4.00			7, 19 / 24, 20, 24, 30 N = 47 300mm penetration	
				4.50	96			
				5.00			8, 10 / 9, 9, 11, 18 N = 47 300mm penetration	
				5.50	100			
				6.00			6, 10 / 14, 18, 24, 24 N = 50 300mm penetration	
				6.50	100			
				7.00			8, 15 / 20, 27, 14, 9 N = 50 300mm penetration	
				7.50	92			
	Soft light brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular to subrounded fine of greywacke. Possibly driller induced.			8.00			2, 7 / 20, 22, 21, 18 N = 50 300mm penetration	
	Very dense grey brown silty sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			8.50	96			
				9.00			23, 35 / 50 N = 50 75mm penetration	
				9.50	98			
				10.00			13, 31 / 20, 25, 23, 15 N = 50 300mm penetration	
				10.50	99			
				11.00				
				11.50				
				12.00				
				12.50				
				13.00				
				13.50				
				14.00				
				14.50				
				15.00				
				15.50				

Bentonite

EOH: 15.73 m

Logger	Start Date	Remarks	Hole Depth (m): 15.73
DW	-		Cluster: -
Driller	**End Date**		-
-	-		

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Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM **Datum:** -

Hole: BH03
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 11.16
Orientation (°): 0
Inclination (°): 90

Material XX	Material X	Material	Description	Weathering (SW MW HW CW)	Graphic Log	Depth	TCR (%) (25 50 75)	SPT N-value (Uncorrected) (10 20 30 40 50)	Sample	Backfill & Installation
			Brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine to medium of greywacke. Rare rootlets.			0.50	95			
			Very dense grey brown slightly silty sandy GRAVEL with abundant cobbles. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			1.00				
			From 2.4 - 3.0 m - Very dry			1.50				
						2.00	96		10, 16 / 22, 30, 29, 23 N = 50 300mm penetration	
						2.50				
						3.00				
			Dense brown silty sandy GRAVEL. Sand is fine to coarse. Gravel is rounded to subangular fine to coarse of greywacke.			3.50	98		12, 11 / 7, 10, 15, 20 N = 42 300mm penetration	
						4.00				
						4.50				
			At 5.3 m - Large cored cobble			5.00	97		6, 11 / 12, 10, 9, 8 N = 39 300mm penetration	Bentonite
						5.50				
						6.00				
						6.50	98		25, 30 / 31, 37, 50 N = 51 225mm penetration	
			Very dense grey very silty sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			7.00				
			At 7.3 m - Large cored cobble			7.50				
						8.00	100		5, 10 / 12, 14, 30, 18 N = 50 300mm penetration	
						8.50				
						9.00				
						9.50	95		4, 20 / 29, 40, 41, 33 N = 50 300mm penetration	
						10.00				
						10.50				
						11.00	100		12, 16 / 39, 21, 25, 24 N = 50 300mm penetration	

EOH: 11.16 m

Logger	Start Date	Remarks	Hole Depth (m): 11.16
DW	-		Cluster: -
Driller	**End Date**		-
-	-		

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Email: admin@do.co.nz

Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM **Datum:** -

Hole: BH04
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 10.30
Orientation (°): 0
Inclination (°): 90

Material XX	Material X	Material	Description	Weathering (SW / MW / HW / CW)	Graphic Log	Depth	TCR (%) (25 / 50 / 75)	SPT N-value (Uncorrected) (10 / 20 / 30 / 40 / 50)	Sample	Backfill & Installation
			Soft dark brown silty CLAY with some rare decomposing rootlets and organic matter.			0.50				
			Brown clayey GRAVEL with some rare cobbles. Gravel is subrounded fine to coarse of greywacke.			1.00	99			
			Brown grey sandy GRAVEL with some iron staining. Sand is fine to coarse. Gravel is subrounded fine to medium of greywacke.			1.50				
			Dense brown slightly silty sandy GRAVEL some rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			2.00	95		10, 9 / 8, 7, 7, 8 N = 30 300mm penetration	
			Dense brown clayey sandy GRAVEL with some rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			2.50				
			Very dense brown clayey SAND with rare fine to coarse gravel and cobbles. Sand is fine to coarse.			3.00				
			Very dense brown clayey sandy GRAVEL with some rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to medium of greywacke.			3.50	98		7, 13 / 10, 12, 9, 5 N = 36 300mm penetration	
						4.00				
						4.50			36 / 50 N = 50 75mm penetration	
						5.00	97			Bentonite
						5.50				
			Very dense brown slight clayey sandy GRAVEL with some cobbles. Sand is medium to coarse. gravel is subrounded fine to coarse of greywacke.			6.00				
						6.50			5, 6 / 6, 18, 24, 22 N = 50 300mm penetration	
						7.00	100			
						7.50				
						8.00			43 / 50 N = 50 75mm penetration	
						8.50	100			
						9.00				
			Very dense light brown clayey sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subrounded fine of greywacke.			9.50	95		5, 2 / 12, 12, 10, 12 N = 46 300mm penetration	
			Very dense brown grey clayey sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			10.00			13, 24 / 50 N = 50 75mm penetration	
			EOH: 10.3 m							

Logger	Start Date	Remarks	Hole Depth (m): 10.30
BVB	-		Cluster: -
Driller	End Date		-
-	-		

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Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM | **Datum:** -

Hole: BH05
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 11.16
Orientation (°): 0
Inclination (°): 90

MaterialXX	MaterialX	Material	Description	Weathering (SW / MW / HW / CW)	Graphic Log	Depth	TCR (%) (25 50 75)	SPT N-value (Uncorrected) (10 20 30 40 50)	Sample	Backfill & Installation
			Brown slightly sandy SILT. Sand is fine. Rare rootlets.			0.00				
			Light brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine of greywacke.			0.50	98			
			Medium dense grey brown silty sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			1.00				
						1.50			6, 7 / 5, 7, 6, 9 N = 27 300mm penetration	
						2.00	98			
			Dense becoming very dense Grey brown silty sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to medium occasionally coarse of greywacke			2.50				
						3.00			14, 8 / 13, 12, 12, 8 N = 45 300mm penetration	
						3.50	97			
						4.00				
						4.50			6, 10 / 9, 12, 11, 18 N = 50 300mm penetration	
						5.00	96			
						5.50				
						6.00			8, 13 / 16, 18, 22, 20 N = 50 300mm penetration	
						6.50	100			
						7.00				
						7.50			20, 28 / 20, 16, 11, 14 N = 50 300mm penetration	
			Grey brown very silty sandy GRAVEL with rare cored cobbles. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			8.00	100			
						8.50				
						9.00			14, 11 / 14, 26, 17, 11 N = 50 300mm penetration	
						9.50	100			
						10.00				
						10.50			7, 15 / 10, 12, 15, 16 N = 50 300mm penetration	
						11.00	98			

EOH: 11.16 m

Logger	Start Date	Remarks	Hole Depth (m): 11.16
DW	-		Cluster: -
Driller	**End Date**		-
-	-		

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Email: admin@do.co.nz

Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM | **Datum:** -

Hole: BH06
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 10.55
Orientation (°): 0
Inclination (°): 90

Material XX	Material X	Material	Description	Weathering (SW, MW, HW, CW)	Graphic Log	Depth	TCR (%) (25, 50, 75)	SPT N-value (Uncorrected) (10, 20, 30, 40, 50)	Sample	Backfill & Installation
			Firm brown sandy gravelly CLAY with light brown partings of silt. Sand is fine to coarse. Gravel is subangular to rounded fine of greywacke.			0.50				
			Grey sandy gravelly greywacke COBBLES. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse of greywacke.			1.00	100			
			Grey brown silty sandy GRAVEL. Sand is fine to coarse. Gravel is rounded to subangular fine to coarse of greywacke.			1.50				
			Dense to very depse grey silty sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to medium of greywacke. From 2.44 m - Gravel becoming fine to coarse			2.00	95		8, 15 / 12, 13, 11, 17 N = 50 300mm penetration	
						2.50				
						3.00				
						3.50	98		9, 14 / 36, 9, 11, 18 N = 50 300mm penetration	
			At 4.08 m - Thin bed of clayey sandy gravel			4.00				
						4.50				
			Dense to very dense grey brown silty sandy GRAVEL with abundant cored cobbles. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke.			5.00	97		7, 15 / 9, 9, 8, 7 N = 33 300mm penetration	
						5.50				
						6.00				
						6.50	99		6, 13 / 11, 14, 19, 6 N = 50 300mm penetration	
						7.00				
						7.50				
			Very dense grey brown silty sandy GRAVEL. Sand is fine to coarse. Gravel is subangular to rounded fine to medium of greywacke.			8.00	99		7, 11 / 11, 8, 9, 15 N = 42 300mm penetration	
						8.50				
						9.00				
			From 9.14 m - Gravel becoming fine to coarse with many cored greywacke cobbles. Rare iron staining			9.50	100		11, 12 / 44, 25, 32, 50 N = 50 300mm penetration	
						10.00				
						10.50			3, 10 / 23, 21, 20, 27 N = 50 300mm penetration	

EOH: 10.55 m

Logger	Start Date	Remarks	Hole Depth (m): 10.55
DW	-		Cluster: -
Driller	End Date		-
-	-		

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Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM **Datum:** -

Hole: BH07
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 15.70
Orientation (°): 0
Inclination (°): 90

Material XX	Material X	Material	Description	Weathering (SW / MW / HW / CW)	Graphic Log	Depth	TCR (%) (25 / 50 / 75)	SPT N-value (Uncorrected) (10 / 20 / 30 / 40 / 50)	Sample	Backfill & Installation
			Soft dark brown silty slightly sandy CLAY with some rootlets. Sand is			0.50	100			
			Soft brown silty slightly sandy CLAY. Sand is medium to coarse.			1.00				
			Brown sandy GRAVEL. Sand is fine to coarse. Gravel is subangular fine to coarse of greywacke.			1.50				
			Dense grey silty GRAVEL. Gravel is subangular fine to medium of			2.00	95		11, 10 / 9, 7, 10, 11 N = 37 300mm penetration	
			Dense orange sandy GRAVEL with some rare cobbles. Heavily iron stained. Sand is fine to coarse. Gravel is subrounded fine to coarse of			2.50				
			Very dense brown silty sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			3.00	98		8, 10 / 11, 12, 13, 8 N = 44 300mm penetration	
			Very dense brown silty sandy GRAVEL with rare cobbles. Sand is medium to coarse. Gravel is subrounded fine to coarse of greywacke.			3.50				
						4.00				
						4.50				
			Very dense brown clayey sandy GRAVEL. Sand is fine to coarse. gravel is subrounded fine to medium of greywacke			5.00	97		10, 15 / 22, 28, 35, 40 N = 50 300mm penetration	
						5.50				
						6.00				
			Very dense brown clayey sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			6.50	99		15, 43 / 32, 33, 25, 22 N = 50 300mm penetration	
						7.00				
						7.50				
			Very dense brown clayey sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to medium of greywacke.			8.00	95		9, 16 / 30, 50 N = 50 150mm penetration	
						8.50				
						9.00				
			Very dense brown slightly clayey sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to medium of greywacke.			9.50	96		15, 15 / 15, 17, 23, 13 N = 50 300mm penetration	
						10.00				
						10.50				
						11.00	100		6, 10 / 17, 12, 12, 12 N = 50 300mm penetration	
						11.50				
						12.00				
						12.50	100		11, 29 / 25, 27, 23, 20 N = 50 300mm penetration	
						13.00				
						13.50				
						14.00	100		, 30 / 25, 50 N = 50 150mm penetration	
						14.50				
						15.00				
						15.50	99		17, 36 / 16, 17, 19, 20 N = 50 300mm penetration	

EOH: 15.7 m

Logger	Start Date	Remarks	Hole Depth (m): 15.70
BVB	-		Cluster: -
Driller	End Date		-
-	-		

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Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM **Datum:** -

Hole: BH08
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 10.55
Orientation (°): 0
Inclination (°): 90

Description	Depth	TCR (%)	SPT N-value (Uncorrected)	Sample	Backfill & Installation
Firm dark brown CLAY with abundant partings of light brown silt. Abundant rootlets throughout	0.50				
Light brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine to occasionally medium of	1.00	95			
Grey silty sandy GRAVEL. Sand if fine to coarse. gravel is angular to subrounded fine to medium of	1.50				
Dense becoming very dense grey brown silty sandy GRAVEL. Sand is fine to coarse. Gravel angular to subrounded fine to coarse of greywacke.	2.00	98		5, 11 / 11, 10, 12, 13 N = 46 300mm penetration	
	2.50				
	3.00				
	3.50	97		6, 9 / 8, 11, 15, 19 N = 50 300mm penetration	
	4.00				
Very dense grey silty sandy GRAVEL partly cemented. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of greywacke	4.50				
Very dense grey brown silty sandy GRAVEL with abundant cobbles. Sand is fine to coarse. gravel is subangular to subrounded fine to coarse of greywacke	5.00	99		7, 12 / 12, 13, 14, 41 N = 50 300mm penetration	Bentonite
	5.50				
	6.00				
Very dense brown silty sandy GRAVEL Sand is fine to coarse. Gravel is subrounded fine occasionally medium of greywacke.	6.50	95		9, 15 / 17, 17, 19, 15 N = 50 300mm penetration	
Very dense grey brown silty sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to medium occasionally coarse of greywacke	7.00				
	7.50				
	8.00	98		7, 17 / 21, 14, 18, 25 N = 50 300mm penetration	
	8.50				
	9.00				
	9.50	99		5, 11 / 14, 16, 21, 25 N = 50 300mm penetration	
	10.00				
	10.50			5, 5 / 15, 15, 12, 20 N = 50 300mm penetration	

EOH: 10.55 m

Logger	Start Date	Remarks	Hole Depth (m): 10.55
DW	-		Cluster: -
Driller	End Date		-
-	-		

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Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM **Datum:** -

Hole: BH09
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 15.20
Orientation (°): 0
Inclination (°): 90

Material XX	Material X	Material	Description	Weathering (SW / MW / HW / CW)	Graphic Log	Depth	TCR (%) (25 / 50 / 75)	SPT N-value (Uncorrected) (10 / 20 / 30 / 40 / 50)	Sample	Backfill & Installation
			Soft dark brown clayey slightly sandy SILT with some rootlets and decaying organic matter. Sand is coarse.			0.50				
			Brown sandy slightly gravelly SILT. Sand is medium to coarse. Gravel is subrounded fine to greywacke.			1.00	100			
			Brown clayey silty slightly sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			1.50				
			Medium dense becoming dense brown sandy GRAVEL with rare cobbles. Sand is fine to coarse. gravel is subrounded fine to coarse of greywacke			2.00	95		10, 13 / 8, 6, 7, 7 N = 28 300mm penetration	
			Medium dense becoming very dense brown clayey slightly sandy GRAVEL with rare cobbles. Sand is medium to coarse. Gravel is subrounded fine to coarse of greywacke.			2.50				
						3.00				
						3.50	98		8, 16 / 23, 12, 8, 6 N = 49 300mm penetration	
						4.00				
						4.50				
						5.00	99		17, 10 / 19, 27, 22, 1 N = 50 300mm penetration	
						5.50				
			Very dense brown slightly clayey sandy GRAVEL. Sand is medium to coarse. Gravel is rounded fine to medium of greywacke.			6.00				
			Very dense brown clayey slightly sandy GRAVEL well cemented. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			6.50	99		16, 8 / 9, 10, 12, 16 N = 47 300mm penetration	
			Very dense brown silty sandy GRAVEL. Sand is medium to coarse. Gravel is subangular fine to coarse of greywacke			7.00				
			Very dense brown clayey slightly sandy GRAVEL. Sand is medium to coarse. Gravel is subrounded fine to coarse of greywacke.			7.50				
						8.00	97		9, 15 / 20, 21, 31, 11 N = 50 300mm penetration	
						8.50				
			Very dense brown slightly clayey sandy GRAVEL with rare cobbles. Sand is medium to coarse. Gravel is subrounded fine to coarse for			9.00				
			Very dense brown slightly clayey slightly sandy GRAVEL. Sand is medium to coarse. Gravel is subrounded fine to coarse of greywacke.			9.50	100		17, 17 / 15, 14, 15, 15 N = 50 300mm penetration	
						10.00				
						10.50				
						11.00	100		4, 16 / 18, 13, 13, 10 N = 50 300mm penetration	
						11.50				
			From 12.0 m - Becoming sandy			12.00				
			From 12.6 m - becomes clayey and well cemented			12.50	95		12, 18 / 24, 30, 40, 30 N = 50 300mm penetration	
						13.00				
						13.50				
						14.00	95		8, 7 / 8, 7, 8, 30 N = 50 300mm penetration	
						14.50				
						15.00	98			

EOH: 15.2 m

Logger	Start Date	Remarks	Hole Depth (m): 15.20
BVB	-		Cluster: -
Driller	End Date		-
-	-		

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Email: admin@do.co.nz

Client: Bealey Developments Limited
Project: Bealey Developments, Hoskyns Road. Kirwee

Location: Hoskyns Road. Kirwee. Christchurch
Description: Proposed subdivision of Lot 1 DP 55412 and Lot 4 DP 13291 into 42 residential lots.

Grid: NZTM **Datum:** -

Hole: BH10
North (m): -
East (m): -
Elevation (m): -
Hole Depth (m): 11.20
Orientation (°): 0
Inclination (°): 90

Material XX	Material X	Material	Description	Weathering (SW MW HW CW)	Graphic Log	Depth	TCR (%) (25 50 75)	SPT N-value (Uncorrected) (10 20 30 40 50)	Sample	Backfill & Installation
			Soft dark brown silty CLAY.			0.50				
			Brown clayey sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to coarse of			1.00	100			
			Dense brown sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			1.50				
						2.00			7, 10 / 11, 15, 8, 10 N = 44 300mm penetration	
						2.50	95			
						3.00				
			Dense becoming very dense brown slightly clayey silty sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			3.50			6, 7 / 6, 8, 8, 10 N = 32 300mm penetration	
						4.00	98			
						4.50				
			Very dense brown clayey sandy GRAVEL. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			5.00			11, 22 / 45, 29, 23, 50 N = 50 300mm penetration	
						5.50	97			
						6.00				
						6.50			5, 11 / 13, 50 N = 50 150mm penetration	
						7.00	99			
						7.50				
						8.00			7, 21 / 31, 20, 22, 27 N = 50 300mm penetration	
			Very dense brown clayey GRAVEL with rare cobbles. Gravel is subrounded fine to coarse of greywacke.			8.50	99			
						9.00				
						9.50			8, 13 / 9, 20, 7, 5 N = 41 300mm penetration	
						10.00	99			
						10.50				
			Very dense brown clayey sandy GRAVEL with rare cobbles. Sand is fine to coarse. Gravel is subrounded fine to coarse of greywacke.			11.00	100		8, 22 / 26, 28, 20, 30 N = 50 300mm penetration	
			EOH: 11.2 m							

Logger	Start Date	Remarks	Hole Depth (m): 11.20
BVB	-		Cluster: -
Driller	End Date		-
-	-		

Davis Ogilvie

APPENDIX C

Professional Opinion of Suitability Statement

Part 4: Geotechnical Requirements, APPENDIX I. Christchurch City Council Infrastructure Design Standard.

Statement of Professional Opinion on the Suitability of Land for Building Construction

ISSUED BY: Elliot Duke Engineer BE(Hons), MIPENZ, CPENG (Senior Civil and Environmental)

TO: Bealey Developments Ltd

TO BE SUPPLIED TO: Selwyn District Council

IN RESPECT OF: Subdivision of Lot 1 DP 350121 and Lot 2 DP 350121

AT: 1651, 1653, 1655, 1735, 1737 Hoskyns Road ,Kirwee

I Elliot Duke, on behalf of Davis Ogilvie and Partners hereby confirm that:

1. I am a suitably qualified and experienced geotechnical engineer and was retained by the owner / developer as the geotechnical engineer on the above development.

2. The original ground not affected by filling and the filled ground are suitable for the construction of a development / subdivision and are not subject to erosion, subsidence in accordance with the provisions of Section 106 of the Resource Management Act 1991 provided that:

    a. Additional testing is required prior to building consent in accordance with NZS3604:2011.

3. This professional opinion is furnished to the territorial authority and the owner / developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity the normal inspection of foundation conditions at the time of erection of any building.

4. This certificate shall be read in conjunction with my/the geotechnical report referred to in Clause 2 above, and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

5. The geotechnical engineering insurance firm issuing this statement holds a current policy of professional indemnity insurance of no less than $ 2,000,000

Date : 28/3/2013

Elliot Duke
Senior Civil and Environmental Engineer
BE (Hons), MIPENZ (Civil and Environmental), CPENG

APPENDIX D

McDougal Park Subdivision Plan (Morgan and Pollard 28/05/2013 001A Preliminary)

Mc DOUGAL PARK

KEY FEATURES

1. HOSKYNS ROAD ENTRANCE FEATURE (PRIMARY)
2. SCHOOL LANE ENTRANCE FEATURE (SECONDARY)
3. CAR PARK
4. SPORTS FIELDS
5. OFF ROAD CYCLE/PEDESTRIAN LINK
6. LINK TO FUTURE STAGES

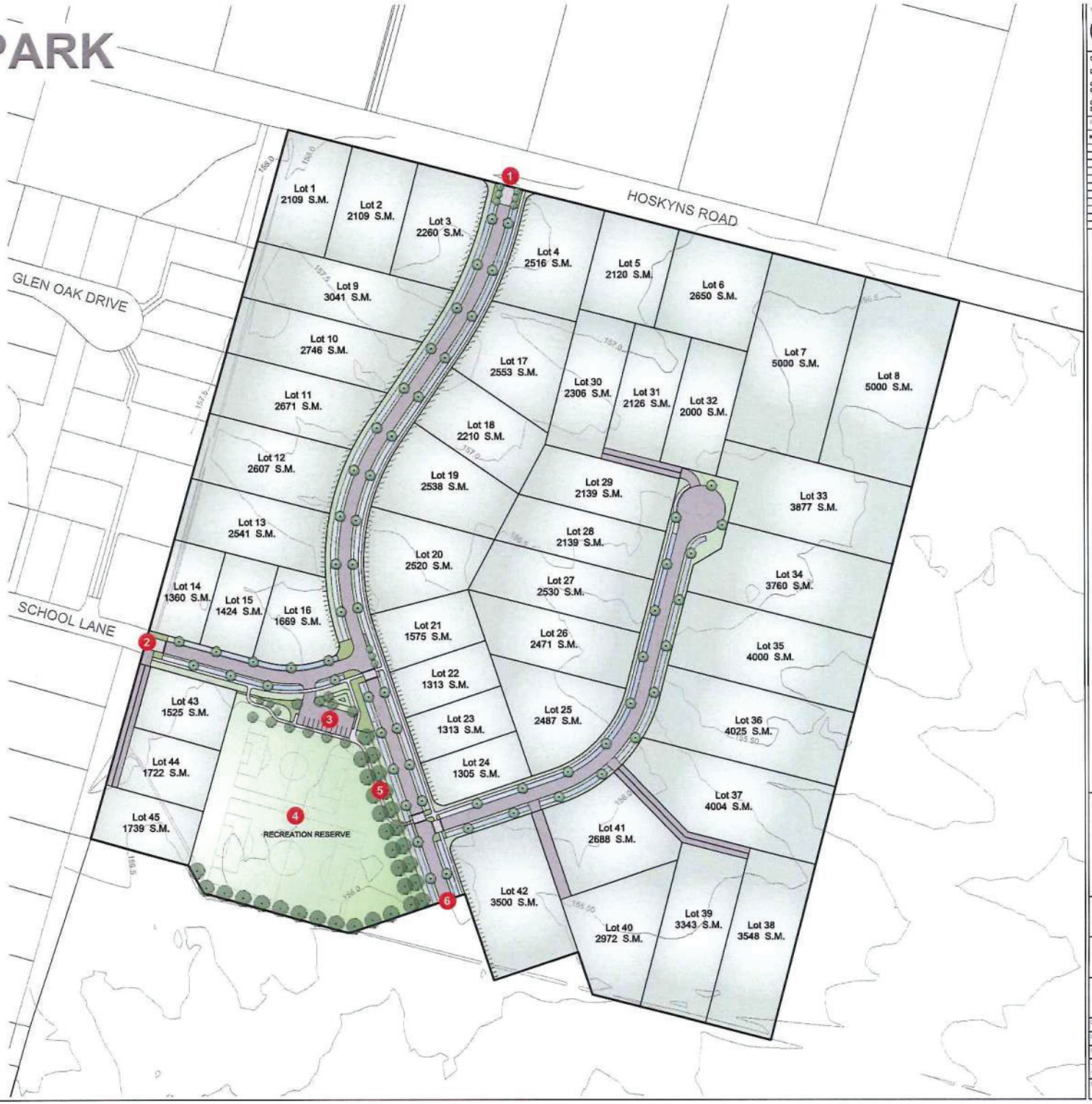
LEGEND

SURFACES
- SECTIONS
- RESERVE
- ROAD RESERVE
- 2.5m WIDE GRASS SWALE WITH SOAKPITS
- LANDSCAPE EASEMENT
- STAGE BOUNDARY

HARDSCAPE
- ROAD
- ROAD FEATURE PAVING
- FOOTPATH

SOFTSCAPE
- SHRUB BED
- COLUMNAR STREET TREE
- STREET TREE
- RESERVE SPECIMEN TREE
- NATIVE SPECIMEN TREE

General Notes
1. REFER TO ENGINEER PLANS FOR DETAILS OF SWALE AND SOAKPIT SPACING



REVISIONS:

No	Remark:	Date:

morgan+pollard
Landscape Architecture
Morgan + Pollard - Landscape Architecture
240 Hoskyns Junction Road, Christchurch 8025
P: 03 977 5532 - F 03 977 5531
www.morgan-pollard.co.nz

CLIENT: BEALEY DEVELOPMENTS

PROJECT: Mc DOUGAL PARK

DWG TITLE: STAGE 1 & 2 PLAN

DESIGNED BY:	CC	SCALE @ A1:	1:1000
DRAWN BY:	CC	DATE:	28/05/2013
APPROVED BY:	RP		
JOB NO:	14338	DWG NO:	001
REVISION:	A		

ISSUED FOR: PRELIMINARY

LOCATION PLAN
DNS

PRECEDENT IMAGES

ACCENT VEHICULAR PAVING AT ENTRANCES AND PEDESTRIAN CROSSINGS

PEDESTRIAN BRIDGE OVER SWALE

TREE LINED PATHS

LONG VISTAS

COMMUNITY RECREATIONAL FACILITIES

NORTH

DO NOT SCALE OFF THE DRAWING

CONTRACTOR MUST VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING WORK

CONTRACTOR TO VERIFY ALL UNDERGROUND SERVICES BEFORE COMMENCING WORK

REVISIONS

No	Revision	Date

morgan+pollard
Landscape Architecture

CLIENT: BEALEY DEVELOPMENTS

PROJECT: Mc DOUGAL PARK

DWG TITLE: RESERVE PLAN

DESIGNED BY	CC	SCALE	1:400
DRAWN BY	CC	DATE	28/05/2013
REVIEWED BY	RP		
JOB NO	14338	DWG NO 002	REVISION A
ISSUED FOR	PRELIMINARY		

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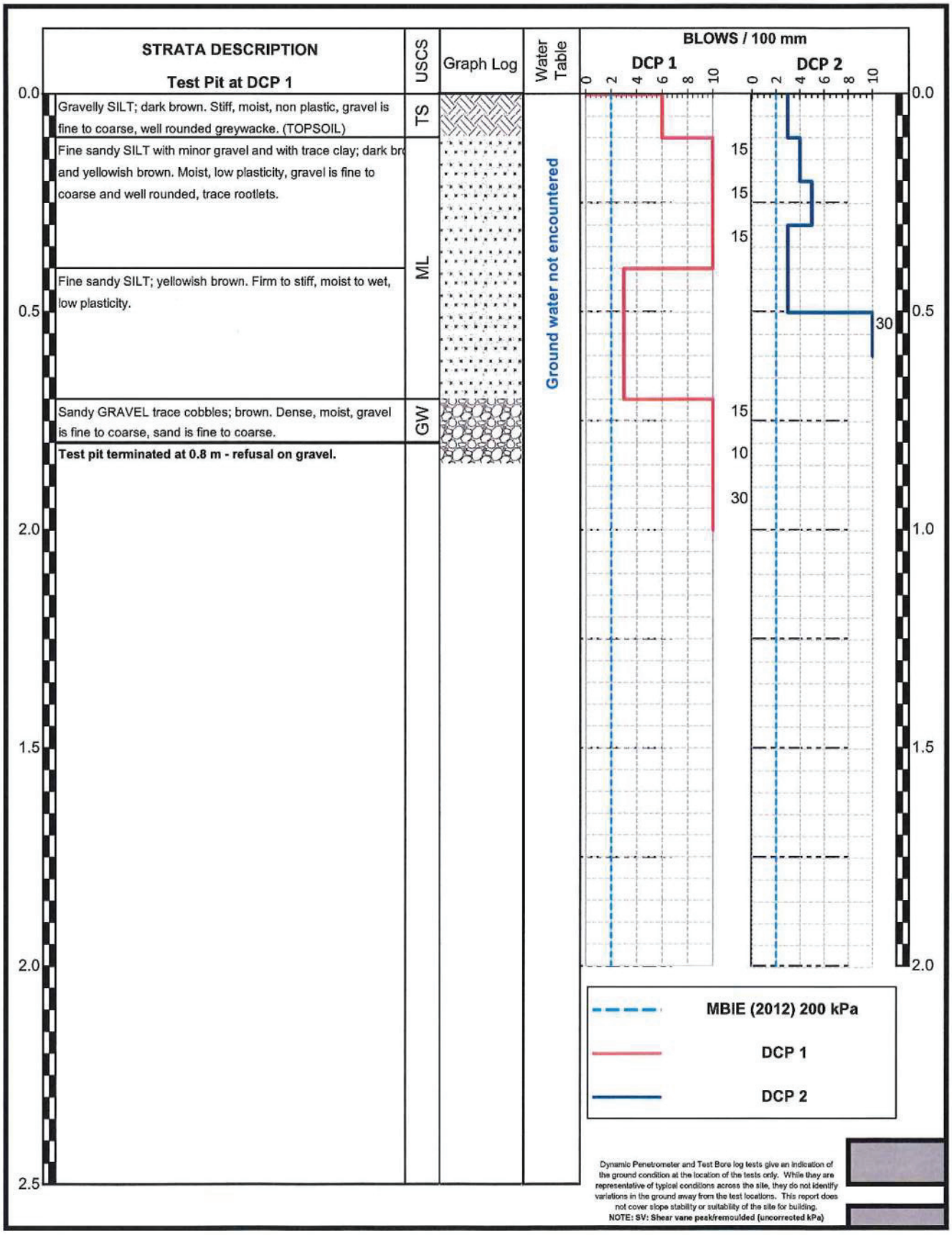
Job No. XXXXXX
DCP 1,2+TP

BORE LOG/SCALA PENETROMETER RESULTS

Project:	4 Austen Place, Rolleston, Canterbury (Lot 2 DP 460063)	Date:	8/08/2014
Client:	Rotary Club of Hornby Charitable Trust	Time:	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (600A)	Field Staff:	KT+AB
Notes:	Shallow Investigation	Equipment:	SP+HA



Dynamic Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This report does not cover slope stability or suitability of the site for building.
NOTE: SV: Shear vane peak/remoulded (uncorrected kPa)

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Job No. XXXXXX

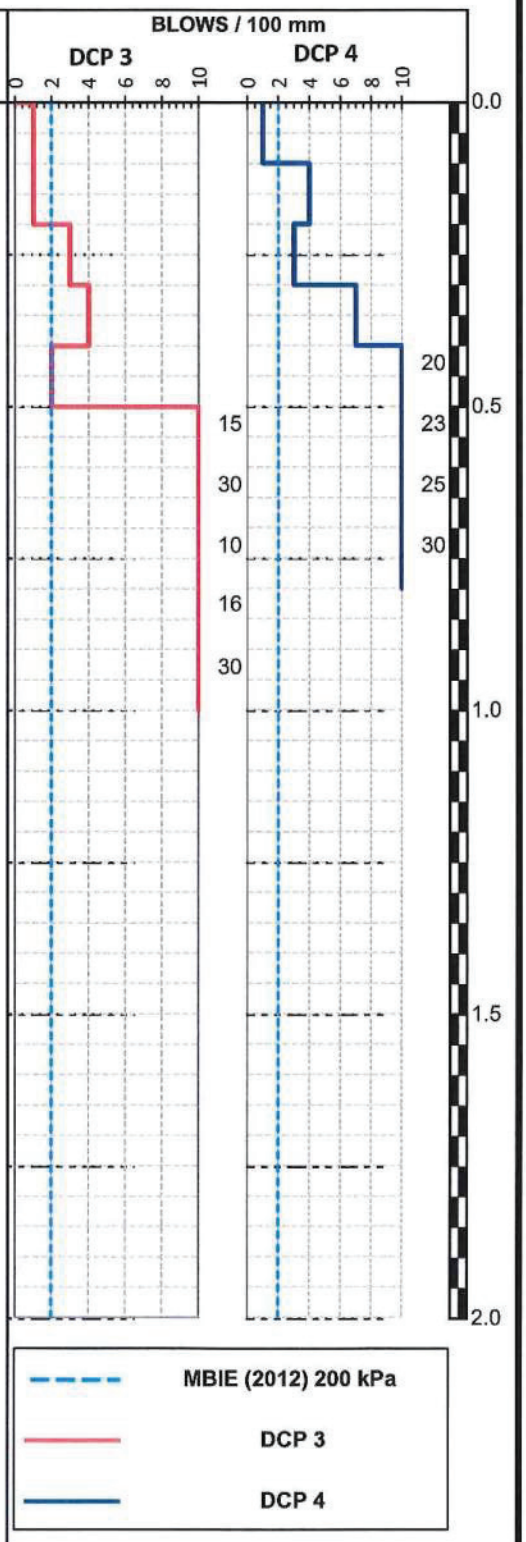
DCP 3,4+TP

BORE LOG/SCALA PENETROMETER RESULTS

Project:	4 Austen Place, Rolleston, Canterbury (Lot 2 DP 460063)	Date:	8/08/2014
Client:	Rotary Club of Hornby Charitable Trust	Time:	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (600A)	Field Staff:	KT+AB
Notes:	Shallow Investigation	Equipment:	SP+HA

STRATA DESCRIPTION Test Pit at DCP 3	USCS	Graph Log	Water Table
SILT with some gravel; dark brown. Soft to stiff, moist, low plasticity, gravel is fine to coarse, well rounded greywacke. (TOPSOIL)	TS		
Silty sandy GRAVEL with trace cobbles and boulders; orangey brown. Loose, moist, gravel is fine to coarse, sand is fine to coarse. At 0.5 m - becomes dense to very dense.	GW		
Test pit terminated at 0.8 m - refusal on gravel.			

Ground water not encountered



Dynamic Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This report does not cover slope stability or suitability of the site for building.

NOTE: SV: Shear vane peak/remoulded (uncorrected kPa)

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11 November 2019

Our ref: 773-CHCGE231520

Murray Boyes
189 Main South Road
Darfield
Canterbury

Attention: Murray Boyes

Geotechnical report to support a plan change application at Hoskyns Road, Kirwee, Selwyn District

1. Introduction

Baseline Group are currently working on an approved subdivision in Kirwee, Selwyn District. Part of the Baseline Group work is to apply for a plan change for the area covered by the approved subdivision. This is to allow an increase in the density of the existing residential zone.

We understand that the original subdivision was approved based on a geotechnical report completed by Davis Ogilvie (DO) in May 2013; however, this report was focused on the areas which were scheduled for residential development and didn't include testing over the whole area which is being presented as part of the plan change application.

Coffey has been engaged by Murray Boyes to complete additional ground investigations at the site and to provide a report which uses the original DO investigation and reporting supplemented with the additional shallow investigation data to provide a geotechnical report to support the plan change application to Selwyn District Council (SDC), which encompasses the entire site.

2. Scope of work

Based the above information we consider the overarching scope of work to include the following:

- Review of available reporting for the site and for the neighbouring Walter Place Subdivision including:

  Baseline Group plan change submission documents including Appendices 1-11.

  Engeo: Geotechnical and Preliminary Environmental Site Investigation for 88 Courtenay Road, Kirwee, Canterbury dated 11 February 2015 (Walter Place subdivision).

- Review of factual data for the site including:
  - New Zealand Geotechnical Database layers.
  - Borehole investigation data available from the DO report
- Shallow ground investigation to infill areas which were not investigated by the original DO report.
  - 5 shallow field tests comprising hand augered boreholes (HA) to 3 mbgl (or refusal) with accompanying dynamic cone penetration testing (DCP) and shear vane testing (SV) where appropriate.
- Provision of a geotechnical report which comments on the items required by Section 106 RMA and is considered suitable to support the plan change application.

The extent of the proposed plan change area is shown in Appendix A.

3. Existing information

3.1. Walter Place Subdivision review

Engeo Limited completed a Geotechnical and Preliminary Environmental Site Investigation for the site at 88 Courtenay Road, Kirwee (now Walter Place) in February 2015. This site is located adjacent to the Hoskyns Road site which is currently under consideration for plan change. A summary of the key information from this report is included below:

- 20 hand auger and Scala penetrometer tests where undertaken across the site.
  - All tests reached practical refusal within the upper 0.7 m of the ground profile (inferred to be dense insitu gravel.
- Ground water was estimated as being in excess of 6 mbgl.
- The site was assessed as being geotechnically suitable for subdivision.

3.2. DO Report review

DO completed a geotechnical assessment of the majority of the subject site in May 2013. A summary of the key findings from this report are summarised below:

- 10 machine boreholes (BH) with standard cone penetration tests (SPT) where under taken by DO across the northern portion of the plan change application site.
  - These boreholes identified less than 1 m of surficial sand and silt overlying dense to very dense silty / sandy gravel to at least 15 mbgl.
  - Ground water was not recorded in the 10 BH at the site.
- Ground water was described based on two publicly available Well Logs (L35/0163 and M35/0921).
  - These wells all describe ground water as being deeper than 24 mbgl in all recordings.
- The site was assessed as being categorised equivalent to MBIE Technical Category TC1.
- The site has been considered suitable for subdivision.

4. Site details

4.1. Site description

The site is located within a rural setting on the outskirts (east) of the town of Kirwee in Canterbury.

The site occupies an area of the Canterbury Plains approximately 5 km to the south of the Waimakariri River. Consistent with this geographical setting the site is generally flat with some minor shallow historical channel features consistent with the past migration of the Waimakariri River.

The area under consideration for the plan change application is currently elevated above the Waimakariri River by approximately 15 m.

4.2. Geological setting

The geological map[1] of the area indicates that the site has surface geology consisting of "*Higher elevation, older alluvial gravel, sand and silt"* of the Springston Formation.

5. Fieldwork summary

5.1. Ground investigation

Coffey performed shallow investigations on 1 November 2019. Our testing consisted of five hand augered boreholes (HA) accompanied by dynamic cone penetrometer (DCP) tests. The hand augered boreholes terminated at depths ranging from 0.3 – 0.7 mbgl. The HA logs are presented in Appendix B of this report.

The HA locations as well as the DO BH locations are shown on Figure 1 below.

[1] Brown, L.J.; Weeber, J.H. 1992: Geology of the Christchurch urban area. Scale 1:25 000 Institute of Geological & Nuclear Sciences geological map 1. 1 sheet + 104 p. Institute of Geological & Nuclear Sciences Limited, Lower Hutt, New Zealand.

Figure 1: Investigation location plan

5.2. Ground conditions

The ground model for this site was derived based on the ground conditions encountered during our investigations along with data from the DO Report. These other investigations comprise 10 machine boreholes (BH).

The subsurface conditions encountered are generally consistent with the published geological information, and the site stratigraphy has been summarised in Table 1 below.

Table 1: Ground stratigraphy.

Description	Depth to Bottom of Layer (mbgl)	Assessed Relative Density or Consistency
TOPSOIL	0.0 to 0.3	-
Silty SAND / Silty SAND	0.3 to 0.7	Loose to medium dense
Silty GRAVEL	15.0 +	Dense to very dense

5.3. Groundwater regime

As ground water was not encountered in the Engo (neighbouring site), Coffey or DO instigations which extended to a maximum depth of 15.0 mbgl it has been assessed that ground water is in excess of 15.0 mbgl at the site.

5.4. Site subsoil class

In accordance with NZS1170.5, Section 3.1.3, a site subsoil classification of "*Class D – Deep or soft soil sites"* may be assumed for this site.

6. Geotechnical Assessment

6.1. Natural hazards

6.1.1. Flood hazard

The site is flat and is elevated above the existing Waimakariri River channel by 15 m. Considering this topography, we consider that there is a low risk of inundation of the site in a future flood event.

6.1.2. Erosion

The site is generally flat meaning the potential for fast uncontrolled water flow which could lead to erosion is considered to be low.

6.1.3. Falling debris

The topography of the site and surrounding area are generally flat meaning there is no risk of rockfall or other geological process causing debris to inundate the site.

6.1.4. Subsidence

The ground conditions which are present at the site which include a thick layer of dry dense to very dense sandy gravel are not considered to be prone to either static or liquefaction induced settlement.

The surficial layer of sand / silt is potentially a cause of minor foundation settlement; however, this can be controlled through good earthworks practice.

6.1.5. Lateral spreading

Given the generally flat topography and non-liquefiable nature of the soils at the site it is considered to be at negligible risk of lateral spreading in a future earthquake event.

6.1.6. Slippage

The given the topography of the site the risk of slope failure is considered to be negligible.

7. Suitability of the site for subdivision

Based on our assessment we consider the site is suitable for subdivision, our Statement of Professional Opinion is attached.

We consider that the foundation recommendations outlined in NZS 3604.2011 to be appropriate for the subdivision, provided that lot specific (building consent) geotechnical investigations confirm the ground conditions identified within this report.

8. Limitations

This report has been prepared solely for the use of our client Murray Boyes, his professional advisers and Selwyn District Council (SDC) in relation to the specific project described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity.

It is recommended that all other parties seek professional geotechnical advice to satisfy themselves as to its on-going suitability for their intended use.

As subsurface information has been obtained solely from discrete investigation locations, which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been taken into account in the report. If variations in the subsoils occur from those described or assumed to exist, then the matter should be referred back to us immediately.

Please also refer to the enclosed *Important Information about Your Coffey Report*.

9. Closure

If you have queries or require further clarification regarding aspects of this report, please contact the undersigned.

For and behalf of Coffey

Prepared by

Andrew Jordan
BSc
Senior Engineering Geologist

Reviewed and authorised by

Richmond Beetham
BE (Civil) BSc MSc Eng DIC FEngNZ PEngGeol CPEng
Principal Geotechnical Engineer

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

Appendix A - Site plan

BASELINEGROUP

Kirwee

Scale 1:5000 @A1
Date 05 Jun 2019
Design EL
Drawn EL
Review SE

Rev.	Date	Amendment
A	20/06/19	Legend Amendments
B	14/08/19	Align to the latest boundary amendment

Revision B

Sheet 1

Appendix B - Hand auger logs

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Engineering Log - Hand Auger

Borehole ID.	***HA01***
sheet:	1 of 1
project no.	***773-CHCGE231520***
client:	***Murray Boye c/o Baseline Group***
date started:	***01 Nov 2019***
principal:	
date completed:	***01 Nov 2019***
project:	***Kirwee Plan Change***
logged by:	***J. Byron-Joyce***
location:	***Kirwee***
checked by:	***A. Jordan***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N					0		OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M				**TOPSOIL**
							ML	**Sandy SILT**: non plastic to low plasticity, pale brown.	M to W	St			**SPRINGSTON FORMATION - BLEAK HOUSE MEMBER (SPB)**
					0.5		GW	**SILTY GRAVEL**: fine to medium grained, rounded, pale brown.		MD			
								Hand Auger HA01 terminated at 0.6 m Refusal on gravel					
					1.0								
					1.5								

CDF_0_9_06_LIBRARY.GLB rev:AR Log COF BOREHOLE: NON CORED + DCP HAND AUGER LOGS.GPJ <<DrawingFile>> 07/11/2019 12:02

method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V
*
e.g.
B
T

support
M mud
C casing
N nil

penetration
1 2 3

water
bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
V
bit
no resistance ranging to refusal
10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System
U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff
HB

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undisturbed sample ##mm diameter
hand penetrometer (kPa)
standard penetration test (SPT)
SPT - sample recovered
SPT with solid cone
vane shear; peak/remouded (kPa)
refusal
hammer bouncing

moisture
VSt very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

method & support	penetration 1 2 3	water		RL (m)	depth (m)	graphic log	classification symbol		moisture condition	consistency / relative density	50 100 150 200	2 4 6 8 10	
AS / N													

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

CDF_0_9_06_LIBRARY.GLB rev:AR Log COF BOREHOLE: NON CORED + DCP HAND AUGER LOGS.GPJ <<DrawingFile>> 07/11/2019 12:02

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Engineering Log - Hand Auger

Borehole ID.	***HA02***
sheet:	1 of 1
project no.	***773-CHCGE231520***
client:	***Murray Boye c/o Baseline Group***
date started:	***01 Nov 2019***
principal:	
date completed:	***01 Nov 2019***
project:	***Kirwee Plan Change***
logged by:	***J. Byron-Joyce***
location:	***Kirwee***
checked by:	***A. Jordan***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	vane shear (kPa) ⊕ remoulded ⊙ peak (50 100 150 200)	DCP (blows/ 100 mm) (2 4 6 8 10)	structure and additional observations
HA N							OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M				**TOPSOIL**
					0.5		ML	**Sandy SILT**: non plastic to low plasticity, pale brown. Hand Auger HA02 terminated at 0.3 m Refusal on gravel	M to W	St			**SPRINGSTON FORMATION - BLEAK HOUSE MEMBER (SPB)**
					1.0								
					1.5								

CDF_0_9_06_LIBRARY.GLB rev:AR Log COF BOREHOLE: NON CORED + DCP HAND AUGER LOGS.GPJ <<DrawingFile>> 07/11/2019 12:02

method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V

*
e.g.
B
T

support
M mud
C casing
N nil

penetration
1 2 3

water
bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample

V
bit no resistance ranging to refusal

10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System

U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff

HB

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moisture
VSt

undisturbed sample ##mm diameter
hand penetrometer (kPa)
standard penetration test (SPT)
SPT sample recovered
SPT with solid cone
vane shear; peak/remouded (kPa)
refusal
hammer bouncing

very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

method & support	penetration 1 2 3	water		RL (m)	depth (m)	graphic log	classification symbol		moisture condition	consistency / relative density	50 100 150 200	2 4 6 8 10	

1 2 3

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

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Engineering Log - Hand Auger

Borehole ID.	***HA03***
sheet:	1 of 1
project no.	***773-CHCGE231520***
client:	***Murray Boye c/o Baseline Group***
date started:	***01 Nov 2019***
principal:	
date completed:	***01 Nov 2019***
project:	***Kirwee Plan Change***
logged by:	***J. Byron-Joyce***
location:	***Kirwee***
checked by:	***A. Jordan***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	vane shear ⊕ remoulded ⊙ peak (kPa) 50 100 150 200	DCP (blows/ 100 mm) 2 4 6 8 10	structure and additional observations
HA N					0		OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M				**TOPSOIL**
								Hand Auger HA03 terminated at 0.25 m Refusal on gravel					
					0.5								
					1.0								
					1.5								

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method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V

*
e.g.
B
T

support
M mud
C casing
N nil

penetration
1 2 3

water
bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample

V
bit
no resistance ranging to refusal

10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System

U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff

HB

undisturbed sample

##mm diameter

hand penetrometer (kPa)

standard penetration test (SPT)

SPT-sample recovered

SPT with solid cone

vane shear; peak/remoulded (kPa)

refusal

hammer bouncing

moisture

VSt very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

Engineering Log - Hand Auger

Borehole ID.	***HA04***
sheet:	1 of 1
project no.	***773-CHCGE231520***
date started:	***01 Nov 2019***
date completed:	***01 Nov 2019***
logged by:	***J. Byron-Joyce***
checked by:	***A. Jordan***

client: ***Murray Boye c/o Baseline Group***

principal:

project: ***Kirwee Plan Change***

location: ***Kirwee***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90° | DCP id.:

drill model: | drilling fluid: | hole diameter : 50 mm | vane id.:

drilling information		material substance				
	samples & field tests		material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components		vane shear remoulded peak (kPa) / DCP (blows/100 mm)	structure and additional observations
		OL	**TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M		**TOPSOIL**
		ML	**Sandy SILT**: non plastic to low plasticity, pale brown.	M to W	St	**SPRINGSTON FORMATION - BLEAK HOUSE MEMBER (SPB)**
			from 0.4m with some gravel			
0.5			Hand Auger HA04 terminated at 0.5 m Refusal on gravel			
1.0						
1.5						

method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V

*
e.g.
B
T

support
M mud
C casing
N nil

penetration

water

bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample

V bit

no resistance ranging to refusal

10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System

U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff

HB

undisturbed sample

##mm diameter

hand penetrometer (kPa)

standard penetration test (SPT)

SPT-sample recovered

SPT with solid cone

vane shear; peak/remoulded (kPa)

refusal

hammer bouncing

moisture

VSt very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit

Engineering Log - Hand Auger

Borehole ID. ***HA05***
sheet: 1 of 1
project no. ***773-CHCGE231520***
client: ***Murray Boye c/o Baseline Group*** date started: ***01 Nov 2019***
principal: date completed: ***01 Nov 2019***
project: ***Kirwee Plan Change*** logged by: ***J. Byron-Joyce***
location: ***Kirwee*** checked by: ***A. Jordan***

position: Not Specified surface elevation: Not Specified angle from horizontal: 90° DCP id.:
drill model: drilling fluid: hole diameter : 50 mm vane id.:

drilling information		material substance				
	samples & field tests	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components		vane shear remoulded peak (kPa)	DCP (blows/ 100 mm)	structure and additional observations
		OL **TOPSOIL: Sandy SILT**: low plasticity, dark brown, with rootlets.	M			**TOPSOIL**
		ML **Sandy SILT**: non plastic to low plasticity, pale brown.	M to W	St		**SPRINGSTON FORMATION - BLEAK HOUSE MEMBER (SPB)**
		Hand Auger HA05 terminated at 0.35 m Refusal on gravel				
0.5					20/50 mm	
1.0						
1.5						

method
A auger drilling*
D auger screwing*
AS hand auger
H washbore
HA hand auger
W
V

*
e.g.
B
T

support
M mud N nil
C casing

penetration

water

bit shown by suffix AD/T
blank bit
TC bit

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample

V
bit

no resistance ranging to refusal

10-Oct-12 water level on date shown
water inflow
water outflow

classification symbol & soil description
based on Unified Classification System

U##
HP
N
N*
Nc
VS
R

consistency / relative density
VS very soft
S soft
F firm
St stiff

HB

undisturbed sample

##mm diameter

hand penetrometer (kPa)

standard penetration test (SPT)

SPT-sample recovered

SPT with solid cone

vane shear; peak/remoulded (kPa)

refusal

hammer bouncing

moisture

VSt very stiff
hard
friable
very loose
loose
medium dense
dense
very dense

D dry
M moist
W wet
S saturated
Wp plastic limit
Wl liquid limit