



ENGEO

— *Expect Excellence* —

Geotechnical Investigation

844 Selwyn Road

Springston

Christchurch

Submitted to:

Hughes Developments Ltd

Christchurch

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18.07.2019

12903.000.000_55



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ENGEO Document Control:

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1 Introduction

ENGEO Ltd was requested by Hughes Development Ltd to undertake a geotechnical investigation of the property at 844 Selwyn Road, Springston, Christchurch, as outlined in our variation proposal (ref. P2016.000.248_042).

The purpose of this assessment was to determine a geological model of the site, assess the likely future land performance, comment on the suitability of the site for residential subdivision, address the requirements of Section 106 of the Resource Management Act (RMA) and provide recommendations for subdivision works and foundations for typical timber framed residential dwellings.

Our scope of works included the following:

- Complete a desktop study of relevant available geotechnical and geological publications, including the NZ Geotechnical and Environment Canterbury Databases.
- Undertake a geotechnical site walkover.
- Undertake eight hand auger boreholes with associated Scala penetrometer tests to assess the near surface material types and strength characteristics.
- Organise and technically supervise the excavation of ten test pits, including geotechnical logging of the exposed soils.
- Preparation of this report outlining our findings on the ground conditions and the suitability of the site for residential subdivision, including geotechnical advice on the likely foundation Technical Category, conceptual foundation recommendations for typical timber framed residential dwellings, and address likely geohazards as required by Section 106 of the RMA.

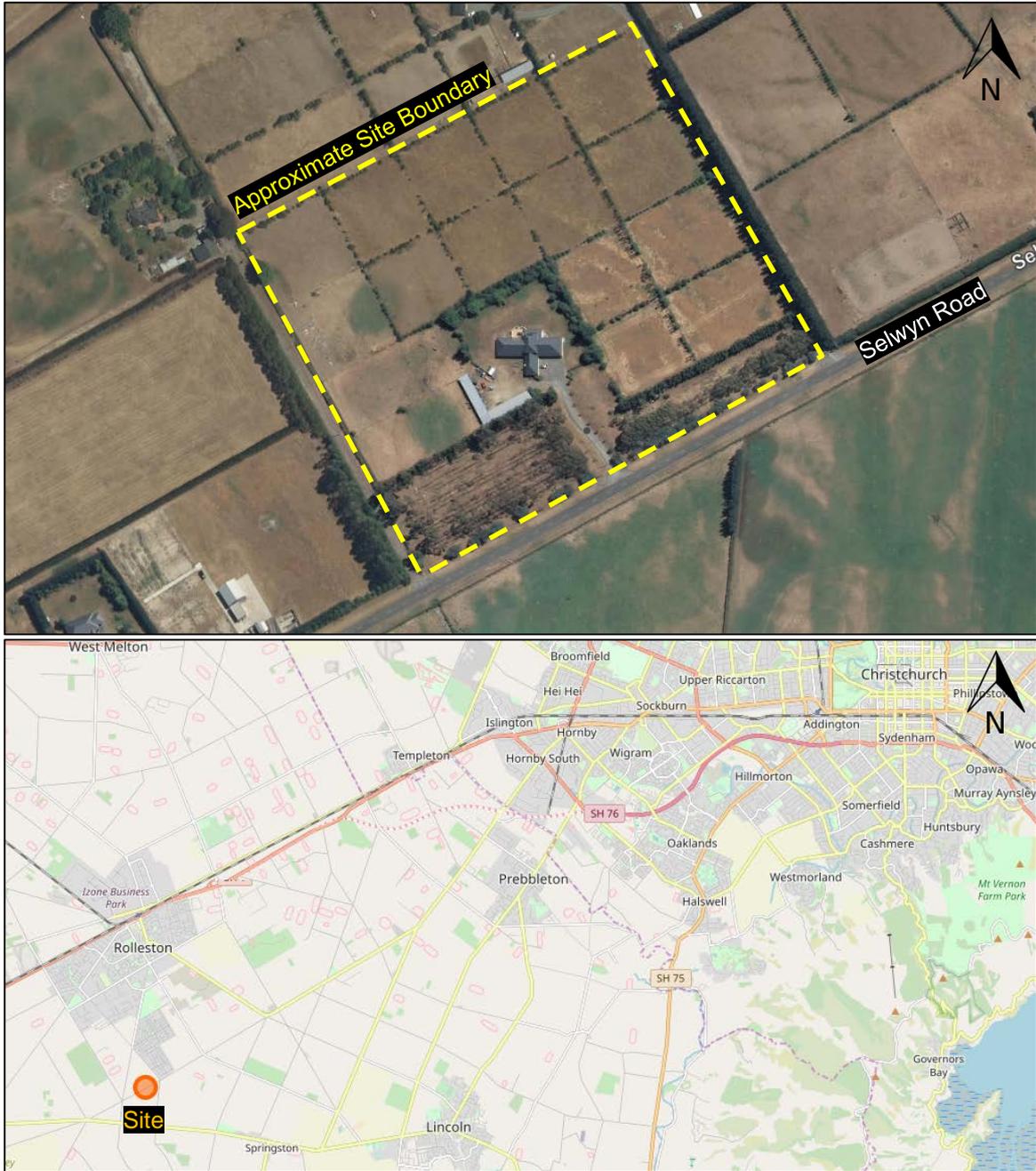
2 Site Description

The site covers a total area of 6.2 ha, and has the following legal description (Selwyn District Council):

- 844 Selwyn Road - Lot 1 DP 343803

It is located approximately 4 km south of Rolleston town centre; rural properties border the site on all sides (Figure 1).

Figure 1: Site Location Plan



Images sourced from Canterbury Maps and "© OpenStreetMap contributors". Not to scale.

3 Geological Model

3.1 Regional Geology

The site has been regionally mapped by GNS (Forsyth et al., 2018) as being underlain by grey river alluvium.

3.2 Geomorphology

The site comprises relatively flat ground, with gentle undulations and depressions in some areas. As evident on aerial imagery (Canterbury Maps, 2019) and observed during our site walkover conducted on 11 July 2019, undulating and depressed ground can be attributed to paleo-channels, which traverse the site in a general northwest to southeast trend. Based on observations, silt and sand deposits with variable thickness (up to 0.6 m) are expected to have in-filled the paleo-channels where they have not remained as channel features. Inferred paleo-channels have been mapped to give an indication of areas with potential channel in-fill (Appendix 1).

Figure 2: Historical Aerial Photography

1940 - 1944

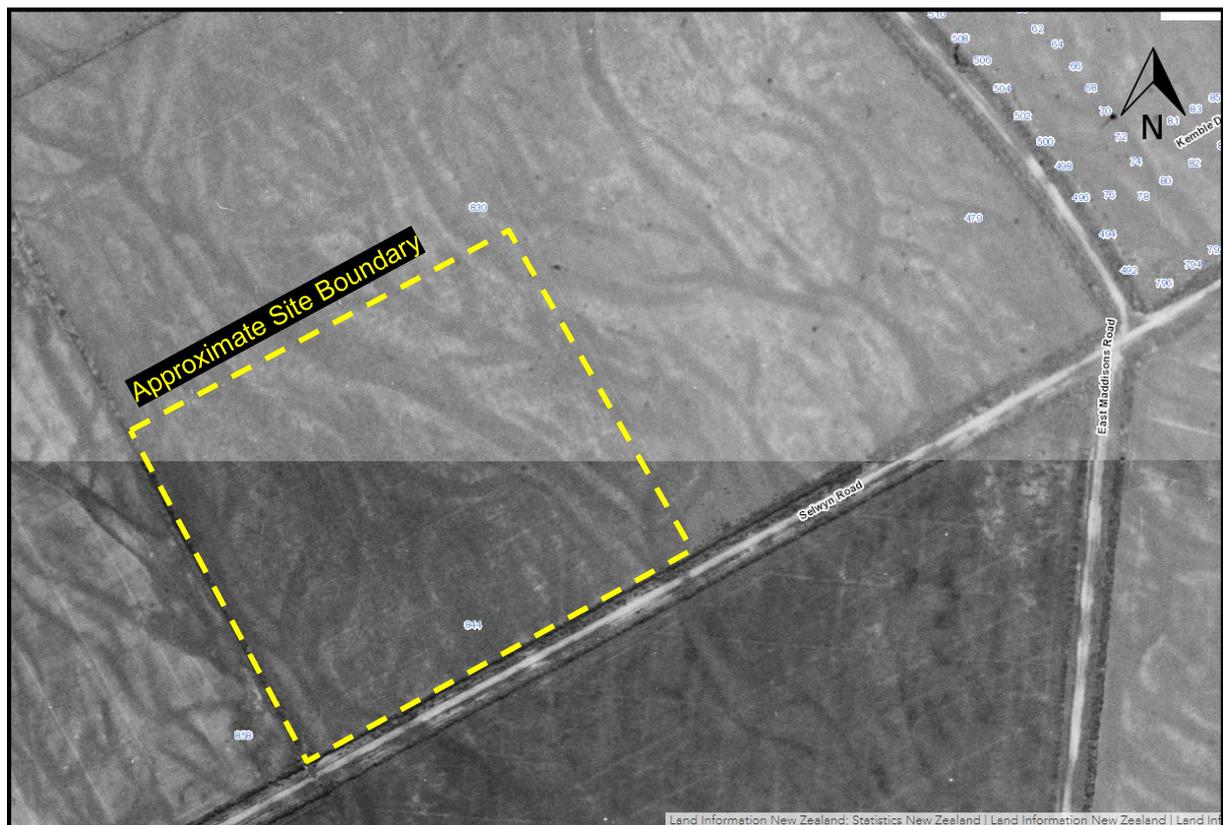


Image sourced from Canterbury Maps

1990 – 1994



Image sourced from Canterbury Maps

3.3 Geohazards

3.3.1 Seismicity

There are no known or mapped faults in the immediate area of the site, however the site may be at risk of ground shaking induced by movement of proximal or distal faults.

The site is located between two recently discovered fault systems, the Greendale Fault and the Port Hills Fault, the ruptures of which initiated the ongoing Canterbury Earthquake Sequence (CES). The Greendale Fault has been mapped approximately 5 km northwest / west of the site and trends roughly east-west with a surface rupture of approximately 28 km (GNS, 2015), while the Port Hills Fault remains unmapped as the fault did not rupture at the surface. Movement on the Port Hills Fault is believed to have occurred at a depth of 1 km to 2 km below ground surface.

Large regional areas of faulting (GNS, 2015) namely the Ashley Fault, Porters Pass - Amberley Fault Zone, and the Hope and Alpine Faults, are further afield but present a high seismic hazard to the Christchurch area due to the anticipated size of earthquakes generated. The largest of these faults is the Alpine Fault, which has a return period of 250 - 300 years and is expected to produce a M8 earthquake. The last rupture on the Alpine Fault is believed to have occurred in 1717 (Pettinga et al., 2001).

3.3.2 Liquefaction and Lateral Spreading

The site is located within an area mapped as ‘damaging liquefaction unlikely’ (NZGD Map CGD5140, 2012).

3.4 Site Investigation

Site investigations to assess the shallow subsurface material types and strength characteristics were undertaken by ENGEO on 11 July 2019. The investigations comprised eight hand auger boreholes and ten test pit investigations with associated Scala penetrometer tests.

The investigations revealed subsurface conditions across the site are consistent with the published geological mapping, as summarised in Table 1. Hand auger and test pit logs are included in Appendix 2 of this report.

Table 1: Generalised Summary of Subsurface Conditions

Soil Type	Depth to Top of Layer (m)	Layer Thickness (m)	Density / Consistency	Additional Comments
TOPSOIL	0.0	0.1 - 0.2	Stiff	-
SILT / SAND	0.2	0.1 - 0.4	Stiff to Very Stiff / Dense to Very Dense	Not present at all test locations
Sandy GRAVEL	0.1 - 0.4	Unknown	Dense to Very Dense	-

3.5 ECan Boreholes

A review of three deep ECan borehole logs was conducted. The first (M36/5254), is located on site, and appears to be a water well servicing the existing dwelling. The other boreholes are located on the northern boundary (M36/7902) and western boundary (M36/4221). A borehole is located south of Selwyn Road (M36/20236) but has no borehole log associated with it on Canterbury Maps.

Well summaries from the three holes of interest are presented in Appendix 3 and summarised in Table 2 below.

Table 2: Generalised Summary of ECan Boreholes

ECan Borehole	Total Depth (m)	Water Level (m)	Generalised borelog as logged by driller
M36/5254	36	6	Clay to 1 m depth underlain by gravel to 36 m depth.
M36/7902	36	8.4	Gravel from 1 m to 36 m depth.
M36/4221	21.44	6.6	Gravel from 0.5 m to 21.44 m depth with a layer of sand between 8 m and 9 m depth.

Figure 3: Nearby ECAN Borehole Locations

Aerial photograph sourced from Canterbury Maps. Not to scale.

3.6 Groundwater

Groundwater is recorded in the surrounding boreholes between approximately 6 m and 8.4 m depth.

3.7 Site Seismic Class

In accordance with NZS 1170.5:2004, Class D applies to this particular site, defining it as a 'deep soft soil site'.

4 Liquefaction Assessment

Based on our site investigation and observations, and owing to the nature of the subsurface materials and depth to groundwater at the site, we consider the potential for liquefaction and lateral spreading on the site to be very low.

We therefore consider the site of the proposed subdivision to have Technical Category 1 (TC1) future land performance whereby future land damage from liquefaction is unlikely, and ground settlements are expected to be within normally accepted tolerances.

5 RMA Section 106 Requirements and Suitability to Subdivide

Section 106 of the Resource Management Act 1991 states a consent authority may refuse to grant a subdivision consent, or may grant a consent subject to specific consent conditions if it considers that:

- There is a significant risk from natural hazards; or
- Sufficient provision has not been made for legal or physical access to each allotment to be created by the subdivision.

An assessment of the risk from natural hazards as required by the RMA includes the following:

- The likelihood of natural hazards occurring (whether individually or in combination);
- The material damage to land in respect of which the consent is sought, other land, or structures that would result from natural hazards; and
- Any likely subsequent use of the land in respect of which the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in paragraph (b).

We have assessed the risk of natural hazards at the site in accordance with Section 106 of the Resource Management Act (RMA) and considered the risk to the site from rockfall, inundation (debris), slope stability, subsidence, flooding and tsunamis. Based on our observations and the nature of the site, its performance during the CES, and the site's distance from the nearest significant watercourse, we consider it is unlikely for the site to be subject to natural hazards such as rockfall, inundation (debris), slope stability, subsidence, flooding and tsunamis. As such, the site is considered suitable for subdivision from a geotechnical perspective.

6 Geotechnical Recommendations

6.1 Earthworks

Earthworks carried out for the subdivision shall be in accordance with NZS 4404:2010, Land Development and Subdivision Infrastructure and NZS 4431:1989, Code of Practice for Earth filling for Residential Development. In particular, any areas to receive fill should be stripped of all vegetation, topsoil, non-engineered fill, soft or organic soils prior to fill placement.

Fill may comprise clean natural sandy gravel or silty soils, or clean imported soils and / or granular fill, compacted to achieve no less than 95% of maximum dry density. Fill faces steeper than 2V:1H and higher than 600 mm should be retained and referred back to ENGEO. Although unlikely, where any springs or groundwater seeps are encountered, they should be intercepted with suitable drainage and discharged to a Council approved outlet.

All unretained batters of pond and stormwater drains constructed with the native sandy gravel material should be at an inclination no steeper than 1V:3H, with protection schemes in place to control erosion of the formed batters within the waterways.

A comprehensive earthworks specification should be provided to the earthworks contractor prior to starting excavations and an inspection / testing regime agreed, along with a robust erosion and sediment control plan.

6.2 Subdivision Roding

Vegetation, any organic or deleterious material, topsoil and non-engineered fill should be removed from the site under pavement areas prior to aggregate placement. Based on our observations during testing, we consider the natural ground below the topsoil at the site should provide an adequate subgrade for the proposed pavement areas.

6.3 Stormwater Control

Concentrated stormwater flows from all impermeable areas must be collected and carried in sealed pipes to the Council system or an alternative disposal point subject to approval from Council. Uncontrolled stormwater must not be allowed to saturate the ground as this will potentially affect future foundation performance both statically and during future seismic activity.

6.4 Foundations

Foundations for future proposed residential dwellings within the subdivision may comprise shallow pad, strip, or slab foundations designed in accordance with the provisions of NZS 3604 Timber Framed Buildings.

Site specific testing will be required for Building Consent, to confirm the bearing materials and capacity. For preliminary design, we anticipate that a geotechnical Ultimate Bearing Capacity of 300 kPa may be assumed for foundations bearing on natural silt, sandy gravel or engineered fill, below any topsoil. We anticipate this to be typically below 0.2 m depth based on our subsurface investigations.

7 References

Canterbury Maps, Groundwater. Retrieved July 2019, from <http://canterburymaps.govt.nz/Viewer>.

Canterbury Maps, Historic Aerial Imagery. Retrieved July 2019, from <https://apps.canterburymaps.govt.nz/CanterburyHistoricAerialImagery>.

Forsyth, P., Barrell, D. J., & Jongens, R. (2008). Sheet 16 - Geology of the Christchurch Area 1:250,000. Lower Hutt: Institute of Geological and Nuclear Sciences.

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Selwyn District Council, Property Search, retrieved July 2019, from <https://www.selwyn.govt.nz/my-property/rates/search-properties>.

Standards Association of New Zealand (1989). NZS 4431:1989. Code of Practice for Earthfilling for Residential Development.

Standards Association of New Zealand (2004). NZS 1170.5:2004. Structural Design Actions Part 5: Earthquake Actions – New Zealand.

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The Ministry of Business, Innovation, and Employment (2016). New Zealand Geotechnical Database. Retrieved November 2018, from <https://www.nzgd.org.nz>.

8 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Hughes Developments Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by



Jed Watts

Engineering Geologist

Report reviewed by



Greg Martin, CMEngNZ (PEngGeol)

Principal Engineering Geologist

APPENDIX 1:
Site Plan and Inferred Paleo Channels



- Legend**
- Hand auger
 - Test pit
 - Inferred Paleo Channel
 - Site boundary
 - Property boundary

Aerial: LINZ and Eagle Technology, CC BY 4.0.
Map image: Eagle Technology.



PROJECTION: NZGD 2000 New Zealand Transverse Mercator



Christchurch Office
124 Montreal Street Sydenham, Christchurch 8023
Tel: 03 328 9012, www.engeo.co.nz

Title:
Site Location and Testing Plan

Client: Hughes Developments Limited		Figure No:
Project:	Designed: JW	1
844 Selwyn Road Springston	Drawn: RW	
	Checked: XX	
	Date: Jul 19	
Proj No:	Scale:	Revision:
12903.000.044	1:1,500	A

DATE PLOTTED: 18 July 2019 10:31:59 a.m. BY: wjlliams
PATH: Z:\Projects\12901 to 13000\12903 - Farrington South Subdivision\044_844 Selwyn Road - Geotech\08_CAD-GIS & Figures\F01_SiteLoc.mxd

APPENDIX 2:
Test Pit and Hand Auger Logs

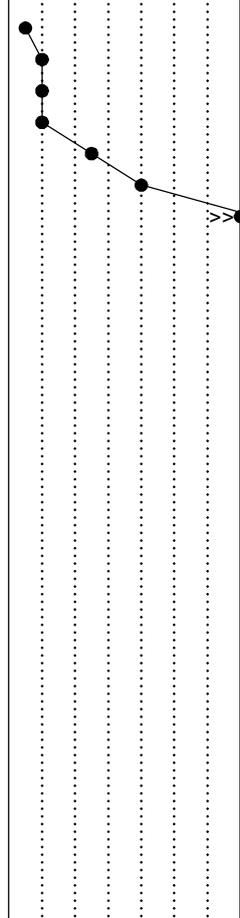


LOG OF TEST PIT TP01

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19 Logged By : HB
Max Test Pit Depth : 2.3 m Reviewed By : JW
Digger Type/Size : Bucket Excavator Latitude : -43.629954
Bucket Type/Size : 6t Longitude : 172.384774

Depth (m BGL)	Material	Excavability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer					
		Easier	Harder									Blows per 100mm					
	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F		2	4	6	8	10	12
0.5	ALLUVIUM			GW	Sandy fine to coarse GRAVEL; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.					MD-D							
1.0					Minor cobbles encountered from 1.0 m depth.				M								
2.3					Depth of Excavation: 2.3 m Termination Condition: Target depth												



GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS GP.J NZ MASTER DATA TEMPLATE.GDT - 17/7/19

Test pit met target depth
TS = TOPSOIL
Standing groundwater was not encountered



LOG OF TEST PIT TP02

844 Selwyn Road
 844 Selwyn Road
 Rolleston, Christchurch
 12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
 Date : 11/07/19 Logged By : HB
 Max Test Pit Depth : 2.2 m Reviewed By : JW
 Digger Type/Size : Bucket Excavator Latitude : -43.629756
 Bucket Type/Size : 6t Longitude : 172.383866

Depth (m BGL)	Material	Excavability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer						
		Easier	Harder									Blows per 100mm						
												2	4	6	8	10	12	
0.0	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F								
0.5					Sandy fine to coarse GRAVEL; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.													
1.0	ALLUVIUM			GW	Minor cobbles encountered from 1.2 m depth.				M	MD-D								
1.5																		
2.0																		
2.2					Depth of Excavation: 2.2 m Termination Condition: Target depth													
2.5																		
3.0																		

GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS.GPJ - NZ MASTER DATA TEMPLATE.GDT - 17/7/19

Test pit met target depth
 TS = TOPSOIL
 Standing groundwater was not encountered



LOG OF TEST PIT TP03

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19 Logged By : HB
Max Test Pit Depth : 2 m Reviewed By : JW
Digger Type/Size : Bucket Excavator Latitude : -43.629019
Bucket Type/Size : 6t Longitude : 172.383458

Depth (m BGL)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer						
		Easier	Harder									Blows per 100mm						
	T			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F		2	4	6	8	10	12	
0.5					Sandy fine to coarse GRAVEL; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.													
1.0	ALLUVIUM			GW	Minor cobbles encountered from 1.0 m depth.				M	MD-D								
2.0					Depth of Excavation: 2 m Termination Condition: Target depth													
2.5																		
3.0																		

GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS.GPJ - NZ MASTER DATA TEMPLATE.GDT - 17/7/19

Test pit met target depth
T = TOPSOIL
Standing groundwater was not encountered

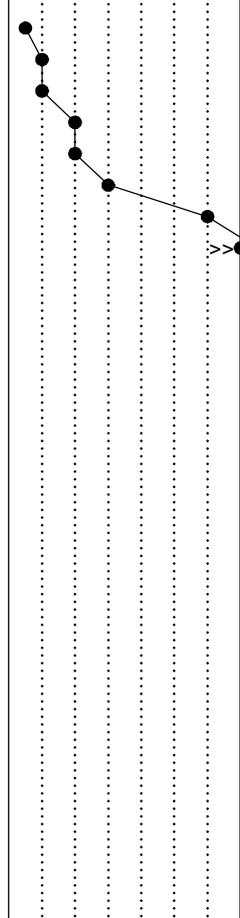


LOG OF TEST PIT TP04

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19 Logged By : HB
Max Test Pit Depth : 2.1 m Reviewed By : JW
Digger Type/Size : Bucket Excavator Latitude : -43.629196
Bucket Type/Size : 6t Longitude : 172.384448

Depth (m BGL)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer					
		Easier	Harder									Blows per 100mm					
												2	4	6	8	10	12
0.0	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F							
0.5				SM	Silty fine to medium SAND; greyish brown. Poorly graded.					MD							
1.0	ALLUVIUM			GW	Sandy fine to coarse GRAVEL with some cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.				M	MD-D							
2.1	Depth of Excavation: 2.1 m Termination Condition: Target depth																



GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS.GPJ - NZ MASTER DATA TEMPLATE.GDT - 17/7/19

Test pit met target depth
TS = TOPSOIL
Standing groundwater was not encountered



LOG OF TEST PIT TP05

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19 Logged By : HB
Max Test Pit Depth : 2.3 m Reviewed By : JW
Digger Type/Size : Bucket Excavator Latitude : -43.628627
Bucket Type/Size : 6t Longitude : 172.384736

Depth (m BGL)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer						
		Easier	Harder									Blows per 100mm						
												2	4	6	8	10	12	
0.0	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F								
0.0 - 0.5				SM	Silty fine to medium SAND; greyish brown. Poorly graded.					MD								
0.5 - 2.3	ALLUVIUM			GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.				M	MD-D								
2.3	Depth of Excavation: 2.3 m Termination Condition: Target depth																	

GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS GP.J NZ MASTER DATA TEMPLATE.GDT 17/7/19

Test pit met target depth
TS = TOPSOIL
Standing groundwater was not encountered



LOG OF TEST PIT TP06

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19 Logged By : HB
Max Test Pit Depth : 2.1 m Reviewed By : JW
Digger Type/Size : Bucket Excavator Latitude : -43.628172
Bucket Type/Size : 6t Longitude : 172.385862

Depth (m BGL)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer					
		Easier	Harder									Blows per 100mm					
0.0	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F		2	4	6	8	10	12
0.5				GW	Sandy fine to coarse GRAVEL with minor cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.				M	MD-D							
1.0	ALLUVIUM																
1.5																	
2.0																	
2.5					Depth of Excavation: 2.1 m Termination Condition: Target depth												
3.0																	

GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS.GPJ - NZ MASTER DATA TEMPLATE.GDT - 17/7/19

Test pit met target depth
TS = TOPSOIL
Standing groundwater was not encountered



LOG OF TEST PIT TP07

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19
Max Test Pit Depth : 2.1 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 6t

Logged By : HB
Reviewed By : JW
Latitude : -43.628764
Longitude : 172.385558

Depth (m BGL)	Material	Excavability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer					
		Easier	Harder									Blows per 100mm					
												2	4	6	8	10	12
0.0	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F							
0.5				SM	Silty fine to medium SAND; greyish brown. Poorly graded.					MD							
0.5				GW	Sandy fine to coarse GRAVEL with some cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.				M								
1.0	ALLUVIUM									MD-D							
1.5																	
2.0					Becomes wet from 1.8 m depth.				W								
2.1					Depth of Excavation: 2.1 m Termination Condition: Target depth												
2.5																	
3.0																	

GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS.GPJ - NZ MASTER DATA TEMPLATE.GDT - 17/11/19

Test pit met target depth
TS = TOPSOIL
Standing groundwater was not encountered



LOG OF TEST PIT TP08

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19 Logged By : HB
Max Test Pit Depth : 1.8 m Reviewed By : JW
Digger Type/Size : Bucket Excavator Latitude : -43.629579
Bucket Type/Size : 6t Longitude : 172.386116

Depth (m BGL)	Material	Excavability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer						
		Easier	Harder									Blows per 100mm						
0.0 - 0.5	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F		2	4	6	8	10	12	
0.5 - 1.8	ALLUVIUM			GW	Sandy fine to coarse GRAVEL with some cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.				M	MD-D								
Depth of Excavation: 1.8 m Termination Condition: Practical refusal																		

GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS.GPJ - NZ MASTER DATA TEMPLATE.GDT - 17/7/19

Test pit met practical refusal
TS = TOPSOIL
Standing groundwater was not encountered



LOG OF TEST PIT TP09

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19 Logged By : HB
Max Test Pit Depth : 2.2 m Reviewed By : JW
Digger Type/Size : Bucket Excavator Latitude : -43.62935
Bucket Type/Size : 6t Longitude : 172.38673

Depth (m BGL)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer						
		Easier	Harder									Blows per 100mm						
												2	4	6	8	10	12	
0.0	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F								
0.0 - 0.5				SM	Silty fine to medium SAND; greyish brown. Poorly graded.					MD								
0.5 - 2.2	ALLUVIUM			GW	Sandy fine to coarse GRAVEL with some cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.				M	MD-D								
Depth of Excavation: 2.2 m Termination Condition: Target depth																		

GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS.GPJ - NZ MASTER DATA TEMPLATE.GDT - 17/7/19

Test pit met target depth
TS = TOPSOIL
Standing groundwater was not encountered



LOG OF TEST PIT TP10

844 Selwyn Road
844 Selwyn Road
Rolleston, Christchurch
12903.000.044

Client : Hughes Developments Ltd. Shear Vane No :
Date : 11/07/19 Logged By : HB
Max Test Pit Depth : 1.8 m Reviewed By : JW
Digger Type/Size : Bucket Excavator Latitude : -43.62898
Bucket Type/Size : 6t Longitude : 172.386437

Depth (m BGL)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remoulded (kPa)	Scala Penetrometer						
		Easier	Harder									Blows per 100mm						
	TS			ML	Sandy SILT with trace rootlets, and gravel; brown. Low plasticity [TOPSOIL].					S-F		2	4	6	8	10	12	
0.5	ALLUVIUM			GP	Sandy fine to medium GRAVEL; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.				M	MD-D								
1.0				GW	Sandy fine to coarse GRAVEL with some cobbles; brownish grey. Well graded, sub-rounded to rounded. Sand, fine to medium.					MD-D								
1.5					Depth of Excavation: 1.8 m Termination Condition: Practical refusal													
2.0																		
2.5																		
3.0																		

GEOTECH TEST PIT LOG - 844 SELWYN ROAD TEST PIT LOGS.GPJ - NZ MASTER DATA TEMPLATE.GDT - 17/7/19

Test pit met practical refusal
TS = TOPSOIL
Standing groundwater was not encountered



LOG OF AUGER HA01

Geotechnical Investigation
844 Selwyn Road
Rolleston, Christchurch
12903.000.000

Client : Hughes Developments Ltd. Shear Vane No :
Client Ref. : N/A Logged By : SC
Date : 11.07.19 Reviewed By : JW
Hole Depth : 0.3 m Latitude : -43.629509
Hole Diameter : 50 mm Longitude : 172.384695

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remoulded	Scala Penetrometer						
										Blows per 100mm						
										2	4	6	8	10	12	
	TOPSOIL	ML	Sandy SILT with trace rootlets; dark brown. Low plasticity. [TOPSOIL]				M	S-F								
	ALLUVIUM	SP	Fine to medium SAND with some silt; yellowish brown. Poorly graded.				M	L								
End of Hole Depth: 0.3 m Termination Condition: Practical refusal																
0.5																
1.0																

GEOTECH HAND AUGER LOGS - 844 SELWYN ROAD.GPJ NZ DATA TEMPLATE 2.GDT 17/7/19

Hand auger met practical refusal at 0.3 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.4 m depth.
Standing groundwater was not encountered



LOG OF AUGER HA02

Geotechnical Investigation
 844 Selwyn Road
 Rolleston, Christchurch
 12903.000.000

Client : Hughes Developments Ltd. Shear Vane No :
 Client Ref. : N/A Logged By : SC
 Date : 11.07.19 Reviewed By : JW
 Hole Depth : 0.2 m Latitude : -43.628845
 Hole Diameter : 50 mm Longitude : 172.384106

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remoulded	Scala Penetrometer						
										Blows per 100mm						
										2	4	6	8	10	12	
	TOPSOIL	ML	Sandy SILT with trace rootlets; brown. Low plasticity. [TOPSOIL]				M	L								
End of Hole Depth: 0.2 m Termination Condition: Practical refusal																
0.5																
1.0																

GEOTECH HAND AUGER - HAND AUGER LOGS - 844 SELWYN ROAD.GPJ - NZ DATA TEMPLATE 2.GDT - 17/7/19

Hand auger met practical refusal at 0.2 m depth on inferred gravel.
 Scala Penetrometer met practical refusal at 0.6 m depth.
 Standing groundwater was not encountered



LOG OF AUGER HA03

Geotechnical Investigation
 844 Selwyn Road
 Rolleston, Christchurch
 12903.000.000

Client : Hughes Developments Ltd. Shear Vane No :
 Client Ref. : N/A Logged By : SC
 Date : 11.07.19 Reviewed By : JW
 Hole Depth : 0.3 m Latitude : -43.629064
 Hole Diameter : 50 mm Longitude : 172.38523

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remoulded	Scala Penetrometer					
										Blows per 100mm					
										2	4	6	8	10	12
	TOPSOIL	ML	Sandy SILT with trace rootlets; brown. Low plasticity. [TOPSOIL]				M	S-F							
	ALLUVIUM	SP	Silty fine to medium SAND with trace rootlets and gravel; yellowish brown. Poorly graded.				M	VL							
End of Hole Depth: 0.3 m Termination Condition: Practical refusal															
0.5															
1.0															

GEOTECH HAND AUGER - HAND AUGER LOGS - 844 SELWYN ROAD.GPJ - NZ DATA TEMPLATE 2.GDT 17/7/19

Hand auger met practical refusal at 0.3 m depth on inferred gravel.
 Scala Penetrometer met practical refusal at 0.5 m depth.
 Standing groundwater was not encountered



LOG OF AUGER HA04

Geotechnical Investigation
844 Selwyn Road
Rolleston, Christchurch
12903.000.000

Client : Hughes Developments Ltd. Shear Vane No :
Client Ref. : N/A Logged By : SC
Date : 11.07.19 Reviewed By : JW
Hole Depth : 0.3 m Latitude : -43.628529
Hole Diameter : 50 mm Longitude : 172.386187

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remoulded	Scala Penetrometer					
										Blows per 100mm					
										2	4	6	8	10	12
	TOPSOIL	ML	Sandy SILT with trace rootlets; brown. Low plasticity. [TOPSOIL]				M	S-F							
	ALLUVIUM	SM	Silty fine to medium SAND with trace rootlets and gravel; brown. Poorly graded. Gravel, fine to medium, subangular to subrounded.				M	L							
End of Hole Depth: 0.3 m Termination Condition: Practical refusal															
0.5															
1.0															

GEOTECH HAND AUGER - HAND AUGER LOGS - 844 SELWYN ROAD.GPJ - NZ DATA TEMPLATE 2.GDT 17/7/19

Hand auger met practical refusal at 0.3 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.5 m depth.
Standing groundwater was not encountered



LOG OF AUGER HA05

Geotechnical Investigation
 844 Selwyn Road
 Rolleston, Christchurch
 12903.000.000

Client : Hughes Developments Ltd. Shear Vane No :
 Client Ref. : N/A Logged By : SC
 Date : 11.07.19 Reviewed By : JW
 Hole Depth : 0.3 m Latitude : -43.62986
 Hole Diameter : 50 mm Longitude : 172.385786

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remoulded	Scala Penetrometer						
										Blows per 100mm						
										2	4	6	8	10	12	
	TOPSOIL	ML	Sandy SILT with trace rootlets; dark brown. Low plasticity. [TOPSOIL]				M	S-F								
	ALLUVIUM	SP	Fine to medium SAND with some silt; yellowish brown. Poorly graded. Trace gravel from 0.2 m depth.				M	L								
End of Hole Depth: 0.3 m Termination Condition: Practical refusal																
0.5																
1.0																

GEOTECH HAND AUGER - HAND AUGER LOGS - 844 SELWYN ROAD.GPJ - NZ DATA TEMPLATE 2.GDT 17/7/19

Hand auger met practical refusal at 0.3 m depth on inferred gravel.
 Scala Penetrometer met practical refusal at 0.5 m depth.
 Standing groundwater was not encountered



LOG OF AUGER HA06

Geotechnical Investigation
 844 Selwyn Road
 Rolleston, Christchurch
 12903.000.000

Client : Hughes Developments Ltd. Shear Vane No :
 Client Ref. : N/A Logged By : SC
 Date : 11.07.19 Reviewed By : JW
 Hole Depth : 0.2 m Latitude : -43.630314
 Hole Diameter : 50 mm Longitude : 172.385321

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remoulded	Scala Penetrometer						
										Blows per 100mm						
										2	4	6	8	10	12	
	TOPSOIL	ML	Sandy SILT with trace rootlets and gravel; dark brown. Low plasticity. [TOPSOIL]				M	S-F								
End of Hole Depth: 0.2 m Termination Condition: Practical refusal																

GEOTECH HAND AUGER - HAND AUGER LOGS - 844 SELWYN ROAD.GPJ - NZ DATA TEMPLATE 2.GDT - 17/7/19

Hand auger met practical refusal at 0.2 m depth on inferred gravel.
 Scala Penetrometer met practical refusal at 0.3 m depth.
 Standing groundwater was not encountered



LOG OF AUGER HA07

Geotechnical Investigation
 844 Selwyn Road
 Rolleston, Christchurch
 12903.000.000

Client : Hughes Developments Ltd. Shear Vane No :
 Client Ref. : N/A Logged By : SC
 Date : 11.07.19 Reviewed By : JW
 Hole Depth : 0.4 m Latitude : -43.630207
 Hole Diameter : 50 mm Longitude : 172.384605

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remoulded	Scala Penetrometer						
										Blows per 100mm						
										2	4	6	8	10	12	
	TOPSOIL	ML	Sandy SILT with trace rootlets; dark brown. Low plasticity. [TOPSOIL]				M	s								
	ALLUVIUM	SM	Silty fine to medium SAND with trace gravel; yellowish brown. Poorly graded.				M	VL								
	End of Hole Depth: 0.4 m Termination Condition: Practical refusal															
0.5																
1.0																

GEOTECH HAND AUGER - HAND AUGER LOGS - 844 SELWYN ROAD.GPJ - NZ DATA TEMPLATE 2.GDT - 17/7/19

Hand auger met practical refusal at 0.4 m depth on inferred gravel.
 Scala Penetrometer met practical refusal at 0.6 m depth.
 Standing groundwater was not encountered



LOG OF AUGER HA08

Geotechnical Investigation
 844 Selwyn Road
 Rolleston, Christchurch
 12903.000.000

Client : Hughes Developments Ltd. Shear Vane No :
 Client Ref. : N/A Logged By : SC
 Date : 11.07.19 Reviewed By : JW
 Hole Depth : 0.3 m Latitude : -43.629875
 Hole Diameter : 50 mm Longitude : 172.386294

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remoulded	Scala Penetrometer							
										Blows per 100mm							
										2	4	6	8	10	12		
	TOPSOIL	ML	Sandy SILT with trace rootlets; dark brown. Low plasticity. [TOPSOIL]				M	S-F									
End of Hole Depth: 0.3 m Termination Condition: Practical refusal																	
0.5																	
1.0																	

GEOTECH HAND AUGER - HAND AUGER LOGS - 844 SELWYN ROAD.GPJ - NZ DATA TEMPLATE 2.GDT - 17/7/19

Hand auger met practical refusal at 0.3 m depth on inferred gravel.
 Scala Penetrometer met practical refusal at 1 m depth.
 Standing groundwater was not encountered

APPENDIX 3:
ECan Borelogs



Bore or Well No	M36/5254		
Well Name	SELWYN ROAD		
Owner	Mr D B Irvine		
Well Number	M36/5254	File Number	CO6C/12625
Owner	Mr D B Irvine	Well Status	Active (exist, present)
Street/Road	SELWYN ROAD	NZTM Grid Reference	BX23:50467-69031
Locality	SPRINGSTON	NZTM X and Y	1550467 - 5169031
Location Description	100M FROM PROP LOT2 ETERN BOUND, 20M RD	Location Accuracy	50 - 300m
CWMS Zone	Selwyn - Waihora	Use	Irrigation,
Groundwater Allocation Zone	Selwyn-Waimakariri	Water Level Monitoring	--
Depth	36.00m	Water Level Count	0
Diameter	150mm	Initial Water Level	6.00m below MP
Measuring Point Description		Highest Water Level	
Measuring Point Elevation	34.35m above MSL (Lyttelton 1937)	Lowest Water Level	
Elevation Accuracy	< 2.5 m	First reading	
Ground Level	0.00m above MP	Last reading	
Strata Layers	6	Calc Min 95%	6.30m below MP
Aquifer Name	Bromley Formation	Aquifer Tests	0
Aquifer Type	Unknown	Yield Drawdown Tests	1
Drill Date	01 Dec 1996	Max Tested Yield	8 l/s
Driller	East Coast Drilling	Drawdown at Max Tested Yield	5 m
Drilling Method	Rotary Rig	Specific Capacity	1.65 l/s/m
Casing Material	STEEL	Last Updated	08 Nov 2013
Pump Type	Unknown	Last Field Check	
Water Use Data	No		

Screens

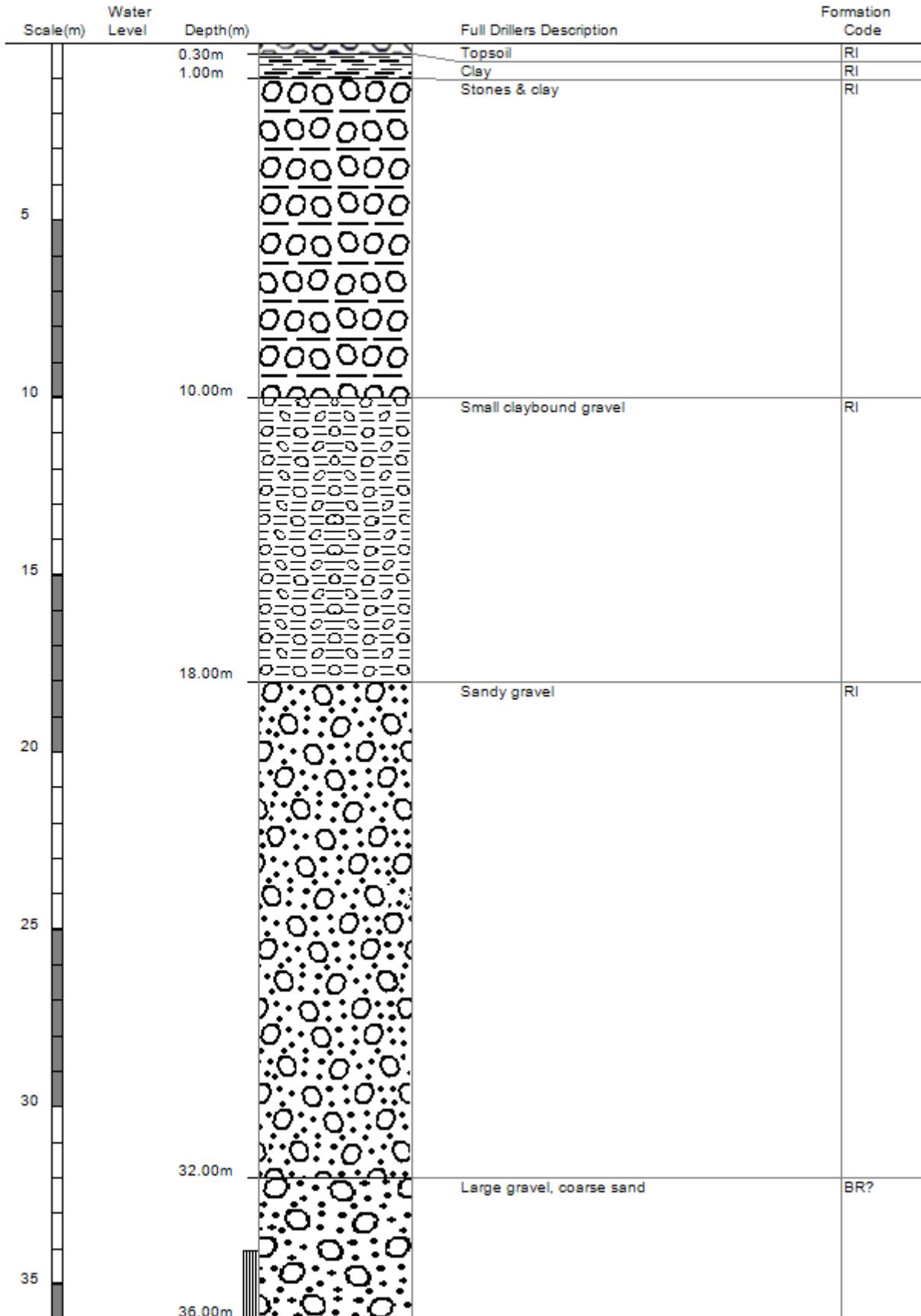
Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	34	36				

Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
01 Dec 1996	1	8.25	108.885017	5	2

Borelog for well M36/5254

Grid Reference (NZTM): 1550468 mE, 5169031 mN
 Location Accuracy: 50 - 300m
 Ground Level Altitude: 34.4 m +MSD Accuracy: < 2.5 m
 Driller: East Coast Drilling
 Drill Method: Rotary Rig
 Borelog Depth: 36.0 m Drill Date: 01-Dec-1996





Bore or Well No	M36/7902		
Well Name	SELWYN ROAD		
Owner	RB & BM CHAPMAN & HAMILTON		
Well Number	M36/7902	File Number	CO6C/23254
Owner	RB & BM CHAPMAN & HAMILTON	Well Status	Active (exist, present)
Street/Road	SELWYN ROAD	NZTM Grid Reference	BX23:50407-69271
Locality	SPRINGSTON	NZTM X and Y	1550407 - 5169271
Location Description		Location Accuracy	10 - 50m
CWMS Zone	Selwyn - Waihora	Use	Domestic and Stockwater,
Groundwater Allocation Zone	Selwyn-Waimakariri	Water Level Monitoring	--
Depth	36.00m	Water Level Count	0
Diameter	150mm	Initial Water Level	8.40m below MP
Measuring Point Description	ToC	Highest Water Level	
Measuring Point Elevation	35.00m above MSL (Lyttelton 1937)	Lowest Water Level	
Elevation Accuracy	< 2.5 m	First reading	
Ground Level	0.30m below MP	Last reading	
Strata Layers	6	Calc Min 95%	
Aquifer Name		Aquifer Tests	0
Aquifer Type		Yield Drawdown Tests	1
Drill Date	09 Aug 2005	Max Tested Yield	4 l/s
Driller	East Coast Drilling	Drawdown at Max Tested Yield	16 m
Drilling Method	Rotary Rig	Specific Capacity	0.23 l/s/m
Casing Material	Steel	Last Updated	08 Nov 2013
Pump Type		Last Field Check	
Water Use Data	No		

Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	34.5	36				

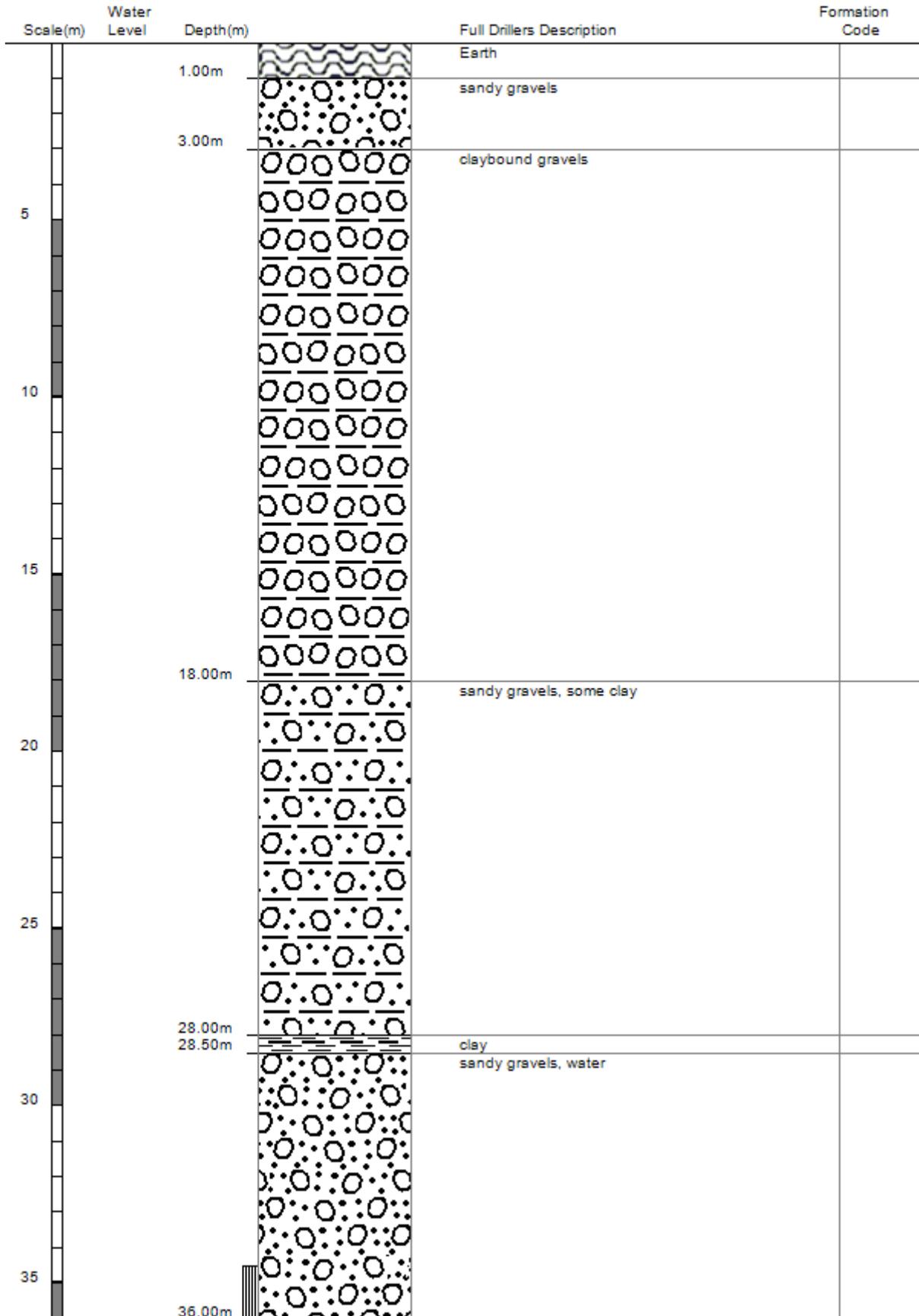
Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
09 Aug 2005	1	3.7	48.83328	15.8	8

No comments for this well

Borelog for well M36/7902

Grid Reference (NZTM): 1550408 mE, 5169271 mN
 Location Accuracy: 10 - 50m
 Ground Level Altitude: 34.7 m +MSD Accuracy: < 2.5 m
 Driller: East Coast Drilling
 Drill Method: Rotary Rig
 Borelog Depth: 36.0 m Drill Date: 09-Aug-2005





Bore or Well No	M36/4221		
Well Name	Cnr GOULDS RD and SELWYN RDS		
Owner	Mr & Ms R J & S E Silcock & Russell		
Well Number	M36/4221	File Number	CO6C/01718
Owner	Mr & Ms R J & S E Silcock & Russell	Well Status	Active (exist, present)
Street/Road	Cnr GOULDS RD and SELWYN RDS	NZTM Grid Reference	BX23:50160-69165
Locality	ROLLESTON	NZTM X and Y	1550160 - 5169165
Location Description	SEE M36/4220	Location Accuracy	2 - 15m
CWMS Zone	Selwyn - Waihora	Use	Irrigation,
Groundwater Allocation Zone	Selwyn-Waimakariri	Water Level Monitoring	--
Depth	21.44m	Water Level Count	0
Diameter	150mm	Initial Water Level	6.60m below MP
Measuring Point Description		Highest Water Level	
Measuring Point Elevation	35.47m above MSL (Lyttelton 1937)	Lowest Water Level	
Elevation Accuracy	< 2.5 m	First reading	
Ground Level	0.00m above MP	Last reading	
Strata Layers	7	Calc Min 95%	6.60m below MP
Aquifer Name	Riccarton Gravel	Aquifer Tests	0
Aquifer Type	Unknown	Yield Drawdown Tests	2
Drill Date	04 Feb 1991	Max Tested Yield	6 l/s
Driller	Weedons WellDrilling	Drawdown at Max Tested Yield	11 m
Drilling Method	Rotary/Percussion	Specific Capacity	0.51 l/s/m
Casing Material	STEEL	Last Updated	08 Nov 2013
Pump Type	Unknown	Last Field Check	
Water Use Data	No		

Screens

Screen No.	Screen Type	Top (m)	Bottom (m)	Slot Size (mm)	Slot Length (mm)	Diameter (mm)	Leader Length (mm)
1	Stainless steel	20.4	21.4				

Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
04 Feb 1991	1	5.8	76.54947	11.35	3

Borelog for well M36/4221

Grid Reference (NZTM): 1550161 mE, 5169165 mN
 Location Accuracy: 2 - 15m
 Ground Level Altitude: 35.5 m +MSD Accuracy: < 2.5 m
 Driller: Weedons WellDrilling
 Drill Method: Rotary/Percussion
 Borelog Depth: 21.4 m Drill Date: 04-Feb-1991

