ENGEO

Expect Excellence

Geotechnical Investigation

19 & 35 Dynes Road

Rolleston

Christchurch

Submitted to:

Hughes Developments Ltd

Christchurch

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ENGEO Document Control:

Report Title	Geotechnical Investigation - 19 & 35 Dynes Road, Rolleston			
Project No.	12903.000.000	Doc ID	59	
Client	Hughes Developments Ltd	Client Contact	Kelvin Back	
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Date	Revision Details/Status	WP	Author	Reviewer
15/08/2019	Issued to Client	DF	JW	GM

1 Introduction

ENGEO Ltd was requested by Hughes Development Ltd to undertake a geotechnical investigation of the property at 19 & 35 Dynes Road, Rolleston, Christchurch, as outlined in our variation proposal (ref. 12903.000.000_57).

The purpose of this assessment was to conceptualise 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 six 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 eight 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.

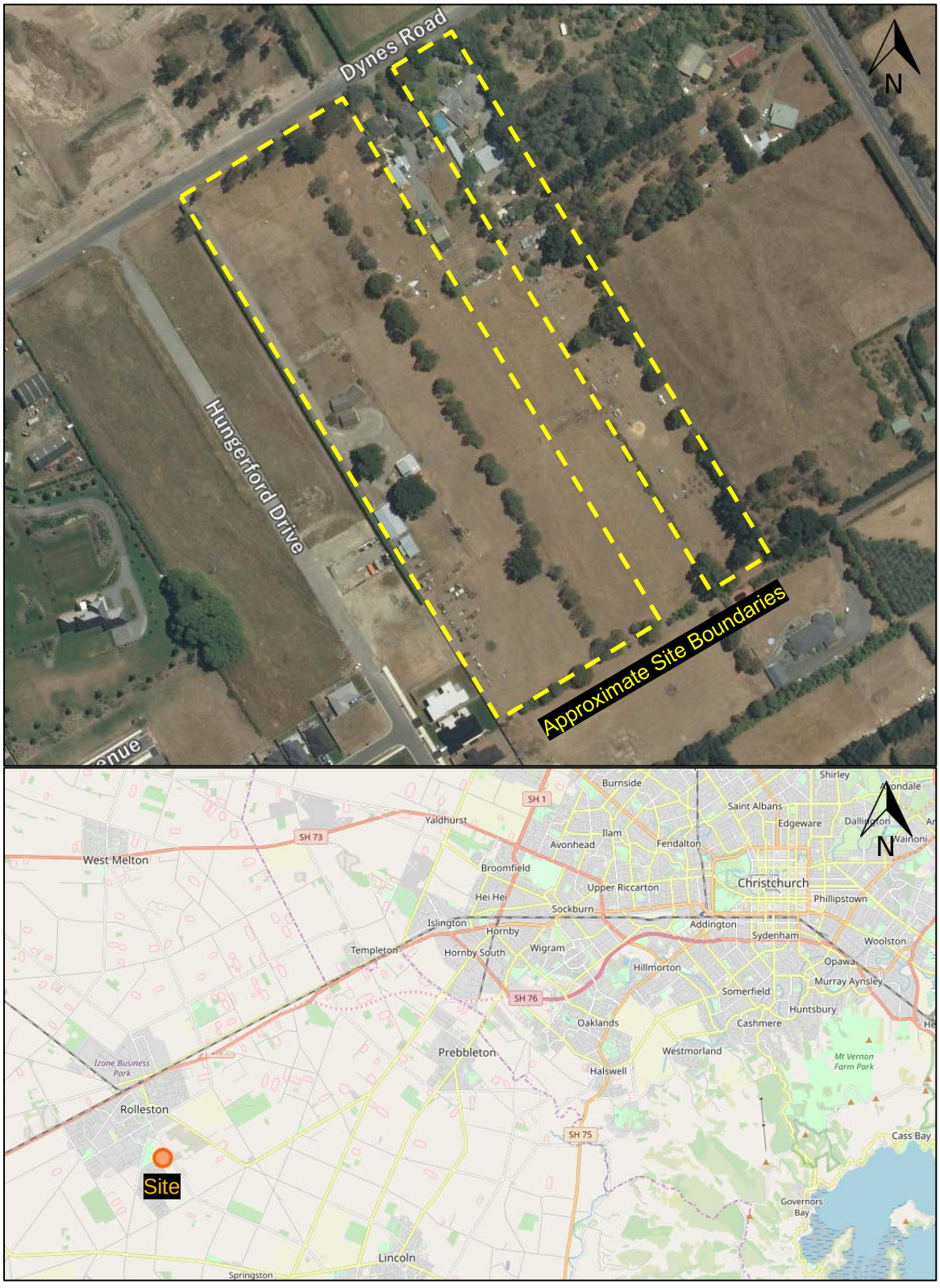
2 Site Description

The site is made up of two properties that will be discussed as one. The site covers a total area of 4.8 ha and has the following legal descriptions (Canterbury Maps):

- 19 Dynes Road - Lot 48 DP 8530
- 19 Dynes Road – Lot 50 DP 8530
- 35 Dynes Road – RS 41726

It is located approximately 2 km south of Rolleston town centre. The site is bound to the northwest by Dynes Road, the southwest and northeast by residential subdivisions and the southeast by rural properties (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 2 August 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 1.0 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

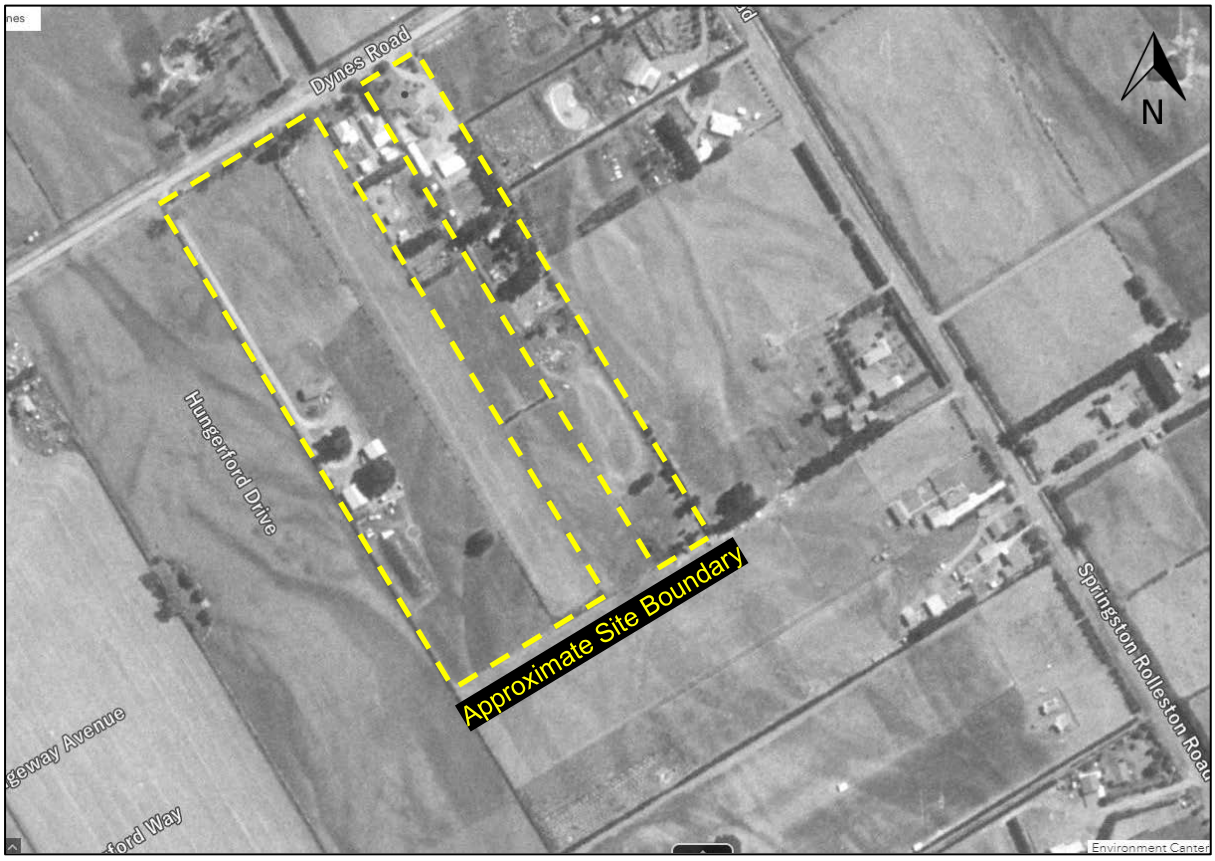


Image sourced from Canterbury Maps

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 extended to within 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 6 August 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	0.2 - 0.3	Stiff	-
SILT / SAND	0.2	0.2 - 0.8	Stiff to Very Stiff / Loose to Dense	Not present at all test locations
Silty GRAVEL / Sandy GRAVEL	0.2 – 1.0	Unknown	Dense to Very Dense	-

3.5 ECan Boreholes

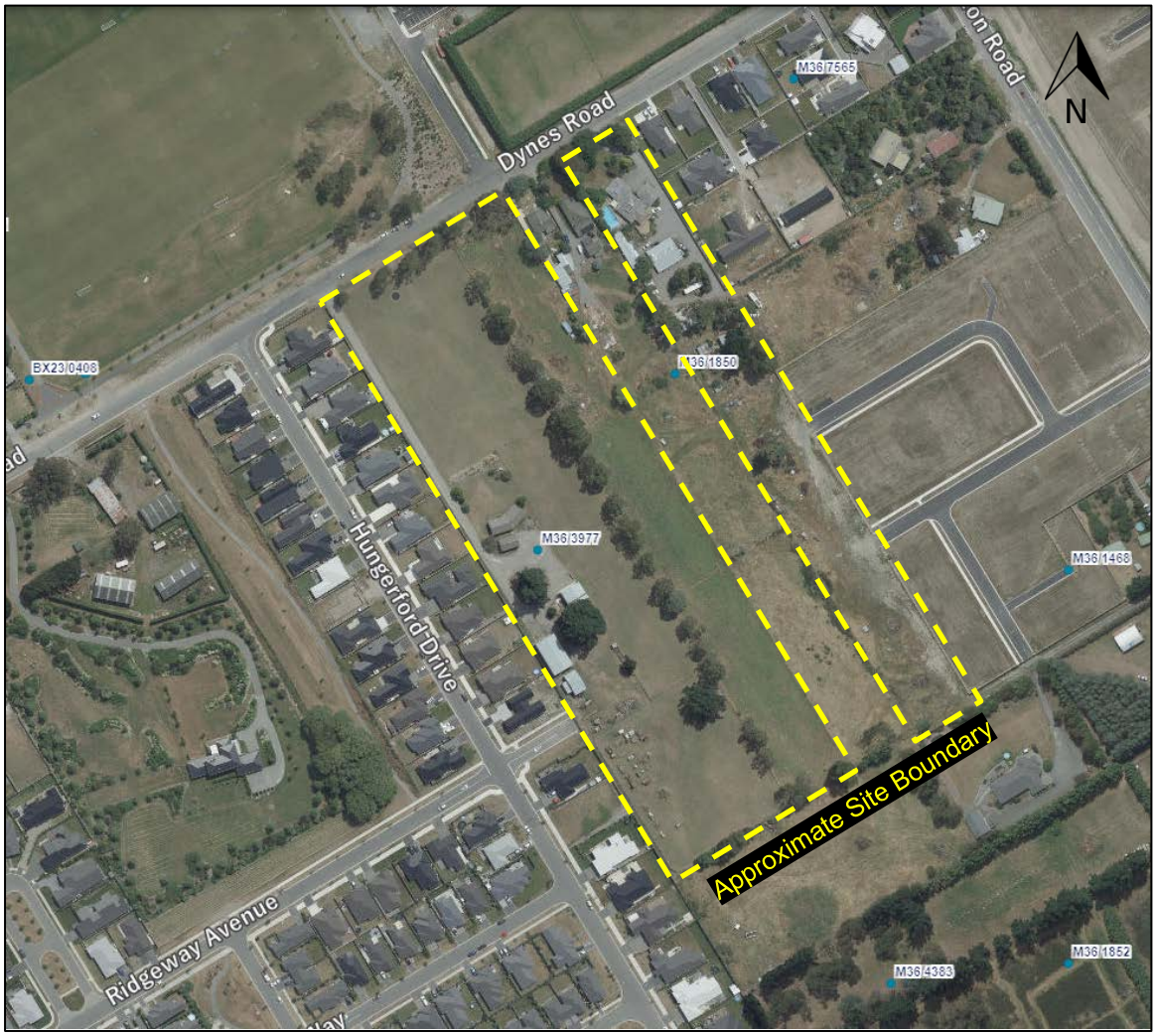
A review of three deep ECan borehole logs was conducted. The first (M36/5254), is located on-site, and appears to be a water well servicing the existing dwelling. The other boreholes are located on the northern boundary (M36/7902) and western boundary (M36/4221). A borehole is located south of Selwyn 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
M36/7565	35	12.5	Gravel to 35 m depth.
BX23/0408	36	11.1	Gravel from 0.5 m to 36 m depth.
M36/4386	24	10.7	Gravel to 24 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 10.7 m and 12.5 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 tsunami. 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 tsunami. 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 Roading

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.

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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.

GNS Science (2015). New Zealand Active Faults Database. Retrieved November 2018, from http://data.gns.cri.nz /af.

Pettinga J.R., Yetton M.D., Van Dissen R.J., & Downes G. (2001). Earthquake Source Identification and Characterisation for the Canterbury Region, South Island, New Zealand. Bulletin of the New Zealand Society for Earthquake Engineering, Vol 34, No. 4, pp 282-317.

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

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

Standards Association of New Zealand (2010). NZS 3604:2010. Timber Framed Buildings.

Standards Association of New Zealand (2010). NZS 4404:2010. Land Development and Subdivision Infrastructure.

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

DATE PLOTTED: 14 August 2019 11:02:51 AM BY: NFlatman

Legend

- Hand Augers
- Test Pits
- Site Boundary Lines
- Overland Flow Path

Sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence

Aerial: LINZ and Eagle Technology, CC-BY-3.0-NZ.
Map image: LINZ NZTopo Series, CC-BY-3.0-NZ.

PROJECTION: NZGD 2000 New Zealand Transverse Mercator

ENGEO
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Title: Geotechnical Site Plan

Client: Hughes Developments Ltd		Figure No: 1
Project: 19 & 35 Dynes Road Rolleston Canterbury	Designed: JW Drawn: NF Checked: GM Date: Aug 19	Size: A3
Proj No: 12903.000.000	Scale: 1:1,500	Revision: A

ORIGINAL FIGURE PRINTED IN COLOUR

PATH: Z:\Projects\12901 to 13000\12903 - Farringdon South Subdivision\047_19 & 35 Dynes Road - Enviro\06_CAD-GIS & Figures\Fig 01.mxd

APPENDIX 2:

Test Pit and Hand Auger Logs

LOG OF TEST PIT TP01

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 24 Tonne

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.612913
Longitude : 172.394353

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TS		SM	Silty fine to medium SAND with trace rootlets; brown. Poorly graded [TOPSOIL].					L-MD		
	ALLUVIUM		SP	Fine to medium SAND with some silt, trace gravel and rootlets; greyish brown. Poorly graded.					L-MD		
0.5			GM	Silty fine to coarse GRAVEL with some sand and trace rootlets; brownish grey. Well graded, subangular to subrounded. Sand, fine to medium.					D		
			GW	Sandy fine to coarse GRAVEL with some silt; grey. Well graded, subangular to subrounded. Sand, fine to coarse.				M	MD-D		
1.0				Silt becomes trace from 1.0 m depth.							
1.5				Trace cobbles encountered from 1.4 m depth.							
2.0				Depth of Excavation: 2 m Termination Condition: Target depth							
2.5											

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12; >>

Test pit met target depth.
Scala Penetrometer met practical refusal.
Standing groundwater was not encountered.

TS = TOPSOIL

LOG OF TEST PIT TP02

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 2.1 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 24 Tonne

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.611748
Longitude : 172.393446

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TS		SM	Silty fine to medium SAND with trace rootlets; brown. Poorly graded [TOPSOIL].					L-MD		
0.5	ALLUVIUM		SP	Fine to medium SAND with some silt, trace gravel and rootlets; brown. Poorly graded. Becomes brownish grey from 0.3 m depth. Lens of gravel at 0.5 m depth.				M	L-MD		
			SW	Fine to coarse SAND with trace silt and gravel; greyish brown. Well graded. Becomes wet from 0.8 m depth.					D		
1.0			GM	Silty fine to coarse GRAVEL with some sand and trace rootlets; brownish grey. Well graded, subangular to subrounded. Sand, fine to medium.					MD-D		
1.5			GW	Sandy fine to coarse GRAVEL with some silt; grey. Well graded, subangular to subrounded. Sand, fine to coarse. Sand becomes some from 1.7 to 1.8 m depth. Trace cobbles from 1.9 m depth.				W	MD-D		
2.0				Depth of Excavation: 2.1 m Termination Condition: Target depth							
2.5											

Test pit met target depth.
Scala Penetrometer met practical refusal.
Standing groundwater was not encountered.

TS = TOPSOIL

GEOTECH TEST PIT LOG 2018.08.08 - TP LOGS - DYNES ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 14/8/19

LOG OF TEST PIT TP03

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 24 Tonne

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.612626
Longitude : 172.393108

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TOPSOIL		SM	Silty fine to medium SAND with trace rootlets; brown. Poorly graded [TOPSOIL].					L		
0.3	ALLUVIUM		ML	Sandy SILT with trace gravel; brownish grey. Low plasticity. Sand, fine.				M	VSt-H		
0.5			GM	Silty fine to coarse GRAVEL with some sand and trace rootlets; brownish grey. Well graded, subangular to subrounded. Sand, fine to medium.					MD-D		
0.8			GW	Sandy fine to coarse GRAVEL with some silt, trace cobbles and rootlets; grey. Well graded, subangular to subrounded. Sand, fine to coarse. Silt becomes trace from 1.0 m depth. No rootlets from 1.2 to 1.6 m depth. Cobbles become minor from 1.8 m depth.				W	MD-D		
2.0				Depth of Excavation: 2 m Termination Condition: Target depth							
2.5											

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12 (>>)

Test pit met target depth.
Scala Penetrometer met practical refusal.
Standing groundwater was not encountered.

GEOTECH TEST PIT LOG 2018.08.08 - TP LOGS - DYNES ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 14/8/19

LOG OF TEST PIT TP04

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 24 Tonne

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.61195
Longitude : 172.392695

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TOPSOIL		SM	Silty fine to medium SAND with trace rootlets; brown. Poorly graded [TOPSOIL].				M	L-MD		
	ALLUVIUM		ML	Sandy SILT with trace gravel and rootlets; brownish grey. Low plasticity. Sand, fine.					VSt-H		
0.5			GM	Silty fine to coarse GRAVEL with some sand and trace rootlets; brownish grey. Well graded, subangular to subrounded. Sand, fine to medium.				W	MD		
			GW	Sandy fine to coarse GRAVEL with some silt and trace rootlets; grey. Well graded, subangular to subrounded. Sand, fine to coarse. Trace cobbles encountered from 1.0 m depth.					MD-D		
1.0			GM	Silty fine to medium GRAVEL with minor sand and trace rootlets; brownish grey. Poorly graded, subrounded. Sand, fine to medium.					MD		
			GW	Sandy fine to coarse GRAVEL with some silt and trace rootlets; grey. Well graded, subangular to subrounded. Sand, fine to coarse. No rootlets from 1.7 m depth. Loosely packed gravel observed from 1.9 to 2.0 m depth.				M	MD-D		
1.5				Depth of Excavation: 2 m Termination Condition: Target depth							
2.0											
2.5											

Test pit met target depth.
Scala Penetrometer met practical refusal.
Standing groundwater was not encountered.

LOG OF TEST PIT TP05

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 2.1 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 24 Tonne

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.611188
Longitude : 172.391713

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TS		SM	Silty fine to medium SAND with trace rootlets; brown. Poorly graded [TOPSOIL].					L-MD		
0.5	ALLUVIUM		GM	Silty fine to medium GRAVEL with some sand and trace rootlets; greyish brown. Well graded, subangular to subrounded. Sand, fine to medium.				M	MD-D		>>
1.0			GW	Sandy fine to coarse GRAVEL with trace silt and rootlets; brown. Well graded, subangular to subrounded. Becomes wet from 0.7 to 1.2 m depth. Trace cobbles from 0.8 to 1.5 m depth. Sand becomes some from 1.0 to 1.3 m depth.				W	MD-D		>>
1.5								M			
2.0				Depth of Excavation: 2.1 m Termination Condition: Target depth							
2.5											

Test pit met target depth.
Scala Penetrometer met practical refusal.
Standing groundwater was not encountered.

TS = TOPSOIL

LOG OF TEST PIT TP06

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 24 Tonne

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.611324
Longitude : 172.391032

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TOPSOIL		SM	Silty fine to medium SAND with trace rootlets; brown. Poorly graded [TOPSOIL].					L-MD		
0.5	ALLUVIUM		SM	Silty fine to medium SAND with trace rootlets; greyish brown. Poorly graded. Trace gravel from 0.6 m depth.					MD		
1.0			GM	Silty fine to medium GRAVEL with some sand and trace rootlets; brownish grey. Poorly graded, subangular to subrounded. Sand, fine to medium.				M	MD-D		
1.5			GW	Sandy fine to coarse GRAVEL with trace silt and cobbles; grey. Well graded, subangular to subrounded. Sand, fine to coarse. Becomes wet from 1.5 m depth. Sand becomes some from 1.8 to 2.0 m depth.				W	MD-D		
2.0				Depth of Excavation: 2 m Termination Condition: Target depth							
2.5											

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12 >>

Test pit met target depth.
Scala Penetrometer met practical refusal.
Standing groundwater was not encountered.

GEOTECH TEST PIT LOG 2018.08.08 - TP LOGS - DYNES ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 14/8/19

LOG OF TEST PIT TP07

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 24 Tonne

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.612396
Longitude : 172.392357

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TS		SM	Silty fine to medium SAND with trace gravel and rootlets; dark brown. Poorly graded [TOPSOIL].					L-MD		
	ALLUVIUM		SM	Silty fine to medium SAND with trace gravel, rootlets and cobbles; brownish grey. Poorly graded.					MD		
0.5			GM	Silty fine to medium GRAVEL with some sand and trace rootlets; brownish grey. Poorly graded, subangular to subrounded. Sand, fine to medium.					MD-D		
			GW	Sandy fine to coarse GRAVEL with trace silt and cobbles; grey. Well graded, subangular to subrounded. Sand, fine to coarse.				M	MD-D		
1.0											
1.5				Sand becomes some from 1.7 m depth. Trace rootlets from 1.8 m depth.							
2.0				Depth of Excavation: 2 m Termination Condition: Target depth							
2.5											

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12 (>>)

Test pit met target depth.
Scala Penetrometer met practical refusal.
Standing groundwater was not encountered.

TS = TOPSOIL

GEOTECH TEST PIT LOG 2018.08.08 - TP LOGS - DYNES ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 14/8/19

LOG OF TEST PIT TP08

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size : 24 Tonne

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.613701
Longitude : 172.393044

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TS		SM	Silty fine to medium SAND with trace gravel and rootlets; dark brown. Poorly graded [TOPSOIL].					L-MD		
0.4	ALLUVIUM		SM	Silty fine SAND with trace rootlets; brown. Poorly graded. Becomes greyish brown from 0.4 m depth.					L-MD		
0.5			ML	Sandy SILT with trace rootlets; greyish brown. Low plasticity. Sand, fine. Trace gravel from 0.7 m depth.					St-VSt		
1.0			GM	Silty fine to medium GRAVEL with some sand and trace rootlets; brownish grey. Poorly graded, subangular to subrounded.				M	MD-D		
1.4			GW	Sandy fine to coarse GRAVEL with some silt and trace cobbles; grey. Well graded, subangular to subrounded. Sand, fine to coarse. Silt becomes trace from 1.4 m depth.					MD-D		
2.0				Depth of Excavation: 2 m Termination Condition: Target depth							
2.5											

Test pit met target depth.
Scala Penetrometer met practical refusal.
Standing groundwater was not encountered.

TS = TOPSOIL

LOG OF TEST PIT HA01

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 0.5 m
Digger Type/Size : Hand Auger
Bucket Type/Size :

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.612373
Longitude : 172.393993

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0.0	TOPSOIL		SM	Silty fine to medium SAND with trace gravel and rootlets; dark brown. Poorly graded [TOPSOIL].					MD		
	ALLUVIUM		SM	Silty fine to medium SAND; greyish brown. Poorly graded. Silt becomes some from 0.3 m depth. Some gravel from 0.4 m depth. Gravel, fine, subangular to subrounded.				M	D		
0.5				Depth of Excavation: 0.5 m Termination Condition: Practical refusal							
1.0											
1.5											
2.0											

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12

Hand auger met practical refusal
Scala Penetrometer met practical refusal
Standing groundwater was not encountered.

GEOTECH TEST PIT LOG 2018.08.08 - HA LOGS - DYNES ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 14/8/19

LOG OF TEST PIT HA02

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 0.4 m
Digger Type/Size : Hand Auger
Bucket Type/Size :

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.611301
Longitude : 172.39277

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0.0	ALLUVIUM/TOPSOIL		SM	Silty fine SAND with trace gravel, rootlets and wood; dark brown. Poorly graded [TOPSOIL].				M	L		
			ML	Sandy SILT with some gravel and trace wood; brown. Low plasticity. Sand, fine to medium. Gravel, fine, subangular to subrounded.					St-VSt		
0.5				Depth of Excavation: 0.4 m Termination Condition: Practical refusal							
1.0											
1.5											
2.0											

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12 (>>)

Hand auger met practical refusal
Scala Penetrometer met practical refusal
Standing groundwater was not encountered.

GEOTECH TEST PIT LOG 2018.08.08 - HA LOGS - DYNES ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 14/8/19

LOG OF TEST PIT HA03

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 0.5 m
Digger Type/Size : Hand Auger
Bucket Type/Size :

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.6132
Longitude : 172.393693

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0.0	TOPSOIL		SM	Silty fine SAND with trace rootlets and gravel; dark brown. Poorly graded [TOPSOIL]. Gravel becomes some from 0.2 m depth. Gravel, fine, subangular to subrounded.				M	L-MD		
0.5	ALLUVIUM		GM	Silty fine to medium GRAVEL with some sand and trace rootlets; brown. Poorly graded, subangular to subrounded. Sand, fine to medium. Becomes greyish brown from 0.45 m depth.					D		
1.0				Depth of Excavation: 0.5 m Termination Condition: Practical refusal							
1.5											
2.0											

Hand auger met practical refusal
Scala Penetrometer met practical refusal
Standing groundwater was not encountered.

GEOTECH TEST PIT LOG 2018.08.08 - HA LOGS - DYNES ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 14/8/19

LOG OF TEST PIT HA04

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 0.65 m
Digger Type/Size : Hand Auger
Bucket Type/Size :

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.611763
Longitude : 172.39174

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0.0	TOPSOIL		SM	Silty fine SAND with trace rootlets; dark brown. Poorly graded [TOPSOIL].				M	L-MD		2 4 6 8 10 12
	ALLUVIUM		ML	Sandy SILT with trace rootlets; greyish brown with orange mottles. Low plasticity. Sand, fine to medium. Trace gravel from 0.45 m depth.					St-VSt		
0.5			GM	Silty fine to medium GRAVEL with some sand; brownish grey with orange mottles. Poorly graded, subangular to subrounded. Sand, fine to coarse.				W	D		>>
				Depth of Excavation: 0.65 m Termination Condition: Practical refusal							
1.0											
1.5											
2.0											

Hand auger met practical refusal
Scala Penetrometer met practical refusal
Standing groundwater was not encountered.

GEOTECH TEST PIT LOG 2018.08.08 - HA LOGS - DYNES ROAD.GPJ NZ MASTER DATA TEMPLATE.GDT 14/8/19

LOG OF TEST PIT HA05

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 0.35 m
Digger Type/Size : Hand Auger
Bucket Type/Size :

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.612851
Longitude : 172.392395

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0.0	TOPSOIL		SM	Silty fine to medium SAND with trace gravel and rootlets; brown. Poorly graded [TOPSOIL].				M	L-MD		
	A		SM	Silty fine to medium SAND with some gravel; brown. Poorly graded. Gravel, fine to medium, subangular to subrounded.					D		
				Depth of Excavation: 0.35 m Termination Condition: Practical refusal							
0.5											
1.0											
1.5											
2.0											

Scala Penetrometer: Blows per 100mm — 2 4 6 8 10 12

Hand auger met practical refusal
Scala Penetrometer met practical refusal
Standing groundwater was not encountered.

A = ALLUVIUM

LOG OF TEST PIT HA06

Geotechnical Investigation
19 & 35 Dynes Road
Rolleston
12903.000.000

Client : Hughes Developments Ltd
Date : 07.08.2019
Max Test Pit Depth : 0.4 m
Digger Type/Size : Hand Auger
Bucket Type/Size :

Shear Vane No : N/A
Logged By : KF
Reviewed By : JRW
Latitude : -43.613185
Longitude : 172.393124

Depth (m BGL)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0.0	ALLUVIUM/TOPSOIL		SM	Silty fine SAND with trace rootlets; brown. Poorly graded [TOPSOIL].				M	L-MD		2 4 6 8 10 12
			ML	Sandy SILT with trace rootlets; greyish brown. Low plasticity. Sand, fine. Some gravel from 0.3 m depth. Gravel, fine to medium, subangular to subrounded.					VSt		>>
0.5				Depth of Excavation: 0.4 m Termination Condition: Practical refusal							
1.0											
1.5											
2.0											

Hand auger met practical refusal
Scala Penetrometer met practical refusal
Standing groundwater was not encountered.

APPENDIX 3:

ECan Borelogs

Bore or Well No	M36/7565
Well Name	551 Dynes Road
Owner	Mr & Mrs T & N Buhrs

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	M36/7565	**File Number**	CO6C/21289
Owner	Mr & Mrs T & N Buhrs	**Well Status**	Active (exist, present)
Street/Road	551 Dynes Road	**NZTM Grid Reference**	BX23:51067-71240
Locality	Rolleston	**NZTM X and Y**	1551067 - 5171240
Location Description		**Location Accuracy**	50 - 300m
CWMS Zone	Selwyn - Waihora	**Use**	Domestic Supply,
Groundwater Allocation Zone	Selwyn-Waimakariri	**Water Level Monitoring**	--
Depth	35.00m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	12.50m below MP
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	42.15m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	6	**Calc Min 95%**	11.60m below MP
Aquifer Name	Linwood Gravel	**Aquifer Tests**	0
Aquifer Type		**Yield Drawdown Tests**	2
Drill Date	01 Jan 2004	**Max Tested Yield**	6 l/s
Driller	Dynes Road Drilling	**Drawdown at Max Tested Yield**	10 m
Drilling Method	Cable Tool	**Specific Capacity**	0.37 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	33	35				

Step Tests

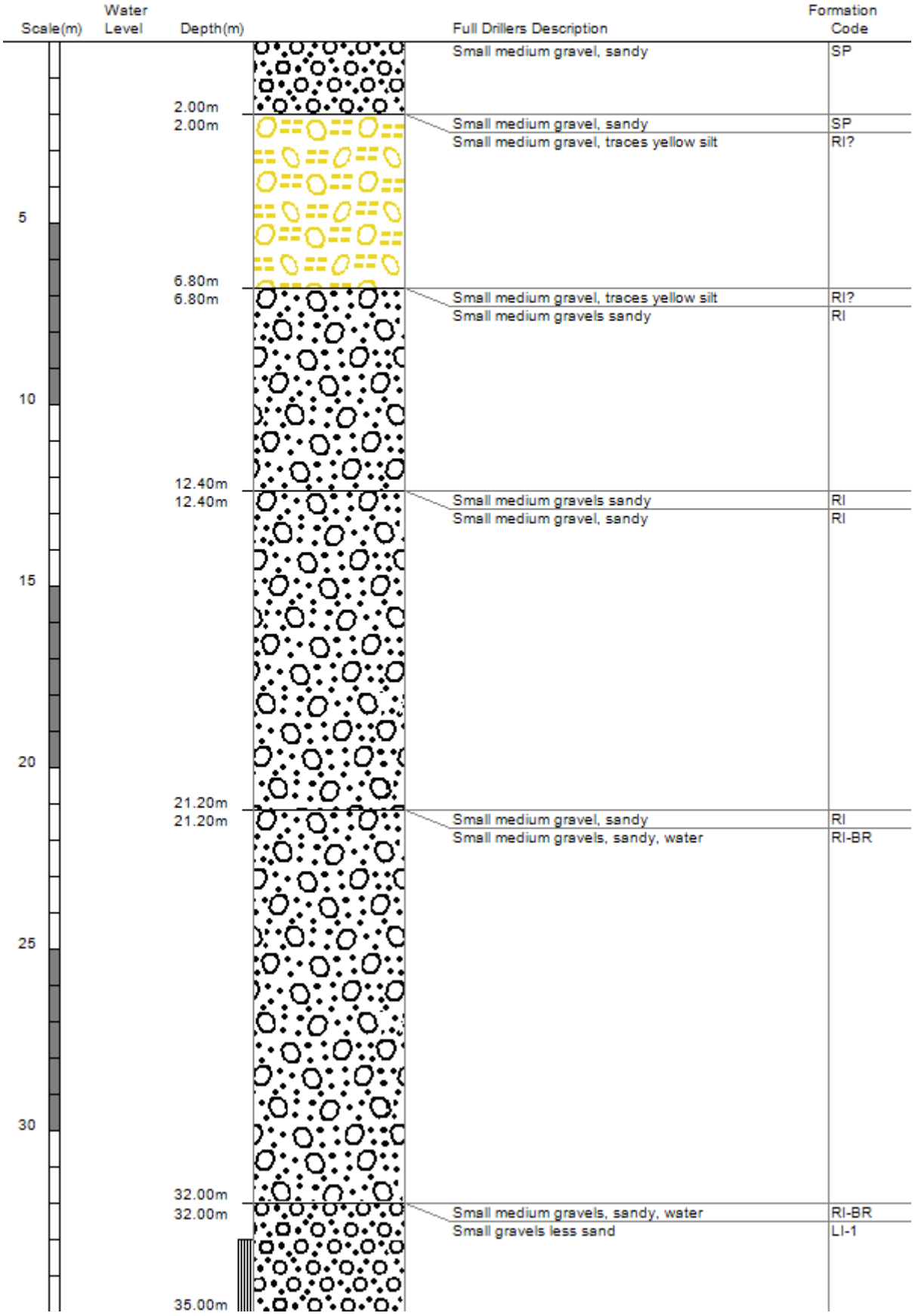
Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
01 Jan 2004	1	3.4	44.8738251	9.14	2
01 Jan 2004	2	5.7	75.2296448	10.36	3

No comments for this well

Borelog for well M36/7565

Grid Reference (NZTM): 1551067 mE, 5171240 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 42.2 m +MSD Accuracy: < 0.5 m
Driller: Dynes Road Drilling
Drill Method: Cable Tool
Borelog Depth: 35.0 m Drill Date: 01-Jan-2004

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha



Bore or Well No	BX23/0408
Well Name	Dynes Road
Owner	Selwyn District Council

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	BX23/0408	**File Number**	CRC152641
Owner	Selwyn District Council	**Well Status**	Active (exist, present)
Street/Road	Dynes Road	**NZTM Grid Reference**	BX23:50678-71087
Locality	Rolleston	**NZTM X and Y**	1550678 - 5171087
Location Description		**Location Accuracy**	10 - 50m
CWMS Zone	Selwyn - Waihora	**Use**	Irrigation,
Groundwater Allocation Zone	Selwyn-Waimakariri	**Water Level Monitoring**	--
Depth	102.00m	**Water Level Count**	1
Diameter	200mm	**Initial Water Level**	11.10m below MP
Measuring Point Description	Top of Casing	**Highest Water Level**	11.10m below MP
Measuring Point Elevation		**Lowest Water Level**	11.10m below MP
Elevation Accuracy		**First reading**	31 Oct 2014
Ground Level	0.50m below MP	**Last reading**	31 Oct 2014
Strata Layers	13	**Calc Min 95%**	
Aquifer Name		**Aquifer Tests**	1
Aquifer Type		**Yield Drawdown Tests**	3
Drill Date	31 Oct 2014	**Max Tested Yield**	
Driller	East Coast Drilling	**Drawdown at Max Tested Yield**	
Drilling Method	Air Rotary	**Specific Capacity**	1.85 l/s/m
Casing Material	Steel	**Last Updated**	03 Apr 2019
Pump Type		**Last Field Check**	31 Oct 2014
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	99	102			175	1000

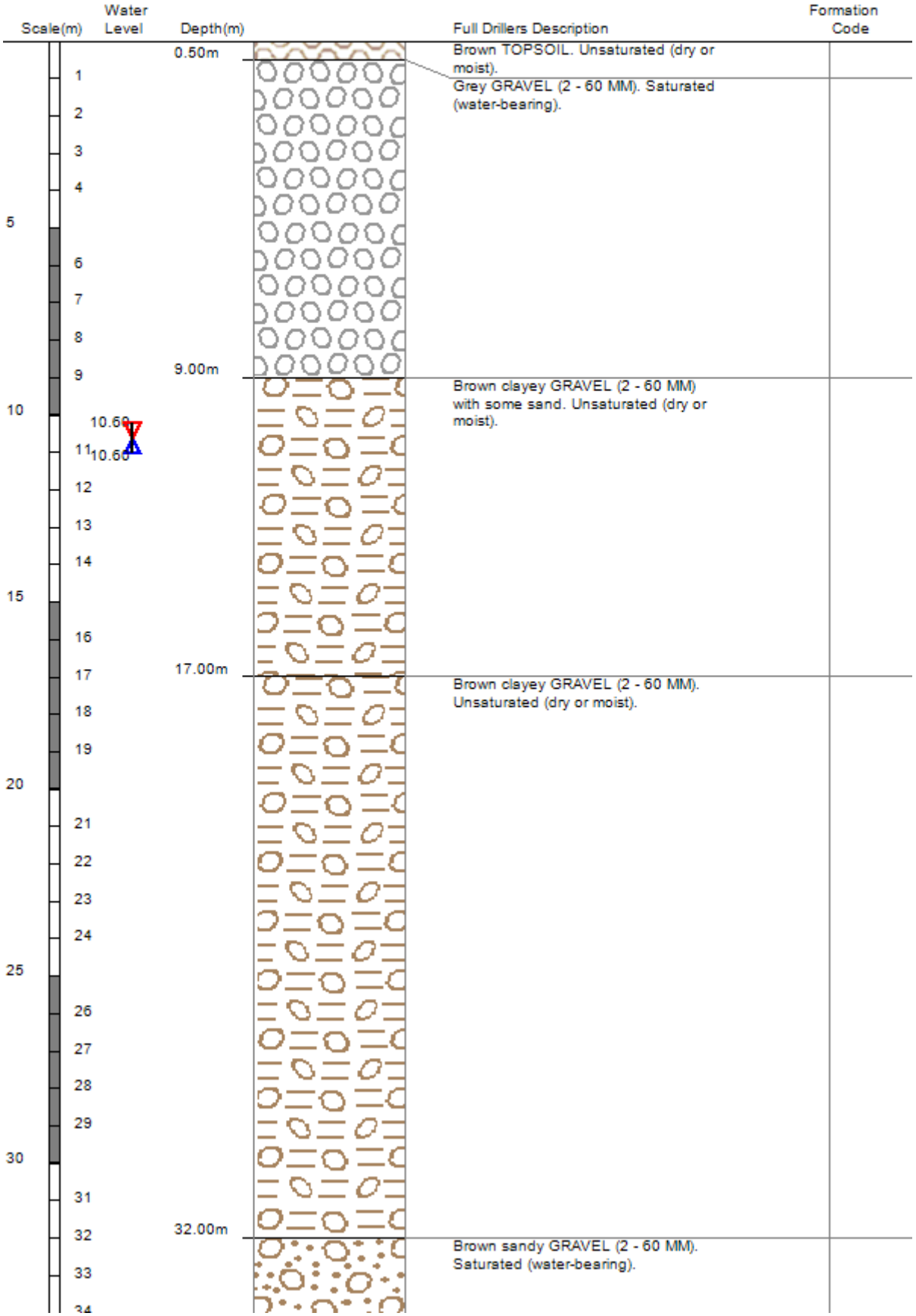
Step Tests

Step Test Date	Step	Yield	Yield GPM	DrawDown	Step Duration
17 Nov 2014	1	8.7	114.824196	4.7	1
17 Nov 2014	2	19	250.765488	14.5	1
17 Nov 2014	3	29	382.7473	31.5	1

Borelog for well BX23/0408 page 1 of 3

Grid Reference (NZTM): 1550678 mE, 5171087 mN
Location Accuracy: 10 - 50m
Ground Level Altitude: m +MSD Accuracy:
Driller: East Coast Drilling
Drill Method: Air Rotary
Borelog Depth: 102.0 m Drill Date: 31-Oct-2014

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha



Bore or Well No	M36/4383
Well Name	SPRINGSTON ROLLESTON RD
Owner	WARMAN D.G.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Well Number	M36/4383	**File Number**	
Owner	WARMAN D.G.	**Well Status**	Active (exist, present)
Street/Road	SPRINGSTON ROLLESTON RD	**NZTM Grid Reference**	BX23:51117-70780
Locality	ROLLESTON	**NZTM X and Y**	1551117 - 5170780
Location Description		**Location Accuracy**	50 - 300m
CWMS Zone	Selwyn - Waihora	**Use**	Domestic Supply,
Groundwater Allocation Zone	Selwyn-Waimakariri	**Water Level Monitoring**	--
Depth	24.00m	**Water Level Count**	0
Diameter	150mm	**Initial Water Level**	
Measuring Point Description		**Highest Water Level**	
Measuring Point Elevation	39.32m above MSL (Lyttelton 1937)	**Lowest Water Level**	
Elevation Accuracy	< 2.5 m	**First reading**	
Ground Level	0.00m above MP	**Last reading**	
Strata Layers	11	**Calc Min 95%**	10.70m below MP
Aquifer Name	Riccarton Gravel	**Aquifer Tests**	0
Aquifer Type	Unknown	**Yield Drawdown Tests**	1
Drill Date	30 Jul 1991	**Max Tested Yield**	3 l/s
Driller	Dynes Road Drilling	**Drawdown at Max Tested Yield**	10 m
Drilling Method	Cable Tool	**Specific Capacity**	0.27 l/s/m
Casing Material		**Last Updated**	08 Nov 2013
Pump Type	Unknown	**Last Field Check**	
Water Use Data	No		

Borelog for well M36/4383

Grid Reference (NZTM): 1551117 mE, 5170781 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 39.3 m +MSD Accuracy: < 2.5 m
Driller: Dynes Road Drilling
Drill Method: Cable Tool
Borelog Depth: 25.0 m Drill Date: 30-Jul-1991

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha