



Geotechnical Investigation

527 Springston Rolleston Road

Faringdon East Extended Block

Rolleston

Submitted to:

Hughes Development Ltd

Canterbury

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28.02.2017

12903.000.000_09



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ENGEO Document Control:

Report Title	Geotechnical Investigation – 527 Springston Rolleston Road, Faringdon East Extended Block				
Project No.	12903.000.000	Doc ID	09		
Client	Hughes Development Ltd	Client Contact	Hughes Development Ltd		
Distribution (PDF)	Hughes Development Ltd				
Date	Revision Details/Status		WP	Author	Reviewer
28/02/2017	Final		NF	JW	GM

1 Introduction

ENGEO Ltd was requested by Hughes Development Ltd to undertake a Geotechnical Investigation for the proposed Faringdon Subdivision, as outlined in our variation proposal (ref. P2016.000.248, dated 21 February 2016).

The property at 527 Springston-Rolleston Road is part of the Faringdon East Extended Block Subdivision. The purpose of this investigation 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 11 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 nine test pits, including geotechnical logging of the exposed soils; and
- Preparation of this report outlining our findings on the ground conditions and the suitability of the site for residential subdivision. This will include 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 2.8 ha (Figure 1), and has the legal description of Lots 37 to 44 DP 8530 (Selwyn District Council). We understand the proposed development is to exclude the block labelled 1 on Figure 1, therefore this report pertains to Block 2. It is located approximately 3 km southeast of Rolleston town centre and is bound by Springston-Rolleston Road to the northeast and farmland on the remaining sides.

Figure 1: Site Location



Image obtained from Davie Lovell-Smith proposed plans. Not to scale.

The predominantly flat site is currently agricultural land and is part of the properties within Block 1 and 2 (Figure 1).

There are no significant watercourses in the area and the site is outside of any ECan defined flood zones as indicated in the Selwyn District Council (SDC) Operative District Plan (SDC, 2015).

The Canterbury Earthquake Recovery Authority (CERA, now disestablished) has categorised the site as 'N/A Rural & Unmapped', meaning future development can proceed following normal consenting processes.

3 Geological Model

3.1 Regional Geology

The site has been regionally mapped by GNS (Forsyth et al., 2008) 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, 2016) and observed during our site walkover conducted on 24 February 2017, 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 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).

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 24 February 2017. The investigations comprised 11 hand auger boreholes with associated Scala Penetrometer tests and 9 test pit investigations.

The investigations revealed subsurface conditions across the site are consistent with the published geological mapping, as summarised in Table 1.

Investigations undertaken within or adjacent to inferred paleo-channels revealed deeper silt deposits to depths up to 1.0 m.

Table 1: Generalised Summary of Subsurface Conditions

Soil Type	Depth to top of layer (m)	Layer Thickness (m)	Density / Consistency	Comment
TOPSOIL	0.0	0.1 – 0.4	Firm to Hard	-
SILT	0.1 to 0.4	0.1 to 0.5	Very Stiff to Hard	Not encountered in all test pits
Sandy GRAVEL and GRAVEL	0.1 to 1.0	Unknown	Medium Dense to Dense	-

“Good ground” (as defined in NZS 3604:2010) under static conditions was typically encountered immediately beneath the topsoil layer (typically 0.2 m) and at a maximum depth of 0.4 m below ground level.

Test Locations are shown on the site plan presented in Appendix 1. Test pit and hand auger hole logs, showing detailed soil descriptions are presented in Appendix 2.

3.5 ECan Boreholes

A review of two deep ECan borehole logs located 200 m south (M36/1852) and 200 m east of the site (M36/0204) was conducted (Canterbury Maps). The location of these boreholes is presented in Figure 2 and includes the well points that have no log data available. The logs from the two holes of interest are presented in Appendix 3 and indicate the site is underlain by a mixture of gravel and sand to depths of at least 27.4 m below ground level.

Figure 2: Nearby ECan Borehole Locations

Image sourced from Canterbury Maps (February 2017). Not to scale.

3.6 Groundwater

Groundwater is recorded in the surrounding boreholes between approximately 10.8 and 11.2 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 where by 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 the land is likely to be subject to the following:

- Erosion, including surface and subsurface erosion, associated with water and wind;
- Falling debris, including rockfall that could impact the site from upslope sources;
- Subsidence, which involves the removal of underlying support by natural or artificial means;
- Slippage, which is defined as the downslope transfer of materials by sliding and / or flowage; and
- Inundation, which may be sourced from streams, coastal processes or excess precipitation.

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 any of the above hazards and, 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 Earthfilling for Residential Development. In particular, any areas to receive fill should be stripped of any 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 2:1 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 of 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 pad, strip or slab foundations designed in accordance with the provisions of NZS 3604 Timber Framed Buildings.

An 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 below 0.4 m depth based on our subsurface investigations.

7 References

- Canterbury Earthquake Recovery Authority. Canterbury Geotechnical Database. Retrieved February 2017, from <https://canterburyrecovery.projectorbit.com/cgd>
- Canterbury Maps, Groundwater. Retrieved February, 2017 from <http://canterburymaps.govt.nz/Viewer>
- 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, Earthquake Commission. (n.d.). Aftershocks. Retrieved 2013, from Geonet: www.geonet.org.nz/canterbury-quakes/aftershocks
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- 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.
- Standards Association of New Zealand (1989). NZS 4431:1989. Code of Practice for Earthfilling for Residential Development.
- 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 (2015), Selwyn District Council Operative District Plan. Retrieved 2016, from <http://www.selwyn.govt.nz/services/planning/district-plan>
- Selwyn District Council, Property Search, retrieved January 2017 from <https://www.selwyn.govt.nz/my-property/rates/search-properties>
- The Ministry of Business, Innovation, and Employment (2016). New Zealand Geotechnical Database. Retrieved January 2017, 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 Development 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 IPENZ/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, PEngGeol

Principal Engineering Geologist

APPENDIX 1: Site Plan and Test Locations



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

TEST LOCATION PLAN

Client: HUGHES DEVELOPMENTS		Figure No:
Project: FARINGDON SOUTH SUBDN 527 SPRINGSTON-ROLLESTON ROAD, ROLLESTON	Designed: JW	1
	Drawn: DF	
	Checked: GM	
	Date: 27.01.17	
Proj No: 12903.000.000	Scale: 1:1000	Size: A3
		Rev: 0

APPENDIX 2:
Test Pit and Hand Auger Borehole Logs



Client : Hughes Developm
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer	
		Easier	Harder								Blows per 100mm	
0.5	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S-Vst			
				GW	Fine to coarse GRAVEL with some cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.				D			
1.0	ALLUVIUM			GW	Fine to coarse GRAVEL with minor sand; grey. Well graded, subrounded. Sand, fine to medium.				M			
1.5												
2.0					Depth of Excavation: 2 m Termination Condition: Practical refusal							

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 24/2/17





Test pit reached target depth
Scala Penetrometer met target depth
Standing groundwater was not encountered

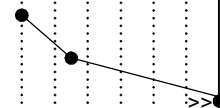
LOG OF TEST PIT TP02

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer					
		Easier	Harder								Blows per 100mm					
	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				F-Vst		2	4	6	8	10	12
0.5				GW	Fine to coarse GRAVEL with some cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.				D							
1.0	ALLUVIUM			GW	Fine to coarse GRAVEL with minor cobbles and minor sand; grey. Well graded, subrounded. Sand, fine to medium.				M							
1.5					Sand becomes fine to coarse at 1.5 m depth.											
2.0					Depth of Excavation: 2 m Termination Condition: Practical refusal											



GEOSCIENCE TEST PIT LOG. TEST PITS.GPJ. NZ MASTER DATA TEMPLATE.GDT. 24/2/17


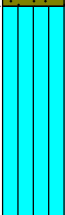


Test pit reached target depth
Scala Penetrometer met practical refusal
Standing groundwater was not encountered

LOG OF TEST PIT TP03

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer					
		Easier	Harder								Blows per 100mm					
	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S-St							
0.5				ML	SILT with some sand; light brown. Low plasticity. Sand, fine to medium.				St-H							
1.0	ALLUVIUM			GW	Fine to coarse GRAVEL with some cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.											
1.5				GW	Fine to coarse GRAVEL with minor cobbles and trace sand; grey. Well graded, subrounded. Sand, fine to medium.				M							
2.0	Depth of Excavation: 2 m Termination Condition: Practical refusal															

GEOSCIENCE TEST PIT LOG. TEST PITS.GPJ. NZ MASTER DATA TEMPLATE.GDT. 24/2/17




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

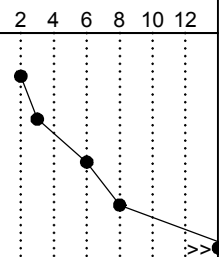
LOG OF TEST PIT TP04

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer					
		Easier	Harder								Blows per 100mm					
	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S-St							
0.5				GW	Fine to coarse GRAVEL with cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.				MD-D							
1.0	ALLUVIUM			GW				D								
1.5				GW	Fine to coarse GRAVEL with cobbles and minor sand; grey. Well graded, subrounded. Sand, fine to coarse.				M							
2.0					Depth of Excavation: 2 m Termination Condition: Practical refusal											







GEOSCIENCE TEST PIT LOG. TEST PITS.GPJ. NZ MASTER DATA TEMPLATE.GDT. 24/2/17

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



Client : Hughes Developm
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer		
		Easier	Harder								Blows per 100mm		
	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S-St				
0.5	ALLUVIUM			GW	Fine to coarse GRAVEL with some cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.			D					
1.0				GW	Fine to coarse GRAVEL with minor cobbles and minor sand; grey. Well graded, subrounded. Sand, fine to medium.								
1.5				GW	Sand becomes fine to coarse at 1.5 m depth.			M					
2.0	Depth of Excavation: 2 m Termination Condition: Practical refusal												

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 24/2/17


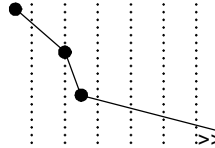


Test pit reached target depth
Scala Penetrometer met practical refusal
Standing groundwater was not encountered

LOG OF TEST PIT TP06

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer
		Easier	Harder								Blows per 100mm
	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S-St		
0.5	ALLUVIUM			ML	SILT with some sand and trace gravel; light brown. Low plasticity. Gravel, fine to medium, subrounded. Sand, fine to medium.			D	H		
1.0				GW	Fine to coarse GRAVEL with some cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.			M			
1.5				GW	Fine to coarse GRAVEL with minor cobbles and trace sand; grey. Well graded, subrounded. Sand, fine to coarse.						
2.0	Depth of Excavation: 2 m Termination Condition: Practical refusal										

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 24/2/17


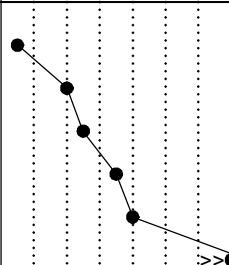
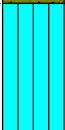


Test pit reached target depth
Scala Penetrometer met practical refusal
Standing groundwater was not encountered

LOG OF TEST PIT TP07

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer					
		Easier	Harder								Blows per 100mm					
	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S-Vst							
0.5				ML	SILT with some sand; light brown. Low plasticity. Sand, fine to medium.				H							
1.0	ALLUVIUM			GW	Fine to coarse GRAVEL with some cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.											
1.5				GW	Fine to coarse GRAVEL with minor cobbles and trace sand; grey. Well graded, subrounded. Sand, fine to medium. Sand becomes fine to coarse at 1.7 m depth.				M							
2.0	Depth of Excavation: 2 m Termination Condition: Practical refusal															

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 24/2/17


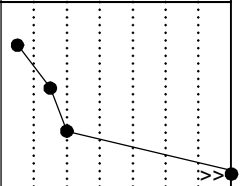



Test pit reached target depth
Scala Penetrometer met practical refusal
Standing groundwater was not encountered

LOG OF TEST PIT TP08

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer					
		Easier	Harder								Blows per 100mm					
	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S-St							
0.5				ML	SILT with some sand; light brown. Low plasticity. Sand, fine to medium.				H							
	ALLUVIUM			GW	Fine to coarse GRAVEL with some cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.			D								
1.0				GW	Fine to coarse GRAVEL with minor cobbles and trace sand; grey. Well graded, subrounded. Sand, fine to coarse.			M								
1.5				GW												
2.0					Depth of Excavation: 2 m Termination Condition: Practical refusal											

GEOSCIENCE TEST PIT LOG. TEST PITS.GPJ. NZ MASTER DATA TEMPLATE.GDT. 24/2/17




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

LOG OF TEST PIT TP09

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Date : 24/02/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

Shear Vane No :
Logged By : RP
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale)		USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer					
		Easier	Harder								Blows per 100mm					
	TOPSOIL			ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S-St		2	4	6	8	10	12
0.5				GW	Fine to coarse GRAVEL with some cobbles, minor silt and trace sand; brownish grey. Well graded, subrounded. Sand, fine to medium.			D								
1.0	ALLUVIUM			GW	Fine to coarse GRAVEL with some cobbles and minor sand; grey. Well graded, subrounded. Sand, fine to medium.			M								
1.5																
2.0					Sand becomes fine to coarse at 1.8 m depth.											
Depth of Excavation: 2 m Termination Condition: Practical refusal																


GEOSCIENCE TEST PIT LOG. TEST PITS.GPJ. NZ MASTER DATA TEMPLATE.GDT. 24/2/17

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

LOG OF AUGER HA01

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd Shear Vane No :
Client Ref. : N/A Logged By : EG
Date : 24/02/17 Reviewed By : JW
Hole Depth : 0.2 m Latitude :
Hole Diameter : 50 mm Longitude :

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TOPSOIL	ML	SILT with minor gravel and trace rootlets; greyish brown. Low plasticity. Gravel, fine to medium, poorly graded, subrounded to subangular [TOPSOIL].				S H							
			End of Hole Depth: 0.2 m Termination Condition: Practical refusal											
0.5														
1.0														


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 HA02

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Client Ref. : N/A
Date : 24/02/17
Hole Depth : 0.2 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude :
Longitude :


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

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 HA03

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd Shear Vane No :
Client Ref. : N/A Logged By : EG
Date : 24/02/17 Reviewed By : JW
Hole Depth : 0.3 m Latitude :
Hole Diameter : 50 mm Longitude :

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


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

LOG OF AUGER HA04

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Client Ref. : N/A
Date : 24/02/17
Hole Depth : 0.2 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude :
Longitude :



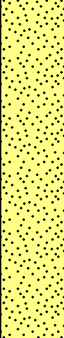
Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low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

Hand auger met practical refusal at 0.2 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
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd Shear Vane No : 2022
Client Ref. : N/A Logged By : EG
Date : 24/02/17 Reviewed By : JW
Hole Depth : 0.8 m Latitude :
Hole Diameter : 50 mm Longitude :

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TOPSOIL	ML	SILT with trace gravel, sand and rootlets; brown. Low plasticity [TOPSOIL].				S-Vst							
		ML	SILT with some sand; grey. Low plasticity. Sand, fine to medium. Poorly graded.			D	Vst							
0.5	ALLUVIUM	SP	Fine to medium SAND with minor silt; grey. Poorly graded.				MD-D	156/28						
			End of Hole Depth: 0.8 m Termination Condition: Practical refusal											
1.0														


Hand auger met practical refusal at 0.8 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.9 m depth.
Standing groundwater was not encountered

LOG OF AUGER HA06

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Client Ref. : N/A
Date : 24/02/17
Hole Depth : 0.3 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude :
Longitude :

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



Hand auger met practical refusal at 0.3 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.6 m depth.
Standing groundwater was not encountered

LOG OF AUGER HA07

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Client Ref. : N/A
Date : 24/02/17
Hole Depth : 0.4 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].				S-Vst							
	A	ML	SILT; grey. Low plasticity.				H							
0.5			End of Hole Depth: 0.4 m Termination Condition: Practical refusal											
1.0														


Hand auger met practical refusal at 0.4 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.5 m depth.
Standing groundwater was not encountered
A = ALLUVIUM

LOG OF AUGER HA08

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Client Ref. : N/A
Date : 24/02/17
Hole Depth : 0.3 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude :
Longitude :

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


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

LOG OF AUGER HA09

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Client Ref. : N/A
Date : 24/02/17
Hole Depth : 0.3 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude :
Longitude :

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			D	St-Vst							
0.5			End of Hole Depth: 0.3 m Termination Condition: Practical refusal					UTP						>>
1.0														


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 HA10

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd
Client Ref. : N/A
Date : 24/02/17
Hole Depth : 0.2 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG
Reviewed By : JW
Latitude :
Longitude :



Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
		ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity [TOPSOIL].				St-VSt							
			End of Hole Depth: 0.2 m Termination Condition: Practical refusal											
0.5														
1.0														

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 HA11

Geotechnical Investigation
527 Springston Rolleston Road
Rolleston
12903.000.000 - 012

Client : Hughes Development Ltd Shear Vane No :
Client Ref. : N/A Logged By : EG
Date : 24/02/17 Reviewed By : JW
Hole Depth : 0.4 m Latitude :
Hole Diameter : 50 mm Longitude :

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer					
									Blows per 100mm					
									2	4	6	8	10	12
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].				S-St							
	A	ML	SILT with minor sand; light brown. Low plasticity. Sand, fine, poorly graded.				H							
0.5			End of Hole Depth: 0.4 m Termination Condition: Practical refusal											
1.0														

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

APPENDIX 3:
ECan Borehole Logs

Borelog for well M36/0204

Grid Reference (NZTM): 1551407 mE, 5170991 mN

Location Accuracy: 50 - 300m

Ground Level Altitude: 39.4 m +MSD Accuracy: < 2.5 m

Driller: J W Horne (& Co)

Drill Method: Unknown

Borelog Depth: 27.4 m Drill Date: 01-Apr-1975



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		0.30m	Topsoil	SP
			Good clean Grey gravel	SP-RI
5				
		9.10m	Tight claybound Brown gravel	RI
10				
		11.90m		
		12.50m	Loose Brown gravel	RI
			Hard compact big Brown gravel	RI
		14.30m		
15			Loose small gravel	RI
		15.50m		
			Hard clean gravel	RI
		17.10m		
			Big rough hard Brown gravel	RI
20		20.10m		
			Loose Yellow claywash gravel	RI
25		25.60m		
		26.20m	Big stones	BR?
			Loose claywash gravel	BR?
		27.40m		

Borelog for well M36/1852

Grid Reference (NZTM): 1551207 mE, 5170791 mN
Location Accuracy: 50 - 300m
Ground Level Altitude: 39.2 m +MSD Accuracy: < 2.5 m
Driller: Smith, J R & I G
Drill Method: Cable Tool
Borelog Depth: 24.3 m Drill Date: 11-May-1981



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			Free Grey gravel and sand	SP-RI
5		4.80m	Free Grey gravel and sand	RI
		8.00m	Free Grey gravel and sand, some smooth round shingle	RI
10		11.00m	Smooth round shingle and fairly tight shingle and sand	RI
		14.20m	Fairly tight shingle and sand	RI
15		17.29m	Fairly tight shingle and sand	RI
		20.40m	Free shingle and sand	RI
20		24.29m		