Private Plan Change Request – Hughes Developments Limited
Appendix B – Geotechnical Investigations

ENGEO

Expect Excellence

Geotechnical Investigation

163 Halkett Road

West Melton

Submitted to:

Hughes Developments Ltd

Canterbury

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ACENZ

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ENGEO Document Control:

Report Title	Geotechnical Investigation - 163 Halkett Road, West Melton			
Project No.	14088.000.000	Doc ID	02	
Client	Hughes Developments Ltd	Client Contact	Kelvin Back	
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Date	Revision Details/Status	WP	Author	Reviewer
03/07/17	Final	BK	LF	GM

1 Introduction

ENGEO Ltd was requested by Hughes Developments Ltd to undertake a geotechnical investigation for the proposed subdivision at 163 Halkett Road, as outlined in our proposal (ref. P2016.000.248, dated 15 June 2017).

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 12 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. 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 an area of 8.317 ha and has a legal description of Lot 1 DP 34902 BLK XI Rolleston SD (Selwyn District Council). It is located to the north-eastern of West Melton with residential properties immediately to the west and rural lots to the east. The property spans between Halkett Road to the north and West Coast Road to the south (Figure 1).

Figure 1: Site Location Plan

Image sourced from Google Maps (July 2017), not to scale.

The site is currently used predominantly as pasture, with three utility sheds located near the central portion of the site. It is predominantly flat, with undulations representing old stream channels. Near the northern side of the site the broad undulations measure up to 2 m high, while near the southern side of the site these are typically 0.5 to 1 m high.

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 beach sand or river sand dunes.

3.2 ECan Boreholes

A review of three deep ECan borehole logs located to the north (M35/10753), west (M35/10751) and east (M35/9443 and M35/5159) of the site was conducted. The locations of these boreholes are presented in Figure 2. While borehole M35/1013 is located on site, there is no data for this borehole.

Figure 2: Nearby ECan Borehole Locations

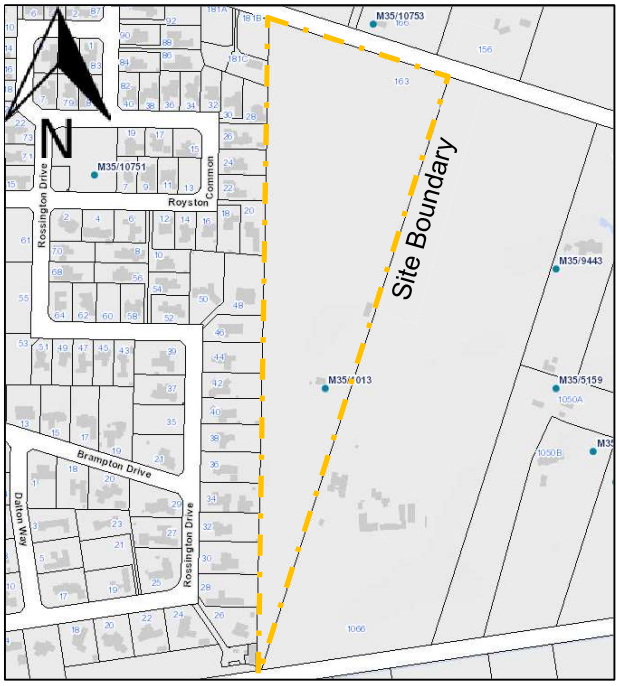

Image sourced from Canterbury Maps (retrieved June 2017).

The borehole logs indicate interbedded sandy gravel and claybound gravel from the surface through to the maximum depth of 78 m.

3.3 Groundwater

Groundwater is recorded within the ECan boreholes discussed above, at depths between 21 m and 24 m below ground level.

3.4 Geomorphology

As evident on aerial imagery (Canterbury Maps, 2016) and observed during our site walkover conducted on 28 June 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 and sand deposits with variable thickness (up to 0.8 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).

3.5 Geohazards

3.5.1 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 north of 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 6 km south 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).

3.5.2 Liquefaction and Lateral Spreading

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

4 Site Investigation

4.1 Subsurface Investigations

ENGEO undertook site investigations to assess the shallow subsurface material types and strength characteristics on 28 June 2017. The investigations comprised 11 hand auger boreholes with associated Scala Penetrometer tests, and 12 test pit excavations.

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

Table 1: Generalised Summary of Subsurface Conditions

Soil Type	Depth to Top of Layer (m)	Layer Thickness (m)	Consistency / Density	Comment
Silt [Topsoil]	0	0.2 to 0.5	Soft to Firm	-
Silt and Sand	0.2 to 0.5	0.1 to 0.5	Soft to Very Stiff / Loose to Medium Dense	No present in all layers
Gravel	0.2 to 0.8	>1.8	Medium Dense to Dense	-

"Good ground" (as defined in NZS 3604:2010) under static conditions was typically encountered below 0.6 m depth.

Test locations are shown on the site plan presented in Appendix 1. Hand auger borehole and test pit logs are presented in Appendices 2 and 3.

4.2 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'.

5 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.

6 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.
- 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.

7 Geotechnical Recommendations

7.1 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.

7.2 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.

7.3 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.

7.4 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.

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 200 kPa may be assumed for foundations bearing on natural soils or engineered fill, below any topsoil. We anticipate this to be typically below 0.2 m depth based on our subsurface investigations. Greater capacity may be available across many Lots and will be confirmed during building consent testing. Alternatively, a geotechnical Ultimate Bearing Capacity of 300 kPa may be assumed for bearing on the underlying gravels, typically encountered below 0.6 m depth.

8 References

Canterbury Earthquake Recovery Authority. My Property. Retrieved June 2017, from http://cera.govt.nz/my-property.

Canterbury Maps, Groundwater. Retrieved January 2017, from http://canterburymaps.govt.nz/Viewer.

Canterbury Maps, Historic Aerial Imagery. Retrieved June 2017, from https://apps.canterburymaps.govt.nz/CanterburyHistoricAerialImagery.

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GNS Science (2015). New Zealand Active Faults Database. Retrieved January 2017, 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 June 2017 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.

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 June 2017, from https://www.nzgd.org.nz.

9 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 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

Lauren Foote

Engineering Geologist

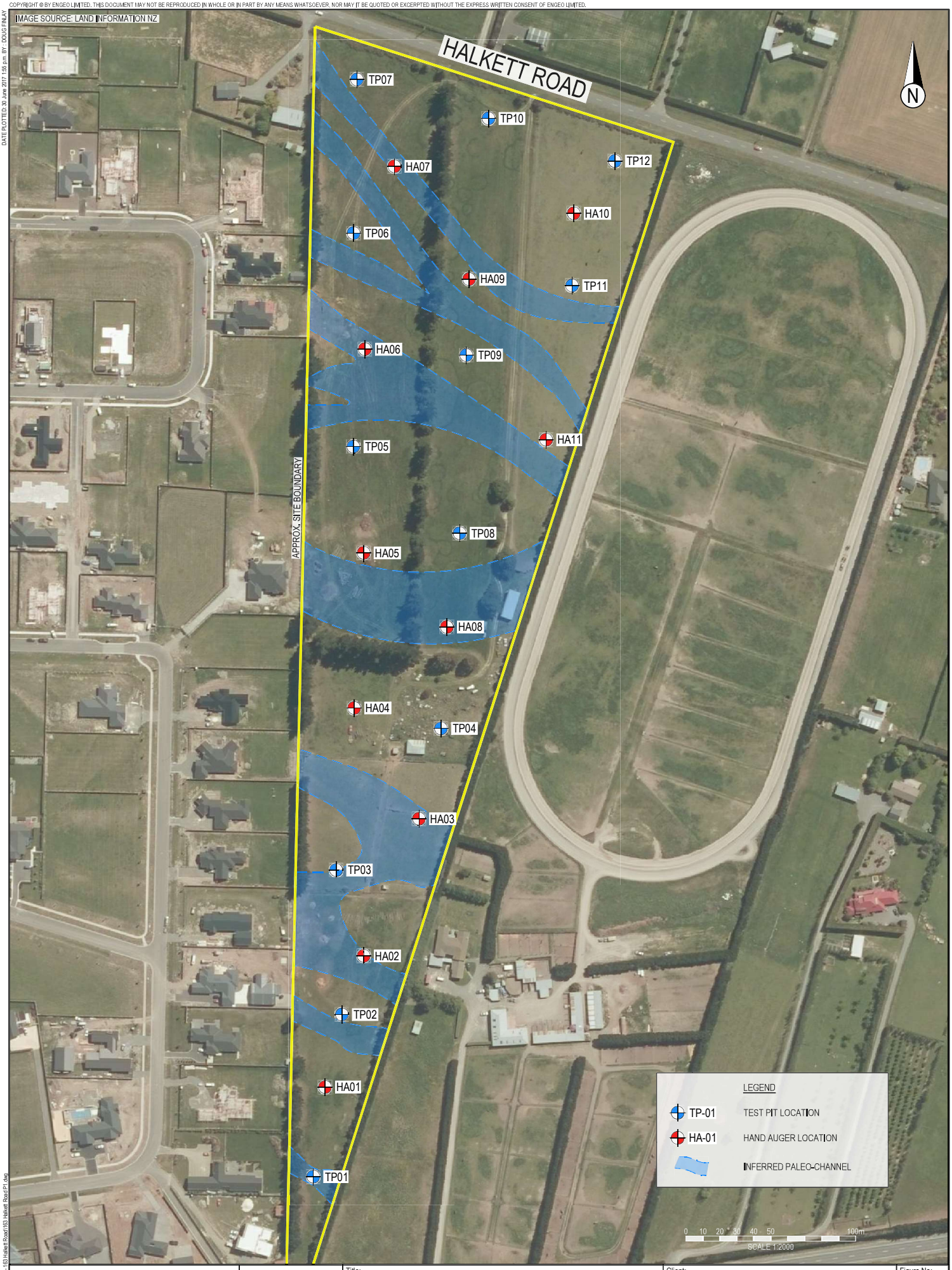
Report reviewed by

Greg Martin, PEngGeol

Principal Engineering Geologist

APPENDIX 1:

Site Location Plan



ENGEO
Expect Excellence

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

Title: TEST LOCATION PLAN

Client: HUGHES DEVELOPMENTS			Figure No: 1
Project: 163 Halkett Road, West Melton, Selwyn District	Designed: LF		
	Drawn: ADF		
	Checked: -		
	Date: 15.06.17		Size: A3
Proj No: 14088.000.000	Scale: 1:2000		Rev: 0

ORIGINAL FIGURE PRINTED IN COLOUR

APPENDIX 2:

Hand Auger Borehole Logs

LOG OF AUGER HA01

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.4 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG/RP
Reviewed By : LF
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
0	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			W	S		
	A	ML	SILT with trace sand; greyish brown. Low plasticity.				F		
			End of Hole Depth: 0.4 m Termination Condition: Practical refusal						

Scala Penetrometer: Blows per 100mm — 2, 4, 6, 8, 10, 12; >> at 0.4 m

Depth (m): 0.5, 1.0, 1.5, 2.0

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

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

LOG OF AUGER HA02

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.3 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG/RP
Reviewed By : LF
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
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			W	S	
	A	SP	Fine to medium SAND; grey. Poorly graded.				MD	
			End of Hole Depth: 0.3 m Termination Condition: Practical refusal					

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

0.5
1.0
1.5
2.0

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
A = ALLUVIUM

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

LOG OF AUGER HA03

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.2 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG/RP
Reviewed By : LF
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
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			W	S	
			End of Hole Depth: 0.2 m Termination Condition: Practical refusal					

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

0.5

1.0

1.5

2.0

Hand auger met practical refusal at 0.2 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.4 m depth.
Standing groundwater was not encountered

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

LOG OF AUGER HA04

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.5 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : RP/EG
Reviewed By : LF
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
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			M	S-F	
	A	ML	SILT with trace sand and gravel; greyish brown. Low plasticity.				F-St	
0.5			End of Hole Depth: 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 at 0.5 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.5 m depth.
Standing groundwater was not encountered
A = ALLUVIUM

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

LOG OF AUGER HA05

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.3 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : RP/EG
Reviewed By : LF
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
0.0	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			M	S-F		
			End of Hole Depth: 0.3 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 at 0.3 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.4 m depth.
Standing groundwater was not encountered

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

LOG OF AUGER HA06

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.3 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG/RP
Reviewed By : LF
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
	TS	ML	SILT with trace sand and rootlets; brown. [TOPSOIL].			W	S	
	A	ML	SILT with trace sand; brownish grey. Low plasticity.				S	
			End of Hole Depth: 0.3 m Termination Condition: Practical refusal					

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

0.5

1.0

1.5

2.0

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

TS = TOPSOIL
A = ALLUVIUM

LOG OF AUGER HA07

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.6 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : RP/EG
Reviewed By : LF
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
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. [TOPSOIL].				S-F	
	ALLUVIUM	ML	SILT with trace sand; brownish grey. Low plasticity.			M	S-St	
0.5		SP	Fine to medium SAND with trace gravel; brownish grey. Poorly graded.			W	L-MD	
			End of Hole Depth: 0.6 m Termination Condition: Practical refusal					

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

1.0

1.5

2.0

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

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

LOG OF AUGER HA08

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.4 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : RP/EG
Reviewed By : LF
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
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. [TOPSOIL].				S-F	
	ALLUVIUM	ML	SILT with trace sand; brownish grey. Low plasticity.			M	S-F	
0.5			End of Hole Depth: 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 at 0.4 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.5 m depth.
Standing groundwater was not encountered

LOG OF AUGER HA09

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.5 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : RP/EG
Reviewed By : LF
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
	TOPSOIL	ML	SILT with trace sand and rootlets; brown [TOPSOIL].				S-F	
	ALLUVIUM	ML	SILT with trace sand; brownish grey. Low plasticity.			M	S-St	
		SP	Fine to medium SAND with trace gravel; brownish grey. Poorly graded.				L-MD	
0.5			End of Hole Depth: 0.5 m Termination Condition: Practical refusal					

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand auger met practical refusal at 0.5 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.9 m depth.
Standing groundwater was not encountered

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

LOG OF AUGER HA10

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.5 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : RP/EG
Reviewed By : LF
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
	TS	ML	SILT with trace rootlets; brown. Low plasticity [TOPSOIL].				S	
	ALLUVIUM	ML	SILT with minor sand; brownish grey. Low plasticity. Sand, fine, poorly graded.			W	S	UTP
0.5			End of Hole Depth: 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 at 0.5 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.6 m depth.
Standing groundwater was not encountered

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

LOG OF AUGER HA11

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Client Ref. :
Date : 28/06/17
Hole Depth : 0.7 m
Hole Diameter : 50 mm

Shear Vane No :
Logged By : EG/RP
Reviewed By : LF
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
	TOPSOIL	ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].				S	
0.5	ALLUVIUM	SP	Fine to medium SAND with trace silt; brownish grey with orange mottles. Poorly graded. Sand becomes minor at 0.5 m depth.			W	L-MD	
			End of Hole Depth: 0.7 m Termination Condition: Practical refusal					

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

Hand auger met practical refusal at 0.7 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.7 m depth.
Standing groundwater was not encountered

GEOSCIENCE HAND AUGER HAND AUGERS.GPJ NZ DATA TEMPLATE 2.GDT 29/6/17

APPENDIX 3:

Test Pit Excavation Logs

LOG OF TEST PIT TP01

ENGEO Expect Excellence

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Date : 28/06/17
Max Test Pit Depth : 1.2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

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

Depth (m)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0.0	TOPSOIL		ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity [TOPSOIL].			M	S-F		
0.5	ALLUVIUM		GW	Fine to coarse GRAVEL with some cobbles and sand; brownish grey. Well graded, subrounded. Sand, fine to coarse, well graded.			W	MD-D		
1.0				Depth of Excavation: 1.2 m Termination Condition: Practical refusal						
1.5										
2.0										

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

Excavator met practical refusal due to cobbles.
Scala Penetrometer met practical refusal

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 29/6/17

LOG OF TEST PIT TP02

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd **Shear Vane No** :
Date : 28/06/17 **Logged By** : RP
Max Test Pit Depth : 2 m **Reviewed By** : LF
Digger Type/Size : Bucket Excavator **Latitude** :
Bucket Type/Size : **Longitude** :

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

Excavator met target depth at 2.0 m depth.
Scala Penetrometer met practical refusal

LOG OF TEST PIT TP03

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Date : 28/06/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

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

Depth (m)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TOPSOIL		ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity [TOPSOIL].				S-F		
0.5	ALLUVIUM		SP	Fine to medium SAND with trace silt and gravel; greyish brown. Poorly graded.				MD-D		
1.0			GW	Fine to coarse GRAVEL with some sand and trace cobbles; brownish grey. Well graded, subrounded. Sand, fine to coarse, well graded.			M	MD-D		
1.5				Some cobbles encountered from 1.4 m depth.						
2.0				Depth of Excavation: 2 m Termination Condition: Target depth						

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

Excavator met target depth at 2.0 m depth.
Scala Penetrometer met practical refusal

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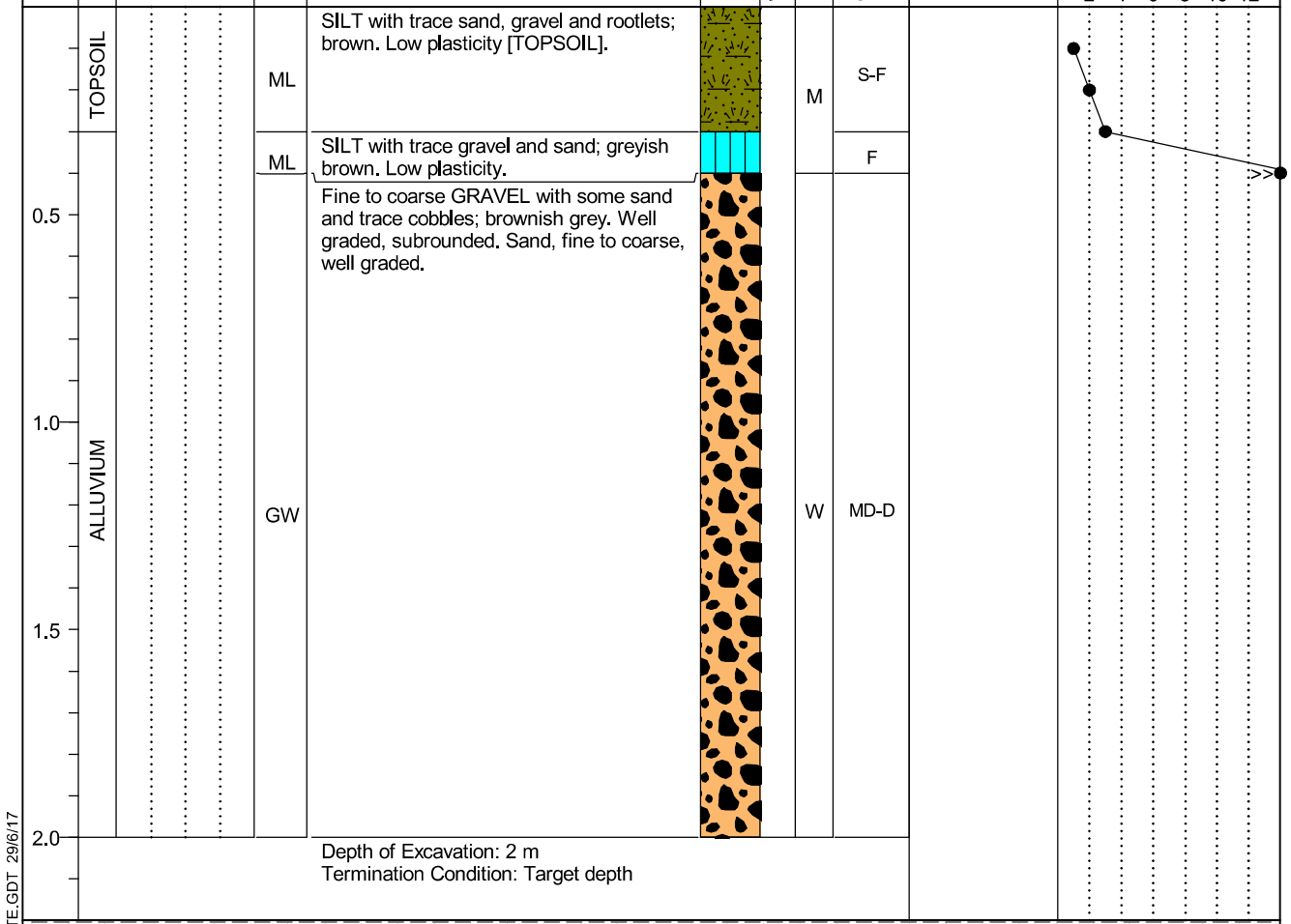
LOG OF TEST PIT TP04

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd **Shear Vane No** :
Date : 28/06/17 **Logged By** : RP
Max Test Pit Depth : 2 m **Reviewed By** : LF
Digger Type/Size : Bucket Excavator **Latitude** :
Bucket Type/Size : **Longitude** :



Excavator met target depth at 2.0 m depth.
Scala Penetrometer met practical refusal

LOG OF TEST PIT TP05

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Date : 28/06/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

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

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

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

Excavator met target depth at 2.0 m depth.
Scala Penetrometer met practical refusal

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LOG OF TEST PIT TP06

ENGEO — Expect Excellence

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Date : 28/06/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :
Shear Vane No :
Logged By : RP
Reviewed By : LF
Latitude :
Longitude :

Depth (m)	Material	Excavatability (Relative Scale) Easier – Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
0.0 – 0.3	TOPSOIL		ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			M	S-F		
0.3 – 0.8	ALLUVIUM		SM	Silty fine to medium SAND; greyish brown. Poorly graded.			M	MD		>>
0.8 – 2.0	ALLUVIUM		GW	Fine to coarse GRAVEL with some sand, trace cobbles and silt; brownish grey. Well graded, subrounded. Sand, fine to coarse, well graded. Some cobbles encountered from 1.5 m depth.			W	MD-D		

Depth of Excavation: 2 m
Termination Condition: Target depth

Excavator met target depth at 2.0 m depth.
Scala Penetrometer met practical refusal

LOG OF TEST PIT TP07

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Date : 28/06/17
Max Test Pit Depth : 1.5 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

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

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

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

Excavator met practical refusal at 1.5 m depth due to cobbles.
Scala Penetrometer met practical refusal

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 29/6/17

LOG OF TEST PIT TP08

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd **Shear Vane No** :
Date : 28/06/17 **Logged By** : RP
Max Test Pit Depth : 2 m **Reviewed By** : LF
Digger Type/Size : Bucket Excavator **Latitude** :
Bucket Type/Size : **Longitude** :

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

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

Excavator met target depth at 2.0 m depth.
Scala Penetrometer met practical refusal

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 29/6/17

LOG OF TEST PIT TP09

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd **Shear Vane No** :
Date : 28/06/17 **Logged By** : RP
Max Test Pit Depth : 2 m **Reviewed By** : LF
Digger Type/Size : Bucket Excavator **Latitude** :
Bucket Type/Size : **Longitude** :

Depth (m)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TOPSOIL		ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].				S-F		
			GW	Fine to coarse GRAVEL with some sand, minor cobbles, trace silt and organics; brownish grey. Well graded, subrounded. Sand, fine to coarse, well graded.				MD		
0.5	ALLUVIUM			Fine to coarse GRAVEL with some sand and minor cobbles; brownish grey. Well graded, subrounded. Sand, fine to coarse, well graded.						
1.0							W			
			GW					MD-D		
1.5				Some cobbles encountered from 1.3 m depth.						
2.0				Depth of Excavation: 2 m Termination Condition: Target depth						

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

Excavator met target depth at 2.0 m depth.
Scala Penetrometer met practical refusal

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 29/6/17

LOG OF TEST PIT TP10

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Date : 28/06/17
Max Test Pit Depth : 2 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

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

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

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

Excavator met target depth at 2.0 m depth.
Scala Penetrometer met practical refusal

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 29/6/17

LOG OF TEST PIT TP11

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd **Shear Vane No** :
Date : 28/06/17 **Logged By** : RP
Max Test Pit Depth : 1.6 m **Reviewed By** : LF
Digger Type/Size : Bucket Excavator **Latitude** :
Bucket Type/Size : **Longitude** :

Depth (m)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TOPSOIL		ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			M	S-F		2 4 6 8 10 12
			ML	SILT with trace gravel and sand; greyish brown. Low plasticity.				S-F		
0.5	ALLUVIUM		GW	Fine to coarse GRAVEL with some sand and cobbles; brownish grey. Well graded, subrounded. Sand, fine to coarse.			W	MD-D		
1.0										
1.5				Depth of Excavation: 1.6 m Termination Condition: Practical refusal						
2.0										

Excavator met practical refusal at 1.6 m depth due to cobbles.
Scala Penetrometer met practical refusal

GEOSCIENCE TEST PIT LOG TEST PITS.GPJ NZ MASTER DATA TEMPLATE.GDT 29/6/17

LOG OF TEST PIT TP12

Geotechnical Investigation
163 Halkett Road
West Melton
14088

Client : Hughes Developments Ltd
Date : 28/06/17
Max Test Pit Depth : 1.4 m
Digger Type/Size : Bucket Excavator
Bucket Type/Size :

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

Depth (m)	Material	Excavatability (Relative Scale) Easier–Harder	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
0	TOPSOIL		ML	SILT with trace sand and rootlets; brown. Low plasticity [TOPSOIL].			M	S-F		
			ML	SILT with trace gravel and sand; greyish brown. Low plasticity.				S-F		
0.5	ALLUVIUM		GW	Fine to coarse GRAVEL with some sand and cobbles; brownish grey. Well graded, subrounded. Sand, fine to coarse.			W	MD-D		
1.0										
1.5				Depth of Excavation: 1.4 m Termination Condition: Practical refusal						
2.0										

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

Excavator met practical refusal at 1.4 m depth due to cobbles.
Scala Penetrometer met practical refusal