GROUND TECHNOLOGIES

Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
55 Fifteenth Avenue West Hoxton NSW 2171
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200 Fax: (02) 8783 8210
Email: lab@groundtech.com.au

GTE851 – Geotechnical Report
23 June 2016

Client: **CABE**

Attention: Scott Diamond
Email: scottd@cabe.com.au

Dear Sir,

RE: GEOTECHNICAL INVESTIGATION **at No. 344 High Street, Penrith, NSW.**

This letter presents a report on the inspection and testing services associated with the geotechnical investigation at the above mentioned location.

Should you have any questions related to this report please do not hesitate to contact the undersigned.

For and on behalf of
Ground Technologies Pty Ltd

Reviewed By

[redacted]

J. Harendran
Geotechnical Engineer

[redacted]

A. Bennett
Senior Geotechnical Engineer

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

Table of Contents

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

1. INTRODUCTION

Ground Technologies Pty Ltd (Ground Tech) has prepared this report to discuss the results of the geotechnical investigation for the proposed development at No. 344 High Street, Penrith, NSW (herein referred to as the "site"). Ground Tech was engaged to provide professional assistance for this component of the project.

The geotechnical investigation included drilling two boreholes using our 4WD Toyota Landcruiser Drill Rig and two DCP tests at locations shown on drawing Figure 1 in Appendix A. This report provides a geotechnical assessment on the existing soil and rock conditions.

This report is based only on the information provided at the time of this report preparation and may not be valid if changes are made to the site or to the construction method.

2. SITE DETAILS

The following information, presented in Table 1, describes the site.

Table 1: Summary of Site Details

Site Address	344 High Street, Penrith
Lot / DP	SP65435
Council Area	Penrith City Council

2.1 Geology

The 1:100,000 scale Geological Series Map of the Penrith region indicates that the subject site is underlain by Ashfield Shale of the Wianamatta Group dating back to the Middle Triassic period and generally comprise *Claystone / Siltstone and fine Sandstone / Siltstone laminite*. The site is mapped as adjacent to a boundary with a zone underlain by alluvial gravels, silts and sands of the Cranebrook formation

2.2 Site Description

The subject site is located on the southern side of High Street in Penrith, it is of an irregular shape comprising two rectangular blocks joined at alternate corners by a narrow strip. A small lane way extends through the center of the site, separating the northern and southern blocks. The northern block is about 20m wide by 40m in length and comprises two small two storey commercial buildings, rear car park with car port. The southern block is about 24m wide by 50m in length, containing a concrete paved car park, car ports and storage shed.

The site is bounded to the north by High Street, to the east by light commercial properties, and to the west and south by a church and associated school or light commercial properties.

Gradients within the site dip at about 2° to 5° towards the south or south-west.

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

3. GEOTECHNICAL INVESTIGATION

Fieldwork was undertaken on 26th of May 2016 and included drilling one two boreholes using our 4WD Toyota Landcruiser Drill Rig and two DCP tests at the locations shown in Figure 1 (Appendix A). All test sites were located in the vicinity of the proposed development. BH1 and BH2 terminated at depths of 9.5m and 8.2m, respectively.

Geotechnical Borehole logs are presented in Appendix B.

3.1 Sub Surface Profile

The generalised geotechnical model based on test hole data is presented in the table below.

Table 2: Summary Geotechnical Model

UNIT	SOIL TYPE	Borehole Intercept Depth (m)	
		BH1	BH2
Unit A	FILL; Pavement underlain by Admixed Sandy Clay, medium plasticity, with fine gravel, brown.	0.0-0.9	0.0-0.8
Unit B	ALLUVIUM; Sandy GRAVEL, fine grained, yellow-brown, with silt.	0.9-1.2	-
Unit C	ALLUVIUM; Silty CLAY, medium plasticity, yellow-brown, pale red-brown, red-brown, very moist, firm.	1.2-3.5 6.5-8.8	-
Unit D	ALLUVIUM; Silty CLAY, medium plasticity, yellow-brown, pale red-brown, red-brown, slightly moist, Stiff to Very Stiff.	3.5-6.5	0.8-7.0
Unit E	SHALE, extremely to highly weathered, grey, dark brown-grey, extremely low to very low strength.	8.8-9.5	7.0-8.2
Unit F	SHALE, inferred moderately to slightly weathered, medium strength. Material inferred at TC bit refusal point.	9.5+	8.2+

The borehole data indicates a geotechnical model for the site comprising:

1. Fill, within the upper 0.9m. As no compaction control certification is available, this is considered Uncontrolled Fill.
2. Soft soils in the form of Alluvial Clayey (Unit C) was observed as having a relatively high moisture content and low strength soil to a depth of 8.8m. This material was encountered within the north-western or western part of the site.
3. Alluvial Clayey soil (Unit D) observed as being relatively low moisture, moderate strength soil mass was observed within the eastern or south-eastern part of the site.
4. The depth to bedrock drops from east to west, from 7.0m in BH2 to 8.8m in BH1. This is consistent with rock levels dropping towards the Penrith alluvial valley, which lies to the west of the site.

3.2 Sub Surface Profile

Groundwater was observed at 8m depth on borehole 1, groundwater was not observed in borehole 2.

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

4. RECOMMENDATIONS

4.1 Proposed Development

It is understood the proposed development comprises the demolition of existing structures and the construction of a six storey apartment building with a basement level car park. It is further understood that excavations of up to 3.0-4.0m depth will be required for the basement excavation.

Figure 1 – Eastern Section

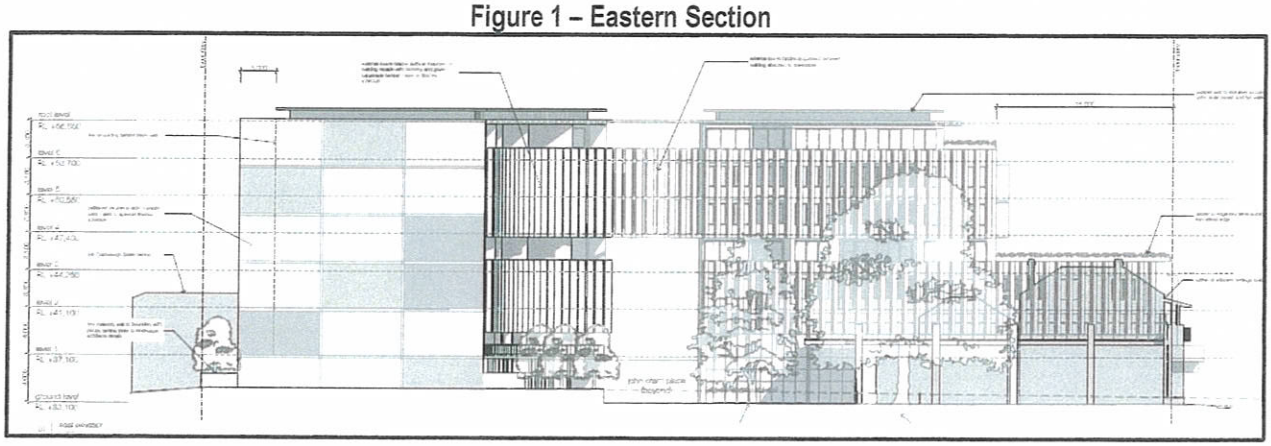
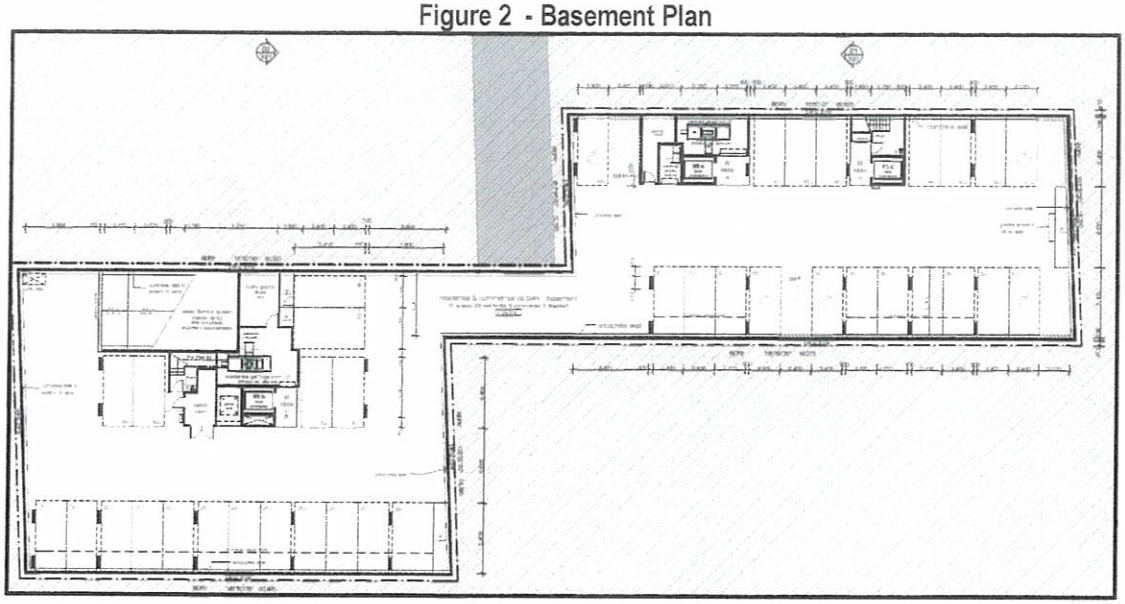


Figure 2 - Basement Plan



Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

4.2 Temporary Shoring

The close proximity to site boundaries for the proposed excavation may preclude the use of temporary batters at this site. Where batters are not suitable, temporary shoring is recommended. Temporary shoring could also be incorporated into the permanent foundation of the structure, thereby reducing costs.

There are a number of temporary shoring methods available, however the most suitable for the scale of this project, would be soldier piles with shotcrete or similar infill panels. The founding depth of the piles for the retaining structure should be calculated to have sufficient socket depth to resist overturning and potential vertical loads.

Prior to the excavation works, it is recommended that dilapidation surveys be undertaken out on the surrounding properties as a means of protecting all parties involved in or affected by the proposed works.

To facilitate the site earthworks and construction it would be prudent to install a temporary catch drain above the proposed excavation to divert surface run-off away from the building area during construction.

4.3 Excavation Support and Retaining Walls

For the design of flexible retaining structures, where some lateral movement is acceptable, an active earth pressure co-efficient (ka) is recommended. If it is critical to limit the horizontal deformation of a retaining structure, such as adjacent to a heritage structure, use of an earth pressure co-efficient at rest (ko) should be considered. Recommended parameters for the design of retaining structures are presented in table 3.

Table 3: Soil/Rock Parameters

Soil Type	Unit	Earth Pressure Coefficients			Bulk Density
		Active (Ka)	At Rest (Ko)	Passive (Kp)	
Natural Silty CLAY soils and FILL	Units A to D	0.33	0.5	3.0	19 kN/m^3
Low to medium strength SHALE	Units E and F	0.22	0.36	100 kPa *	21 kN/m^3

** Rectangular Horizontal Earth Pressure (kPa)*

The retaining wall designs should also allow for any additional surcharge loads, which should be calculated separately. Appropriate drainage systems and free draining backfill should be provided to prevent the build-up of hydrostatic pressures behind all retaining walls except in the case of the shoring piles, which should be designed for a full hydrostatic pressure.

Due to the presence of soft soils, shotcrete lifts should be placed at 1.5m intervals. In addition, we recommend that excavations remain without shotcrete infill for a maximum of 20 days, in order that drying and development of associated shrinkage cracks within the clay profile do not de-stabilise the cut faces between the bored piers.

Due to the presence of soft soils, consideration should be given to placing piles in a closely spaced (non-contiguous) pattern adjacent to heritage structures.

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

4.4 Footing Design Parameters

Piled foundations may be designed in accordance with parameters provided in Table 4 below.

Table 4: Footing Design Parameters

Material	Allowable End Bearing Capacity	Shaft Adhesion
SHALE, extremely to highly weathered, extremely low to low strength (Unit E)	800 kPa	100 kPa
SHALE, moderately to slightly weathered, medium strength (Unit F)	1000* kPa	150* kPa

* Inferred from auger refusal point. Should higher strength design parameters be required for design, a more detailed investigation with NMCL diamond drilling techniques would be required.

The quality of the founding stratum in all footing excavations is to be assessed by a structural or geotechnical engineer to confirm that the design parameters recommended in this report are appropriate. Footing excavations are to be cleaned, to be free of loose debris and wet soil prior to concrete placement. Concrete is to be placed within 24 hours of excavation, since the weathered bedrock may deteriorate rapidly upon exposure.

Due to the presence of soft soils (Unit C) within the site, it is recommended that all internal columns be supported on bored piers down to bedrock

4.5 Excavations

It is understood that formation of the basement is expected to entail excavations in the order of 3m deep below existing ground surface levels. We expect overburden soils comprising fill and natural clays to be readily excavated by conventional earthworks equipment such as excavators.

Trafficability problems may arise locally during wet weather, or if water is allowed to pond on the exposed materials. As no seepage or groundwater was encountered in the boreholes during drilling to depths below the intended bulk excavation level, we do not anticipate significant groundwater inflow into the proposed excavation. It should be noted however, that groundwater conditions of a site might change with climatic and development variations. It is our assessment that groundwater inflow during excavation, if any, may be adequately handled by a conventional sump and pump system.

4.6 Internal Floor Slabs / Pavements

Excavations for the basement level of the development will extend to approximately 3.0m to 4.0m below existing ground surface levels. Material exposed at the base of this excavation will most likely comprise a stiff to very stiff silt clay material (Unit D). The proposed floor slab can be constructed at bulk excavation level designed on a Sub-grade Reaction Modulus (k) of 30 kPa/mm or CBR of 3%.

It should be noted that the soft soils (Unit C) may be exposed at bulk excavation levels. This material will require over excavation and replacement prior to the placement of basement level slabs.

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

5. CONDITIONS OF THE RECOMMENDATIONS

The advice given in this report is based on the assumption that the test results are representative of the overall subsurface conditions. However, it should be noted that actual conditions in some parts of the building site may differ from those found in the test holes. If excavations reveal subsurface conditions significantly different from those shown in our attached Soil/Rock Log(s), Ground Tech must be consulted and excavations stopped immediately.

The foundation depths quoted in this report are measured from the surface during our testing and may vary accordingly if any filling or excavation works are carried out. The description of the foundation material for has been provided for its easy recognition over the whole building site.

Any sketches in this report should be considered as only an approximate pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions or slope information should not be used for any building cost calculations and/or positioning of the building. Dimensions on logs are correct.

6. LIMITATIONS

This type of investigation (as per our commission) is not designed or capable of locating all ground conditions, (which can vary even over short distances). The advice given in this report is based on the assumption that the test results are representative of the overall ground conditions. However, it should be noted that actual conditions in some parts of the site might differ from those found. If further sampling reveals ground conditions significantly different from those shown in our findings, Ground Tech must be consulted.

The scope and the period of Ground Tech services are described in the report and are subject to restrictions and limitations. Ground Tech did not perform a complete assessment of all possible conditions or circumstances that may exist at the Site. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Ground Tech in regards to it.

Where data has been supplied by the client or a third party, it is assumed that the information is correct unless otherwise stated. No responsibility is accepted by Ground Tech for incomplete or inaccurate data supplied by others.

Any drawings or figures presented in this report should be considered only as pictorial evidence of our work. Therefore, unless otherwise stated, any dimensions should not be used for accurate calculations or dimensioning.

This document is COPYRIGHT- all rights reserved. No part of this document may be reproduced or copied in any form or by means without written permission by Ground Technologies Pty Ltd. All other property in this submission shall not pass until all fees for preparation have been settled. This submission is for the use only of the party to whom it is addressed and for no other purpose. No responsibility is accepted to any third party who may use or rely on the whole or any part of the content of this submission. No responsibility will be taken for this report if it is altered in any way, or not reproduced in full. This document remains the property of Ground Technologies Pty Ltd until all fees and monies have been paid in full.

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

APPENDIX A

Figures

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

GROUND TECHNOLOGIES
Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200

DATA SHOWN IS APPROXIMATE & INTENDED TO ILLUSTRATE TEST LOCATIONS, SUBJECT TO DETAILED SURVEY.
COPYRIGHT OF BASEMAP REMAINS WITH WWW.MAPS.SIX.NSW.GOV.AU

SCALE:	NTS
PLOT SIZE	A4

PROJECT:	GTE815
TITLE:	TEST LOCATIONS
FIGURE No:	1
REV:	A
DATE:	14/6/2016
DRAWN:	JH
CHECKED:	AB

APPENDIX B

Borehole Logs

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

APPENDIX C

Dynamic Cone Penetrometer Test Data

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

GROUND TECHNOLOGIES
Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
55 Fifteenth Avenue West Hoxton 2171
PO Box 1121 Green Valley NSW 2168

Determination of the Penetration Resistance of Soil

Using a Dynamic Cone Penetrometer

Test No:	BH2	DCP2					
Location:							
Start Level:	Existing ground surface						
Depth (m)	Number of Blows per 100mm						
0 – 0.1	-	-					
0.1 – 0.2	-	-					
0.2 – 0.3	2	2					
0.3 – 0.4	2	2					
0.4 – 0.5	3	2					
0.5 – 0.6	3	2					
0.6 – 0.7	2	2					
0.7 – 0.8	3	3					
0.8 – 0.9	8	5					
0.9 – 1.0	9	3					
1.0 – 1.1	4	4					
1.1 – 1.2	11	5					
1.2 – 1.3	23	4					
1.3 – 1.4	30+ PR	4					
1.4 – 1.5		5					
1.5 – 1.6		9					
1.6 – 1.7		14					
1.7 – 1.8		14					
1.8 – 1.9		15					
1.9 – 2.0		25+ PR					
2.0 – 2.1							
2.1 – 2.2							
2.2 – 2.3							
2.3 – 2.4							
2.4 – 2.5							

PR: Practical refusal, HR: Hard refusal

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

GROUND TECHNOLOGIES

BOREHOLE ENGINEERING LOG

Test Site / BH No.: **BH1**

Project: No.: GTE851
Location: 344 High Street, Penrith

Date of Drilling: 26/05/2016
Logged by: JH/SM

Method: 4WD Mounted rig, solid flight spiral augers
Sheet 1 of 2

Surface RL:
Co-ords:

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	0	-	ASPHALTIC CONCRETE	-	-			PAVEMENT
			Admixed Sandy Clay, medium plasticity, with fine gravel, brown.	W >>Wp			S1	FILL
	0.5							
	1	GP-GM	Sandy GRAVEL, fine grained, yellow-brown, with silt.	W	MD			ALLUVIUM
		CH	Silty CLAY, medium plasticity, yellow-brown, pale red-brown.	VM >Wp	F		S2	
	1.5						S5	
	2		As above, pale grey, red, yellow, with fine ironstone gravel, subrounded.					P.P. 100 kPa
	2.5							
	3							
	3.5			SM <Wp	VSt			PP. 250 kPa
	4							
	4.5							
	5							
	5.5		Silty CLAY, medium to high plasticity, red-brown, red, with fine ironstone gravel.		St - VSt			PP. 200 kPa
	6							

Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD ,Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H
Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

GROUND TECHNOLOGIES

BOREHOLE ENGINEERING LOG

Test Site / BH No.: **BH1**

Project: No.: GTE851
Location: 344 High Street, Penrith

Date of Drilling: 26/05/2016
Logged by: JH/SM

Method: 4WD Mounted rig, solid flight spiral augers
Sheet 2 of 2

Surface RL:
Co-ords:

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
			Admixed Sandy Clay, medium plasticity, with fine gravel,					
	6.5	CL-CH	Interbedded Silty CLAY / Clayey SILT, medium plasticity, pale brown, yellow-brown.	VM-W >>Wp	F			
	7							
	7.5							
▽	8							
	8.5							
	9	ROCK	SHALE, extremely to highly weathered, grey, dark brown-grey, extremely low to very low strength.					BEDROCK
	9.5		Borehole terminated at 9.5m					TC bit refusal on SHALE, inferred medium strength.
	10							
	10.5							
	11							
	11.5							
	12							

Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD ,Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H
Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

GROUND TECHNOLOGIES

BOREHOLE ENGINEERING LOG

Test Site / BH No.: **BH2**

Project: No.: GTE851
Location: 344 High Street, Penrith

Date of Drilling: 26/05/2016
Logged by: JH/SM

Method: 4WD Mounted rig, solid flight spiral augers
Surface RL:
Sheet 1 of 2
Co-ords:

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
NIL	0	-	CONCRETE, with reinforcement.	-	-			PAVEMENT
			Admixed Sandy Clay, medium plasticity, with fine gravel, glass fragments, brown.	M >Wp				FILL
	0.5						S3	
			Silty CLAY, medium to high plasticity, red and pale grey, with fine grained iron stone gravel.	SM <Wp	F-St			ALLUVIUM PP. 100 kPA
	1						S4	
							S5	
	1.5		As above, mainly pale grey, with some red.		St			PP. 200 kPa
	2							
	2.5				VSt			PP. 320 kPa
	3							
	3.5		As above, layers of pale grey, pale brown and red.					
	4							
	4.5							
	5							
	5.5							
	6							

Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD ,Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H
Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021

GROUND TECHNOLOGIES

BOREHOLE ENGINEERING LOG

Test Site / BH No.: **BH2**

Project: No.: GTE851
Location: 344 High Street, Penrith

Date of Drilling: 26/05/2016
Logged by: JH/SM

Method: 4WD Mounted rig, solid flight spiral augers
Sheet 2 of 2

Surface RL:
Co-ords:

WATER	DEPTH (m)	USCS	SOIL/ROCK DESCRIPTION	MOISTURE	DENSITY / CONSISTENCY	GRAPHIC LOG	SAMPLES	REMARKS
	6.5		Admixed Sandy Clay, medium plasticity, with fine gravel,					
	7	ROCK	SHALE, extremely to highly weathered, grey, dark brown-grey, extremely low to very low strength.					BEDROCK
	7.5							
	8							
	8.5		Borehole terminated at 9.5m					TC bit refusal on SHALE, inferred medium strength.
	9							
	9.5							
	10							
	10.5							
	11							
	11.5							
	12							

Explanatory Notes

Density / Consistency: Very Loose: VL, Loose: L, Medium Dense: MD, Dense: D, Very Dense: VD ,Very Soft: VS, Soft: S, Firm: F, Stiff: St, Very Stiff: VSt, Hard: H
Moisture Condition: Dry: D, Slightly Moist: SM, Moist: M, Very Moist: VM, Wet: W. For Cohesive Soils moisture is related to Atterberg limits: Plastic limit: Wp, Liquid Limit: Wl

Document Set ID: 9858781
Version: 1, Version Date: 17/12/2021