Attachment C13

Proponent Geotechnical Report

Appendix K – Geotechnical investigation

Goodman Limited

BURROWS INDUSTRIAL ESTATE
GEOTECHNICAL INVESTIGATION

PSM2808-005R REV1 MAY 2019

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1 INTRODUCTION

This report presents the results of the geotechnical investigation undertaken by Pells Sullivan Meynink (PSM) for the proposed Burrows Industrial Estate Warehouse Development at 1 – 3 Burrows Road, Alexandria.

The work was undertaken in accordance with our proposal letter PSM2808-001L dated 20 July 2015 and PSM2808-006L dated 18 March 2019.

This report has been revised to include the results of the site investigation on the following dates:

1. 13 August 2015
2. Between 23 April and 24 April 2019

The aim of the geotechnical investigations was to assess the subsurface conditions and to provide geotechnical design advice and recommendations for the current proposed redevelopment.

2 PROPOSED REDEVELOPMENT

We were provided with the following documents:

- 117708001-00 – Survey Drawings
- 18119 SK23-27 – Architectural Drawings

Based on your email and drawings, we understand the following:

- The site area is 35,895m^2
- The current proposed redevelopment will comprise demolition of some of the existing buildings and pavements and construction of a three-storey warehouse with a basement level expected to have a clearance height of 4.2 m.
- The proposed basement FFL is at RL 1.0 m.

3 GEOTECHNICAL INVESTIGATION

3.1 Fieldwork – 13 August 2015

Fieldwork was undertaken on 13 August 2015 and comprised:

- 6 x Cone Penetrometer Tests (CPT 1 to CPT 6)
- 3 x Bulk samples (CBR1 to CBR 3)

The CPTs were carried out using a 15.5 tonne truck mounted testing rig. The CPTs were undertaken to a refusal depth between 12 and 14 m. CPT results and interpreted profiles are presented in Appendix A.

Prior to testing, on-site service location "scans" were undertaken by a service locator in the presence of a PSM geotechnical engineer to ensure the test locations were free from buried utilities. Coring through pavement was undertaken to allow the CPT cone to test the underlying material and also to recover bulk samples for testing.

The testing and sampling locations are shown in Figure 1. Testing and sampling locations were located with a GPS with the accuracy of +5 m.

3.2 Geotechnical Laboratory Testing (August 2015)

Three (3) bulk samples (CBR 1, CBR 2 & CBR 3) recovered during the fieldwork using hand-auger were sent to a NATA registered geotechnical testing laboratory for California bearing ratio (CBR) testing. The test result sheets are attached in Appendix B and the results are tabulated in Table 1 below.

TABLE 1
CBR TESTING RESULT SUMMARY

CBR SAMPLE ID	SAMPLE DEPTH (m)	MATERIAL DESCRIPTION	FIELD MOISTURE CONTENT (%)	STANDARD MAXIMUM DRY DENSITY (t/m^3)	OPTIMUM MOISTURE CONTENT (%)	4 DAY – SOAKED CBR (%)
CBR 1	0.2 – ~0.5	Clayey SAND	25.5	1.63	20.1	15
CBR 2	0.2 – ~0.5	Clayey SAND	30.8	1.26	31.0	10
CBR 3	0.2 – ~0.5	Clayey SAND	17.3	1.69	17.5	50

3.3 Fieldwork – 23 to 24 April 2019

Fieldwork was undertaken on 23 to 24 April 2019 and comprised:

- 3 x Cored boreholes (BH01 to BH03)

The boreholes were drilled using a track mounted rig. All boreholes employed rotary auger drilling in soil, with NMLC coring used to recover bedrock. The boreholes were drilled to a depth of 15 m and piezometer were installed in each of the boreholes. Point load index testing has been undertaken on the recovered rock cores at approximately 1 m intervals. Boreholes logs are presented in Appendix C and point load index testing results are presented in Appendix D.

The testing and sampling locations are shown in Figure 1.

3.3.1 Standpipe piezometers

Three standpipe piezometers were installed at the borehole locations. Appendix E presents the construction records of the piezometers. A water level logger was installed in each piezometer to record water level eg. every hour (automatic data collection). This allows us to assess the effect of rainfall on the groundwater, etc.

4 SITE CONDITIONS

4.1 Geological Setting

The 1:100,000 Sydney Geological map indicates that the site is underlain by Quaternary alluvium being peat, sandy peat and mud.

4.2 Surface Conditions

The site is currently occupied by single storey warehouses and up to two storey offices. The north west of the site is paved with asphalt overlying a concrete slab and the north east of the site is covered with a concrete slab. The pavement is up to 300 mm thick.

4.3 Subsurface Conditions

The subsurface conditions encountered by the CPTs are summarised in Table 2 and Table 3.

TABLE 2
SUMMARY OF SUBSURFACE UNITS ENCOUNTERED AT CPT LOCATIONS

UNIT NAME	APPROXIMATE DEPTH TO THE TOP OF UNIT (m)	DESCRIPTION
PAVEMENT	0.0	Pavement comprises asphalt and concrete slab or concrete slab only.
FILL	0.2 to 0.3	Gravelly SAND to Clayey SAND. Density index ranges from medium dense to very dense.
UPPER SAND	1.0 to 3.0	Silty SAND. Density index ranges from loose to dense.
UPPER CLAY	2.8 to 5.2	CLAY to Silty CLAY. Soft to firm clay.

UNIT NAME	APPROXIMATE DEPTH TO THE TOP OF UNIT (m)	DESCRIPTION
LOWER SAND	4.0 to 8.7	SAND to Silty Sand. Density index ranges from dense to very dense. Grey, fine to medium grained.
LOWER CLAY	7.9 to 10.7	CLAY to Silty Clay. Consistency stiff to very stiff. Pale grey mottled brown and red to mottled dark grey and brown. High Plasticity.
BEDROCK A	10.4 to 13.5	SHALE: Dark grey with some brown stains to black, inferred to be very low strength. Extremely weathered to moderately weathered. Inferred from CPT refusal.
BEDROCK B		SHALE: Dark grey to black, inferred to be low to medium strength. Slightly weathered to Fresh.

TABLE 3
ASSESSED LEVELS OF GEOTECHNICAL UNITS AT CPT AND BH LOCATIONS

UNIT NAME	APPROXIMATE REDUCED LEVEL OF TOP OF UNIT (m AHD)								
	CPT 1	CPT 2	CPT 3	CPT 4	CPT 5	CPT6	BH01	BH02	BH03
CONCRETE PAVEMENT (COLLAR RL)	2.8	2.3	3.75	2.9	3.5	3.45	2.05	2.3	3.5
FILL	2.6	2.1	3.55	2.7	3.2	3.25	1.75	2.1	3.25
UPPER SAND	1.2	1.3	2.25	-0.1	0.5	1.45	-2.35	-1.7	-1
UPPER CLAY	-0.2	-0.5	-0.25	-1.6	-1.2	-1.75	NE	NE	NE
LOWER SAND	-3	-3.9	-2.25	-4.7	-4	-5.25	NE	NE	NE
LOWER CLAY	-5.1	-8.4	-5.85	-6.1	-6.7	-5.95	-5.95	-6.5	-5.5
BEDROCK A	-9.2	-10.1	-9.05	-11	-9.8	-10.65	-8.35	-10.9	-8
BEDROCK B	NE	NE	NE	NE	NE	NE	-9.75	NE	-9.3
END OF HOLE	-9.2	-10.1	-9.05	-11	-9.8	-10.65	-12.97	-12.88	-11.5

Note: NE – Not Encountered

The collar levels were estimated from the survey plan provided to PSM.

4.4 Groundwater

Groundwater was encountered during drilling / augering between 0.6 and 1.8 m below the surface; (i.e. between RL 1.4 m and 1.7). We note that these levels were higher than those recorded in the water loggers below.
A PSM geotechnical engineer visited the site on 8 May 2019 to download the water level data from the loggers. The monitoring data from the piezometer is presented in Figure 4 to Figure 6. The data is consistent with dip measurement undertaken manually using a measuring tape.

PSM will be undertaking ongoing groundwater monitoring.

5 DISCUSSION AND RECOMMENDATIONS

5.1 General

The design advice provided in the following sections has been prepared on the following basis:

- No major earthworks will be undertaken on the site. The current subgrade levels will be maintained for the redevelopment.
- The subgrade and any minor earthworks to bring the subgrade to the current levels will be undertaken in accordance with Section 5.2 below.
- Further testing including plate load testing and additional CBR testing will be undertaken following demolition to confirm the advice provided in the following Sections.

If any of those bases are not applicable, PSM should be requested to confirm that the design advice below is still applicable.

5.2 Subgrade Treatment and Minor Earthworks

We recommend that, after the existing structures are demolished, debris and building / pavement rubble are removed, and the site is graded:

- The exposed subgrade surface be proof rolled with a minimum 12 tonne smooth drum non vibratory roller. A PSM engineer should witness the proof rolling and advise the number of passes for each section.
- Any “soft” spots identified, should be excavated and replaced with approved material, with maximum compacted layer thickness of 200 mm.
- Replacement material to be compacted to a density ratio of between 98% and 102% (Standard) and moisture variation of between 2% dry and 2% wet, unless otherwise directed by PSM.
- Each “soft” spot is to have the minimum of 1 density test completed by a GITA.

Should minor filling (filling up to 300 mm deep) be required to bring the exposed subgrade to the existing level, following the above subgrade treatment we recommend:

- Fill to be placed and compacted to a density ratio of between 98% and 102% (Standard) and moisture variation of between 2% dry and 2% wet.
- Fill to be placed in Lots that are defined as a single layer of Engineered Fill consisting of uniform material which has undergone similar treatment.
- The minimum density testing frequency to be taken as follows:
  - For Lots less than 30 m^3 – 1 test per Lot
  - For Lots between 30 m^3 to 150 m^3 – 2 tests per Lot

- For Lots greater than 150 m^3 – shall not be less than the greater of:
  - 1 test per 500 m^3 of material placed
  - 3 tests per lot.

- If any one test undertaken within a Lot fails, the whole of the Lot shall be reworked and retested, i.e. “a none to fail basis”.

We recommend plate load testing be undertaken at the final surface to confirm the design advice prior to the slab construction.

Following the testing, PSM will issue final design advice, the intention being to confirm the design advice in this report.
We recommend that our inspection regime and testing be presented to the structural engineer and builder. On this basis, Goodman can be confident that, at completion, the works have been constructed in accordance with the designs and geotechnical recommendations.

Should major earthworks be required e.g. to raise the site level, then a Bulk Earthwork Specification will be required. PSM can prepare this Specification if required.

5.3 Site Classification

While the proposed development is out of scope of AS2870 (2011) *Residential slabs and footings*, we assess that, for the subgrade, the characteristic surface movement, y_s, would be less than 20 mm and thus would classify the site as Class S.

5.4 Permanent and temporary batters

The batter slope angles shown in Table 3 are recommended for the design of batters up to 3 m height and above the groundwater table; subject to the following recommendations:

1. The batters shall be protected from erosion.
2. Permanent batters shall be drained.
3. Temporary batters shall not be left unsupported for more than 1 month without further advice, and inspection by a geotechnical engineer should be undertaken following significant rain events.
4. Where loads are imposed or structures/services are located within one batter height of the crest of the batter, further advice should be sought.

TABLE 3
BATTER SLOPE ANGLES

UNIT	TEMPORARY	PERMANENT
SOIL UNITS, eg. ENGINEERED FILL, NATURAL SOIL	2.0H : 1V	2.5H : 1V

Steeper batters may be possible subject to further advice, probably including inspection during construction.

5.5 Excavation support

Permanent cuts in the ENGINEERED FILL, NATURAL SOIL and BEDROCK units steeper than the recommended permanent batter slopes in Table 3 will need to be supported by some form of retaining structure.

The excavation of the proposed basement level(s) thoroughfare will need to be supported by some form of retaining structure and should be based on the following:

- Effective soil strength parameters in Table 4,
- Water pressure (depending on the type of structure)
- Surcharge loads

Note that design of retention systems may be based on either K_a or K_o earth pressures. Design using active earth pressures provides the minimum lateral earth pressure that must be supported to avoid failure and requires a wall that can rotate or translate to allow the pressures to reduce to these values (vertical and lateral movements up to 2% of height may occur, typical movements will be much less).

Where the design is based on K_o pressures, construction should be carefully controlled to avoid unwanted effects. It should be noted that designing for K_o pressures does not, of itself, ensure that movement does not occur. Movements are controlled by the construction method, especially sequence.

Both surface and sub-surface drainage needs to be designed and constructed properly to prevent pore water pressures from building up behind the retaining walls or appropriate water pressures must be included in the design.

5.6 Slab on ground

The design of slabs can be based on a subgrade with a Young's modulus *(E)* shown in Table 4 and subsurface profile discussed in Section 4.3. A short term Young's modulus of 15 MPa can be adopted for slab founded on FILL or UPPER SAND unit.

We note that slabs will be affected by settlement of the deeper soil layers.

The structural designer or builder may wish to employ a surface layer of road base / crushed sandstone / concrete for trafficability or structural purposes. This is not required to achieve the properties provided in this design advice.

For the basement slab, the designer needs to also consider the water pressure (depending on the type of structure).

5.7 Footings

5.7.1 Shallow Footings

Pad footings can be founded on or within the FILL or UPPER SAND unit. They can be proportioned on the basis of an allowable bearing pressure (ABP) presented in Table 4. These pads are to have a minimum horizontal dimension of 1 m and an embedment depth of at least 500 mm. Shallow footings should not be founded closer than their minimum plan dimension to the UPPER CLAY unit.

Please note that an allowable bearing pressure (ABP) is not a soil property. It depends on many factors such as the size of the footings, the embedment depth, the load direction and eccentricity, the stiffness of the footing, the adopted factor of safety (FOS), as well as the soil properties. As footings get bigger or deeper the capacity increases very quickly, as the load gets eccentric or inclined the capacity reduces very quickly.

Higher ABPs may be available but these depend on the size, depth, loads, etc. and would be subject to specific advice.

Settlement of footings should be assessed based on a foundation material with a long term Young's modulus shown in Table 4.

5.7.2 Pile footings

Piles should be designed in accordance with the requirements in AS 2159 (2009), Piling – Design and Installation.

Selection of the pile system depends on many considerations and should be undertaken by the designer in conjunction with the Principal and contractor / builder.

We envisage that piles to be founded within the BEDROCK unit. If piles need to be founded within SAND units, further advice should be sought, but we do not expect this to be practical.

With regards to the pile design we recommend that:

- A geotechnical strength reduction factor, Φg = 0.60 (AS2159 CL. 4.3.2) be adopted for a high redundancy system for an assessed average risk rating (ARR) of 3.0. This should be reviewed to suit the specific design and construction methods proposed by the structural designers.
- It may be possible to increase the pile reduction factors, if the details of the proposed pile installation procedures indicate a high level of quality control with regards to concrete placement, base cleanliness etc.

Where the pile is sized using the allowable bearing capacity in Table 4 (i.e. assuming all the serviceability load is carried by the base), the settlement would be expected to be less than 1% of the pile diameter.

Any structural settlement due to shortening (or extension) of the footing element itself should be considered.

Where the founding or loading conditions between footings vary consideration should be given to the effects of differential settlements.

5.7.3 Differential Settlements

Where adjacent foundation and slab details differ (e.g. between the remaining existing structure and new extension), differential settlement will need to be assessed.

5.8 Groundwater and Dewatering

At this stage we have preliminary information regarding the groundwater level from the installed standpipe piezometers. The groundwater monitoring undertaken between 24 April and 8 May 2018 indicates depth to groundwater between RL -1.5 m and RL 0.66 m. We note that the neighbouring site activity (WestConnex site) may also have affected the groundwater level within the site.

It is anticipated that the proposed basement excavation will potentially intersect the groundwater table; thus dewatering (temporary and or permanent) may be required.

For a conservative permanent design, the structural designer can consider a design groundwater level at surface.

We note that the design groundwater level is a trade-off between the design/construction cost and ongoing operation cost, eg. pumping.

For an appropriate outcome, it is our option that the preliminary design groundwater level can be taken to RL 1.7 m, eg. 1 metre above the measured level. Such design will require proper pressure relief system to be designed and constructed. We will review this advice regarding the design groundwater level based on our ongoing groundwater monitoring.

We observed hydrocarbon within BH03 during drilling. Environmental assessment may be required to remove groundwater and material in this area.

TABLE 4
ENGINEERING PARAMETERS OF INFERRED GEOTECHNICAL UNITS

INFERRED UNIT	BULK UNIT WEIGHT (kN/m^3)	SOIL EFFECTIVE STRENGTH PARAMETERS		ULTIMATE BEARING PRESSURE UNDER CENTRIC VERTICAL LOADING (KPa)	ALLOWABLE BEARING PRESSURE UNDER CENTRIC VERTICAL LOADING (KPa)	ULTIMATE SHAFT ADHESION (KPa)	ELASTIC PARAMETERS	
		c' (kPa)	*ϕ'* (deg)				YOUNG MODULUS (MPa)	POISSON' S RATIO
FILL	18	0	25	250*	100*	N/A	10	0.3
UPPER SAND	18	0	25	250*	100*	N/A	10	0.3
UPPER CLAY	18	0	20	No footings anticipated in this unit		N/A	4	0.3
LOWER SAND	18	0	35	No footings anticipated in this unit		N/A	30	0.3
LOWER CLAY	18	0	32	No footings anticipated in this unit		N/A	20	0.3
BEDROCK A	22	N/A	N/A	3000	1000**	100	100	0.3
BEDROCK B	22	N/A	N/A	6000	2500**	350	500	0.25

Note: * Minimum footing dimensions: 1 m x 1 m in plan with an embedment depth at least = 0.5 m
** ABP in BEDROCK to cause settlement of <1% of minimum footing dimension.

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5.9 Pavements

Due to limited access to the subgrade underlying the concrete pavement, only three (3) CBR tests were undertaken. The CBR test results show a wide range of values.

For the purposes of preliminary structural pavement thickness design, a design CBR of 10% can be adopted for existing subgrade. Higher CBR values might be possible if testing is undertaken at specific areas. We recommend that specific CBR testing be undertaken at subgrade level when pavement layouts are finalised and after the demolition work is completed.

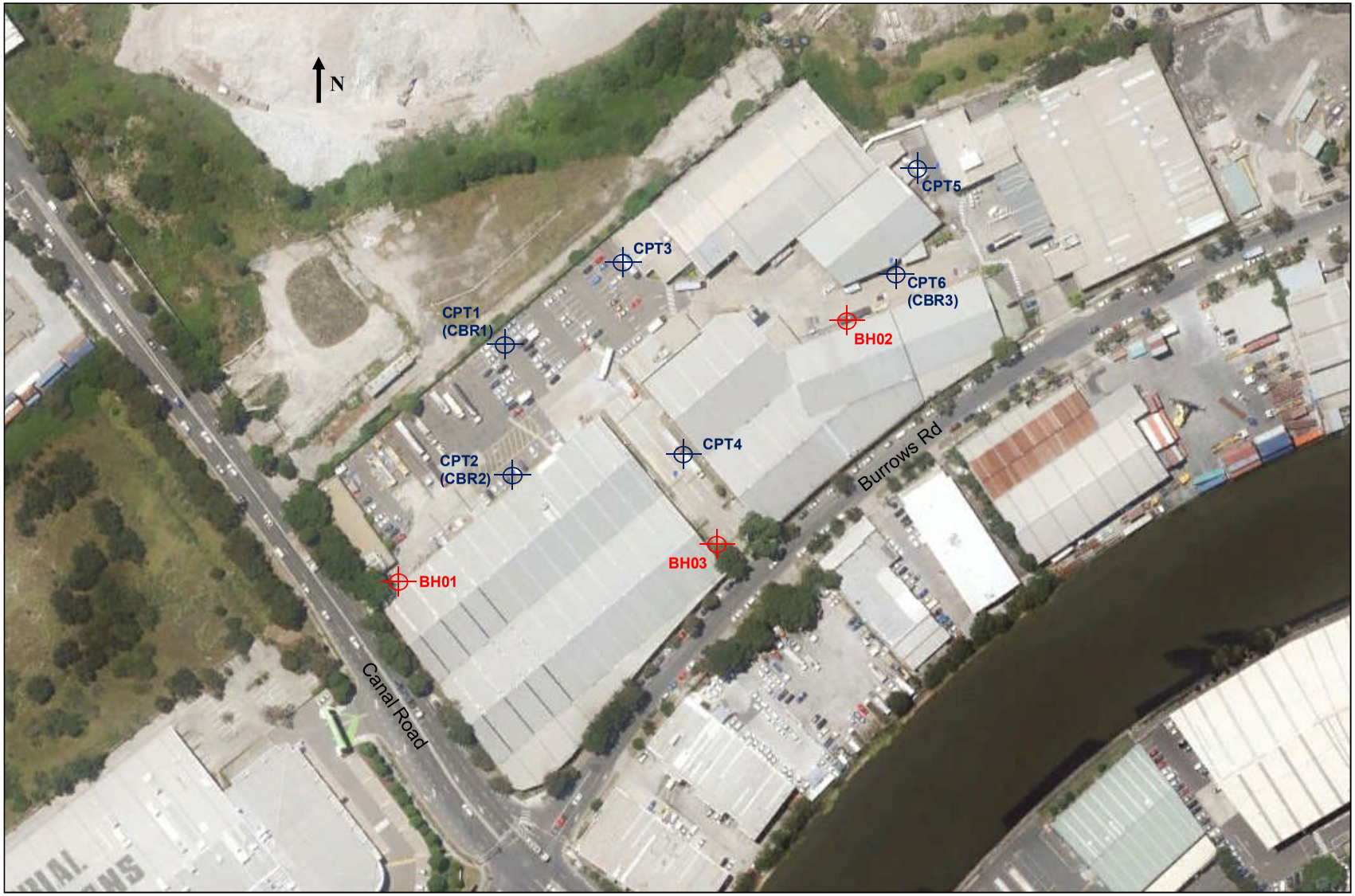
5.10 Earthquake Classification

Given that the sub-surface conditions comprise material with an assessed consistency of soft, eg. UPPER CLAY unit and that it is less than 20 m thick, we have classified the site sub-soil to be Class De in accordance with AS 1170.4-2007 Section 4.2

For and on behalf of
PELLS SULLIVAN MEYNINK

JOSSELIN RIBOT
GEOTECHNICAL ENGINEER

AGUSTRIA SALIM
PRINCIPAL



Notes:

1. Plan obtained from Google Earth.

Previous site investigation on 13 August 2015 (Approx. only)

Cored Boreholes locations on 23 and 24 April 2019 (Approx. only)

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1 - 3 Burrows Road, St Peters

Geotechnical Investigation

LOCALITY PLAN

PSM2808-005R	Figure 1

Photo 1 - General Site Conditions - Site Entrance

Photo 2 - General Site Conditions - View to the South from entrance

Photo 3 - General Site Conditions - North part of the site looking South

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1 - 3 Burrows Road, St Peters

Geotechnical Investigation

SITE INVESTIGATION 23 and 24 April 2019

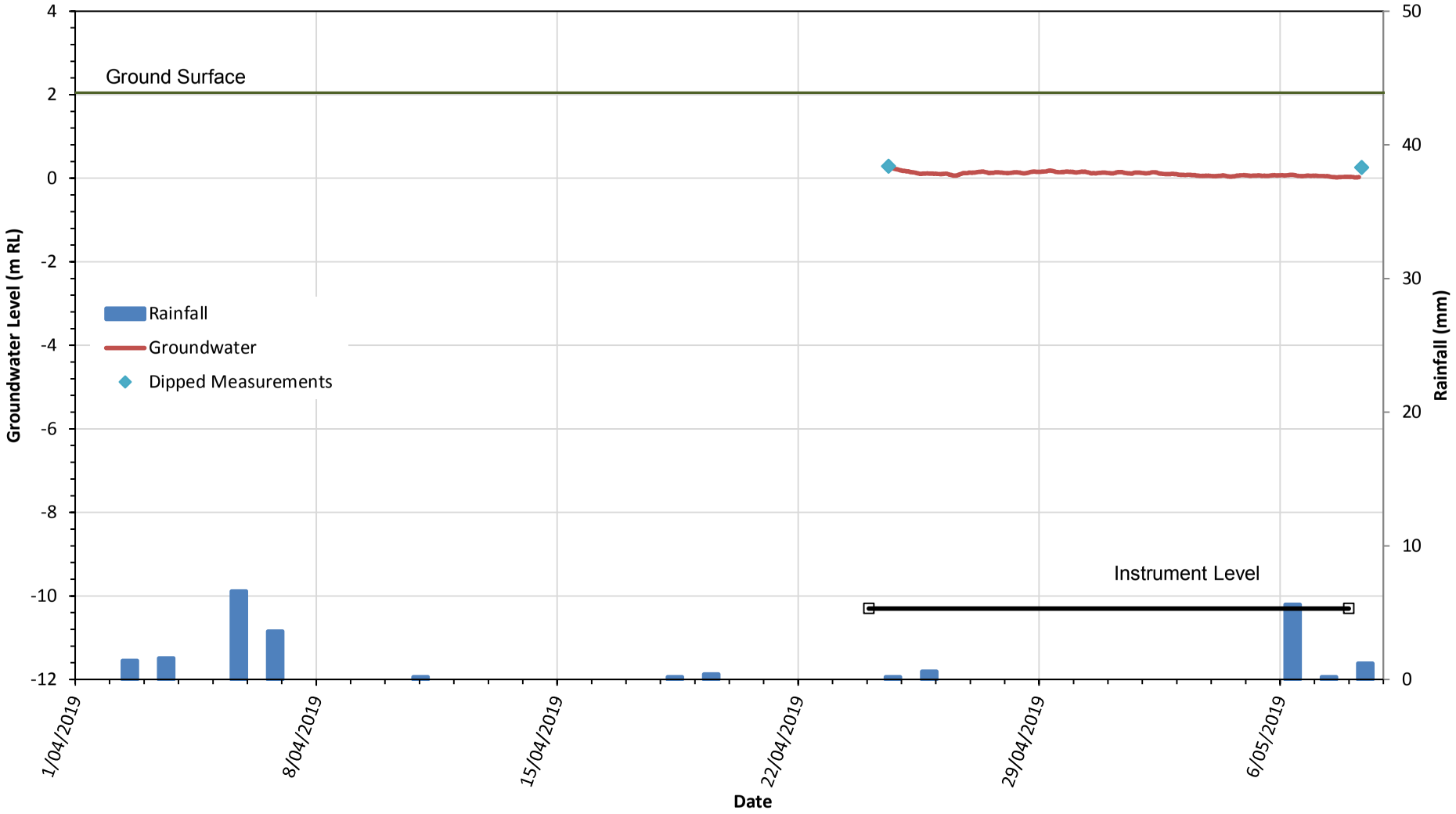
SELECTED SITE PHOTOS [1 OF 2]

Pells Sullivan Meynink	**PSM2808-005R** / **FIGURE 2**

Photo 4 - General Site Conditions - View to the North from the South

Photo 5 - Drilling rig and exclusion zone

Goodman Limited **1 - 3 Burrows Road, St Peters** **Geotechnical Investigation** **SITE INVESTIGATION 23 and 24 April 2019** **SELECTED SITE PHOTOS [2 OF 2]**	
Pells Sullivan Meynink	**PSM2808-005R** / **FIGURE 3**



Notes:

1. Instrument depth (m RL): -10.3
2. Rainfall data source: BoM Sydney Aeroport (station number: 66037)
3. Measured water level on 24/04/2019 at -1.76 (m BGL)
4. Data logger installed on 24/04/2019

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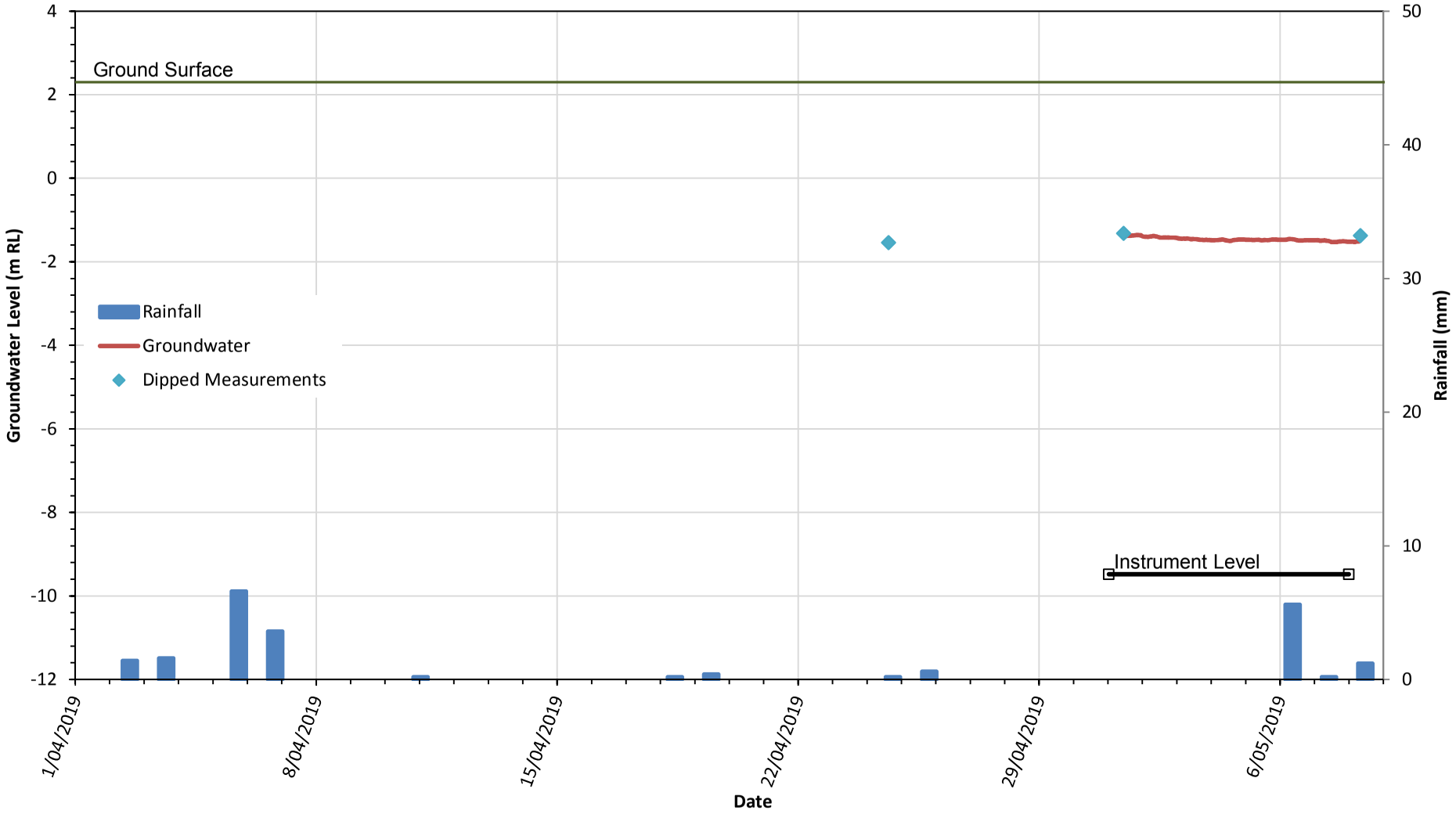
Burrows Road Estate
St Peters, NSW
GROUNDWATER MONITORING
BH01

PSM2808	Figure 4



Notes:

1. Instrument depth (m BGL): -9.48
2. Rainfall data source: BoM Sydney Aeroport (station number: 66037)
3. Measured water level on 24/04/2019 at -3.84 (m BGL)
4. Data logger installed on 1/05/2019

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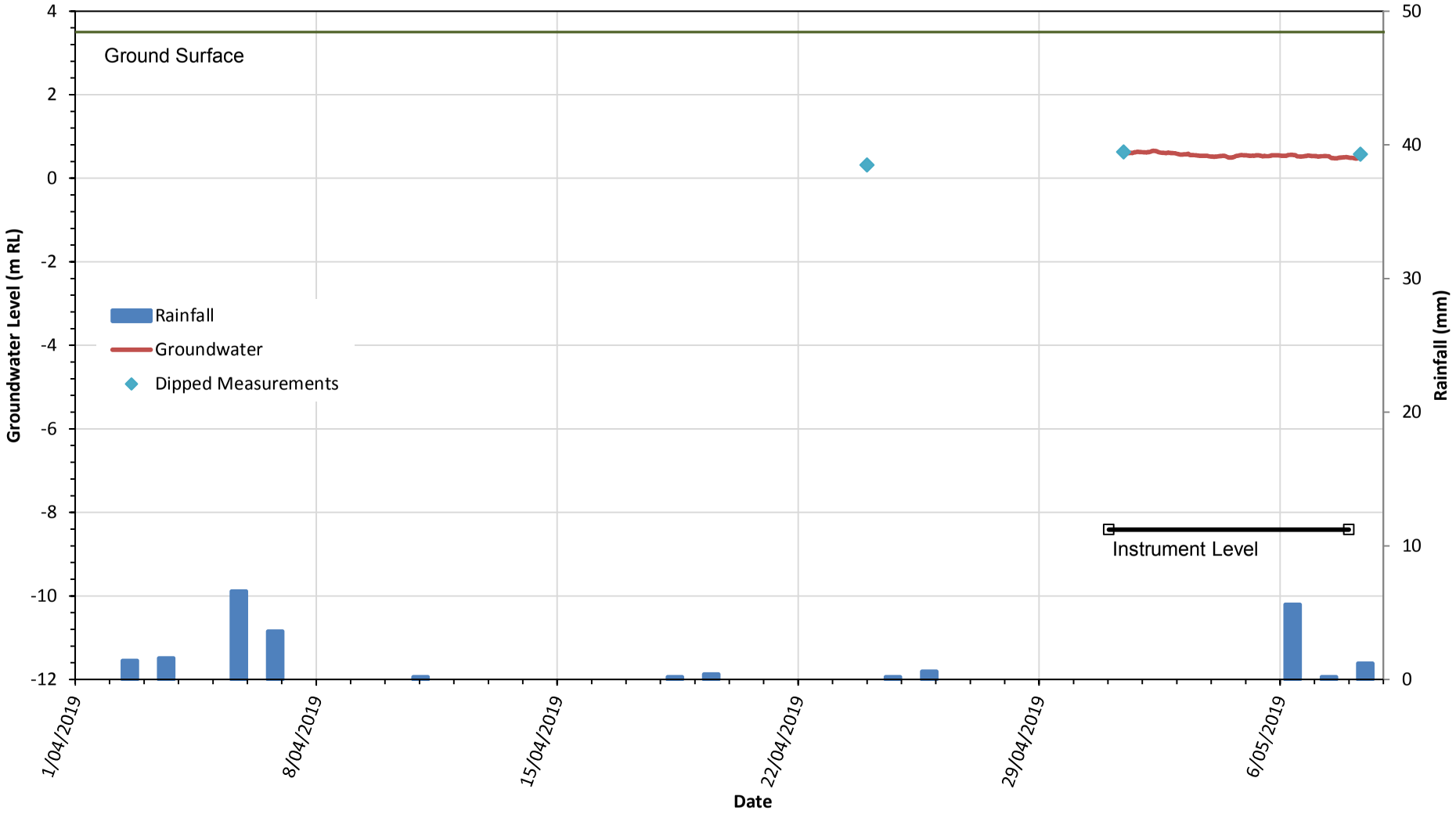
Burrows Road Estate
St Peters, NSW
GROUNDWATER MONITORING
BH02

PSM2808	Figure 5



Notes:

1. Instrument depth (m BGL): -8.41
2. Rainfall data source: BoM Sydney Aeroport (station number: 66037)
3. Measured water level on 24/04/2019 at -3.18 (m BGL)
4. Data logger installed on 1/05/2019

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GROUNDWATER MONITORING
BH03

PSM2808	Figure 6

APPENDIX A

CPT RESULTS AND INTERPRETED PROFILES

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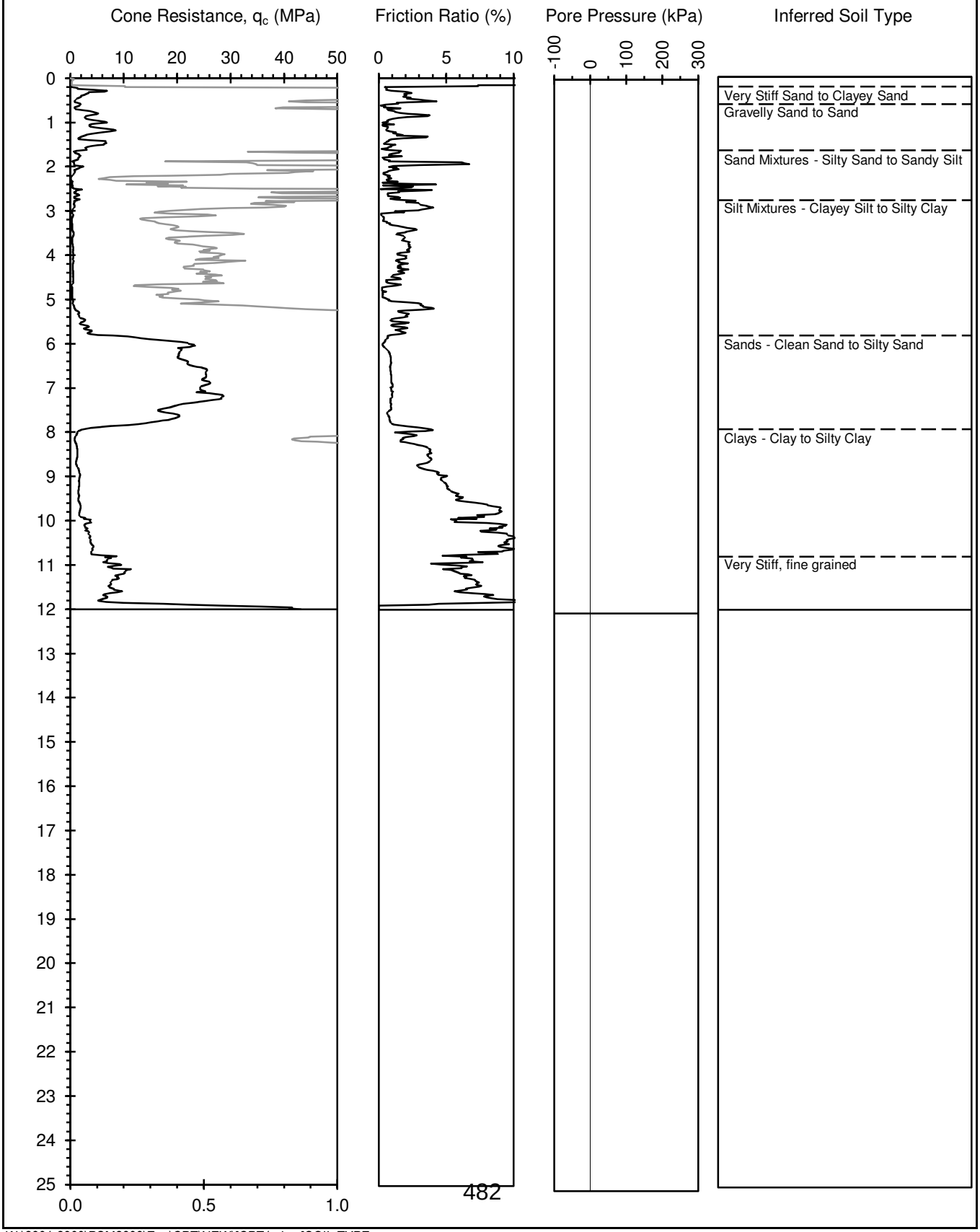
CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM2808***	**Test No.**	***CPT1***
Project	***1-3 Burrows Avenue, Alexandria***	**Page**	***1 of 1***

Pushing rig	*Ground Test 15.5T CPT Rig*	Test date	*13/08/2015*
Location	*331594 m E, 6245451 m N*	Cone I.D.	*120631*
Surface R.L.	*#N/A*	Field work	*HP*



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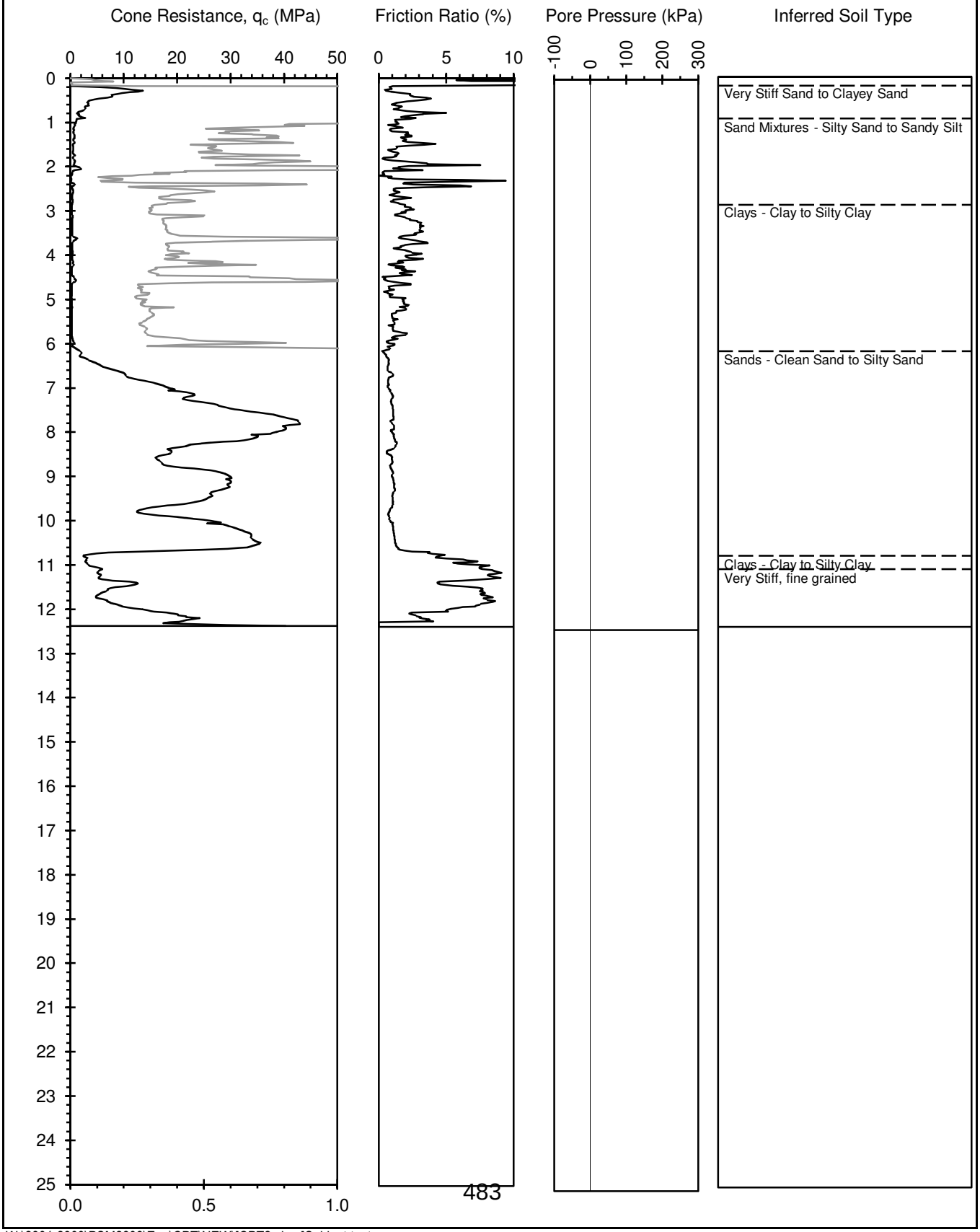
CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM2808***	**Test No.**	***CPT2***
Project	***1-3 Burrows Avenue, Alexandria***	**Page**	***1 of 1***

Pushing rig	*Ground Test 15.5T CPT Rig*	Test date	*13/08/2015*
Location	*331599 m E, 6245403 m N*	Cone I.D.	*120631*
Surface R.L.	*#N/A*	Field work	*HP*



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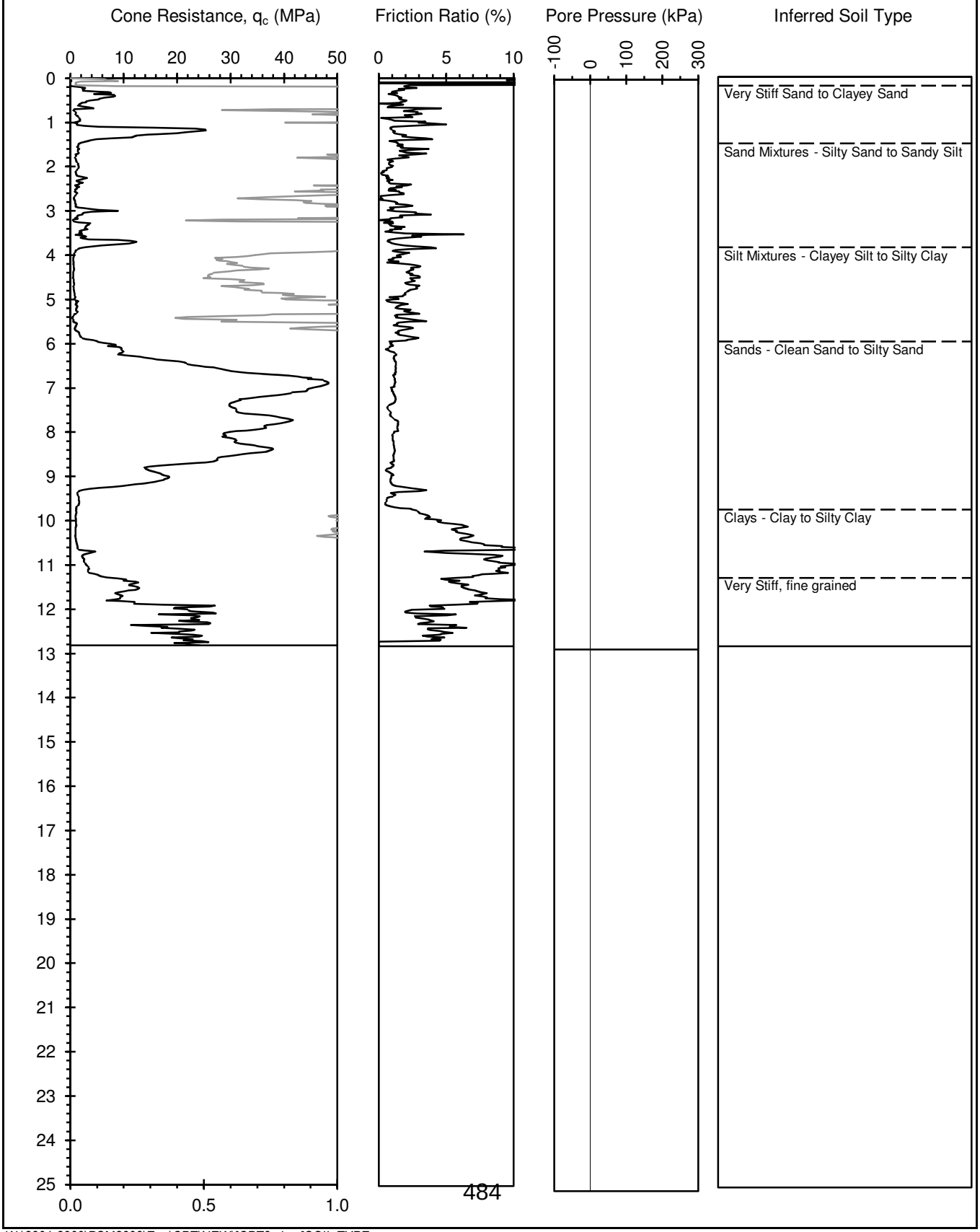
CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM2808***	**Test No.**	***CPT3***
Project	***1-3 Burrows Avenue, Alexandria***	**Page**	***1 of 1***

Pushing rig	*Ground Test 15.5T CPT Rig*	Test date	*13/08/2015*
Location	*331640 m E, 6245486 m N*	Cone I.D.	*120631*
Surface R.L.	*#N/A*	Field work	*HP*



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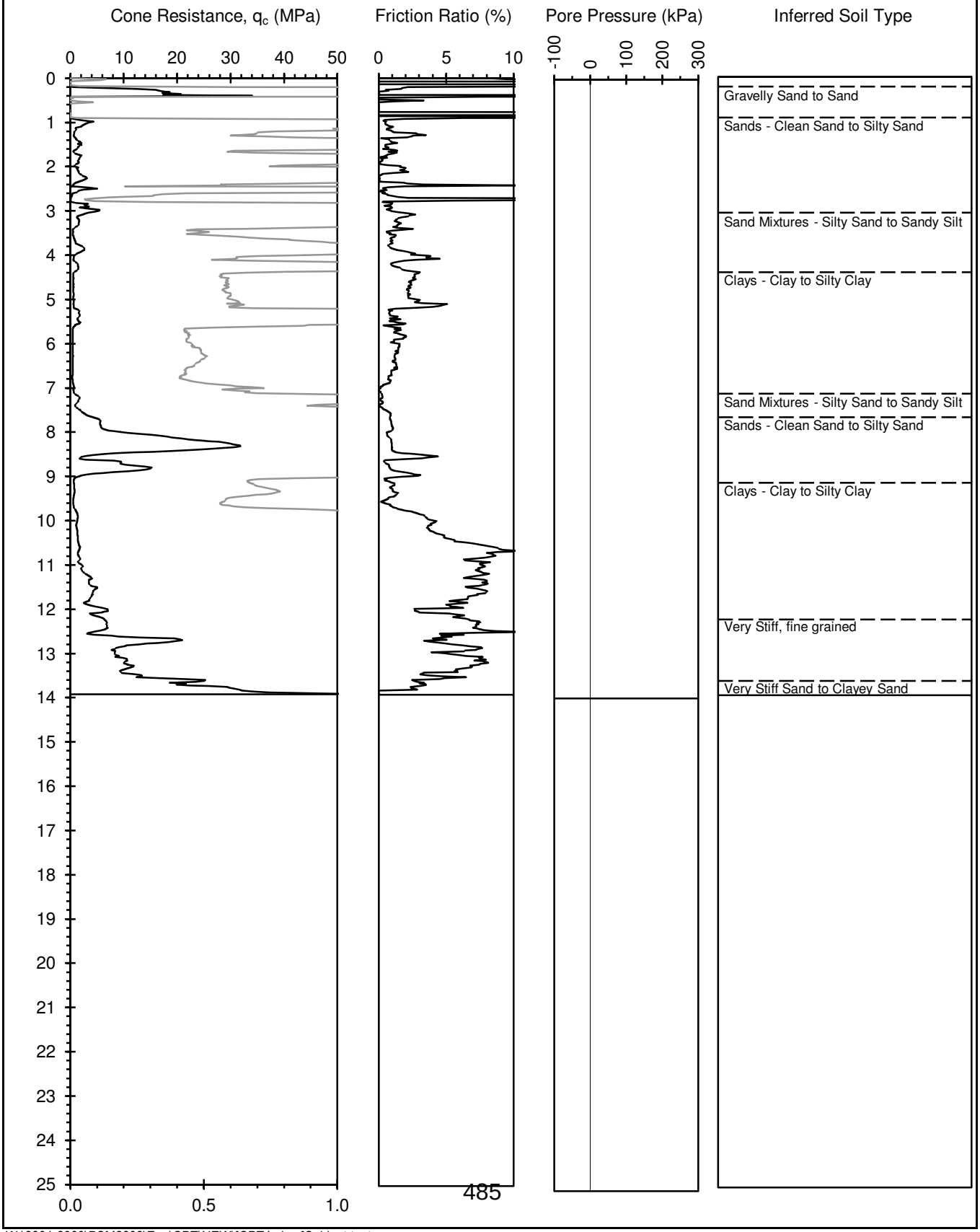
CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM2808***	**Test No.**	***CPT4***
Project	***1-3 Burrows Avenue, Alexandria***	**Page**	***1 of 1***

Pushing rig	*Ground Test 15.5T CPT Rig*	Test date	*13/08/2015*
Location	*331657 m E, 6245405 m N*	Cone I.D.	*120631*
Surface R.L.	*#N/A*	Field work	*HP*



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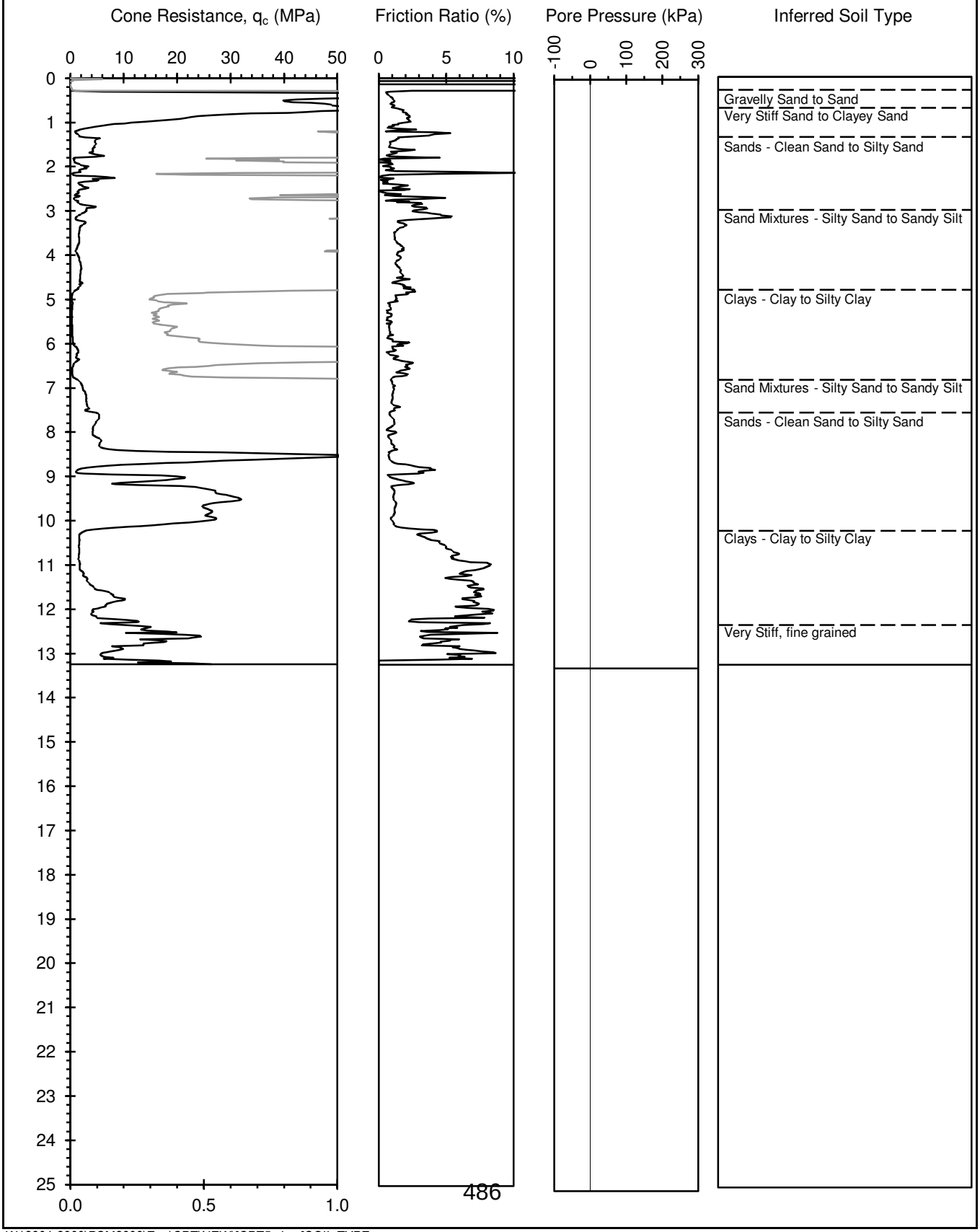
CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM2808***	**Test No.**	***CPT5***
Project	***1-3 Burrows Avenue, Alexandria***	**Page**	***1 of 1***

Pushing rig	*Ground Test 15.5T CPT Rig*	Test date	*13/08/2015*
Location	*331754 m E, 6245523 m N*	Cone I.D.	*120631*
Surface R.L.	*#N/A*	Field work	*HP*



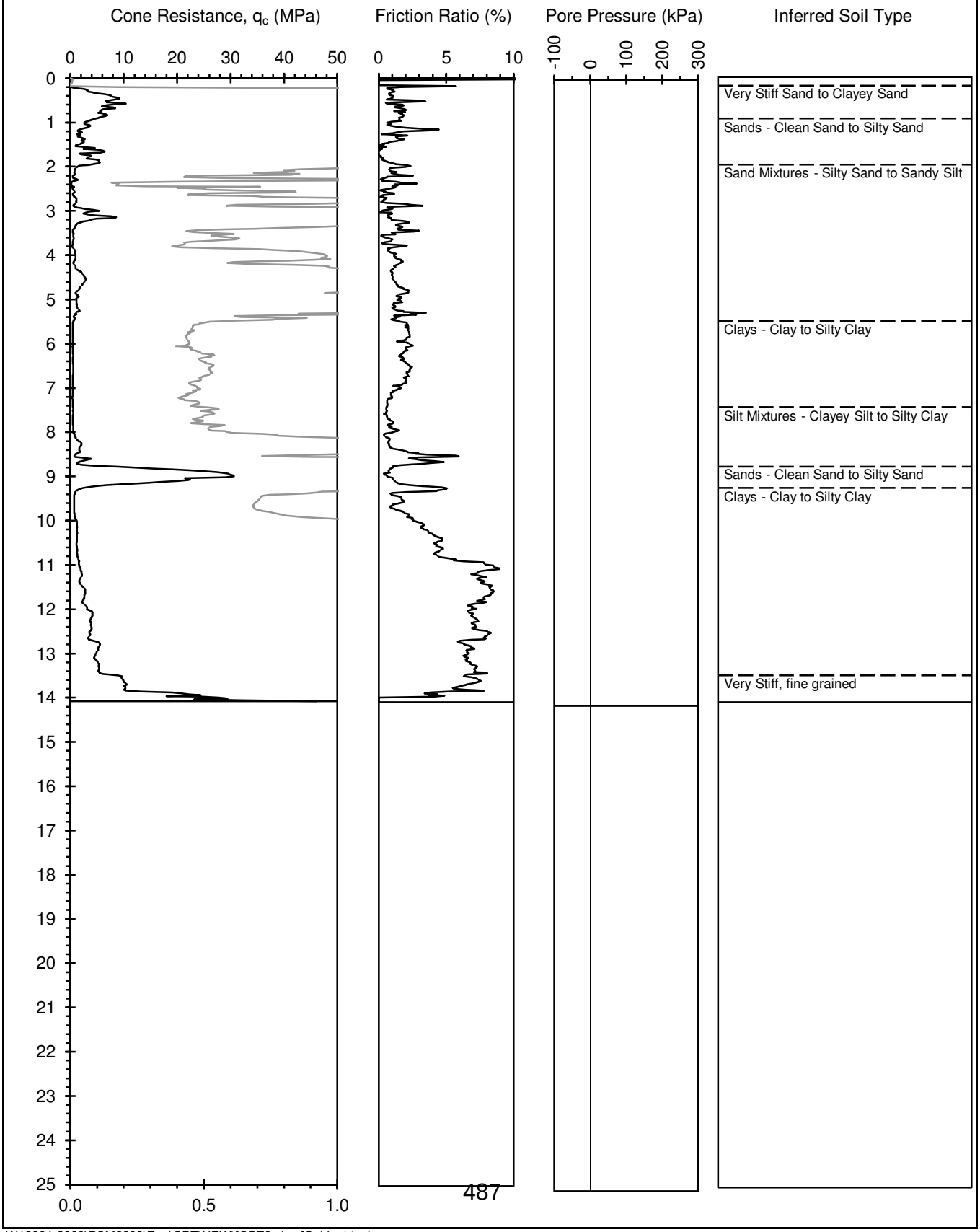
W:\2801-2900\PSM2808\Eng\CPT\NEW\[CPT5.xlsm]SOIL TYPE

Pells Sullivan Meynink

CONE PENETRATION TEST - INFERRED SOIL TYPE

Job No.	***PSM2808***	**Test No.**	***CPT6***
Project	***1-3 Burrows Avenue, Alexandria***	**Page**	***1 of 1***

Pushing rig	*Ground Test 15.5T CPT Rig*	Test date	*13/08/2015*
Location	*331738 m E, 6245487 m N*	Cone I.D.	*120631*
Surface R.L.	*#N/A*	Field work	*HP*



W:\2801-2900\PSM2808\Eng\CPT\NEW\[CPT6.xlsm]Subject test

APPENDIX B

CBR TEST REPORT

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: Pells Sullivan Meynink Pty Ltd
PSM Project No.: PSM2808-004L

Ref No: L3788E
Report: 1
Report Date: 25/08/2015
Page 1 of 1

SAMPLE NUMBER	1	2	3
Surcharge (kg)	4.5	4.5	4.5
Maximum Dry Density (t/m^3)	1.63 STD	1.26 STD	1.69 STD
Optimum Moisture Content (%)	20.1	31.0	17.5
Moulded Dry Density (t/m^3)	1.55	1.28	1.68
Sample Density Ratio (%)	95	101	99
Sample Moisture Ratio (%)	118	95	91
Moisture Contents			
Insitu (%)	25.5	30.8	17.3
Moulded (%)	23.7	29.4	16.0
After soaking and			
After Test, Top 30mm(%)	24.1	29.9	18.6
Remaining Depth (%)	22.9	33.5	18.6
Material Retained on 19mm Sieve (%)	5*	7*	15*
Swell (%)	0.0	0.0	0.0
C.B.R. value:			
@5.0mm penetration	15	10	50

NOTES:

- Refer to appropriate notes for soil descriptions
- Test Methods : AS1289 6.1.1, 5.1.1 & 2.1.1.
- Date of receipt of sample: 14/08/2015.
- * Denotes not used in test sample.

NATA
NATA Accredited Laboratory Number:1327

Accredited for compliance with ISO/IEC 17025.
This document shall not be reproduced except in full.

Authorised Signature / Date
(D. Treweek)
25/8/15

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APPENDIX C

BOREHOLES LOGS

Borehole ID

BH01

Page 1 of 5

Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331557.0 m E 6245383.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	2.05 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT		N								Asphalt: 50 mm thick. Concrete: 250 mm thick.				
AD/V		N	Observed at 1.76 m in standpipe			1.1	1			Sandy Clayey GRAVEL: to 20 mm, sub-rounded to sub-angular, dark grey to black; clay non-plastic; sand fine to medium grained.				0.30: Inferred FILL.
						0.1	2			Silty CLAY: medium plasticity, black; some shale fragments, metal, rubber and plastic observed.	W	L to F		
						-1.0	3							
						-2.0	4		SW-SM	Silty SAND with clay: fine to medium grained, grey; clay low plasticity.		D to VD		4.40: Inferred alluvial soil.

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

PSM 3.02.1 LIB.GLB Log PSM AU NONCORE BH NZ AU PSM2808.GPJ <<DrawingFile>> 10/05/2019 16:52 10.0.000 Datgel Fence and Map Tool | Lib: PSM 3.02.1 2019-03-06 Prj: PSM 3.02.1 2019-03-06

Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331557.0 m E 6245383.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	2.05 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Observed at 1.76 m in standpipe			-4.0	6		SW-SM	Silty SAND with clay: fine to medium grained, grey; clay low plasticity. *(continued)*	W	D to VD		
						-5.0	7							
						-6.0	8		CH	CLAY: high plasticity, grey.		VSt		
						-7.0	9		CH	CLAY: high plasticity, pale grey-brown and red. Structure becomes visisble at 9.8m	M	H		

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
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See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

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Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331557.0 m E 6245383.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	2.05 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Observed at 1.76 m in standpipe			-9.0	11		CH	CLAY: high plasticity, pale grey-brown and red. *(continued)*	M	H		
										SHALE: grey-brown, extremely weathered, very low to low strength..				11.05: V-bit refusal.
										Continued on cored borehole sheet				
						-10.0	12							
						-11.0	13							
						-12.0	14							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
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SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

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M - Moist
W - Wet

Consistency/Relative Density
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S - Soft
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VSt - Very stiff
H - Hard
VL - Very loose
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MD - Medium dense
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Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

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Engineering Log - Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331557.0 m E 6245383.0 m N	Checked By:	AS

Drill Model and Mounting: Track Mounted | Inclination: -90° | RL Surface: 2.05 m
Barrel Type and Length: NMLC 3 m | Bearing: | Datum: AHD | Operator: Rockwell

Drilling Information							Rock Substance					Rock Mass Defects	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial ○ - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					-9.0	11		Continued from non-cored borehole sheet				
NMLC	Observed at 1.76 m in standpipe	98	11.15m 1 Is(50) d=0.01 a=0.01 MPa					SHALE: dark grey and brown, developed bedding.				
								SHALE: dark grey, thinly laminated, well developed bedding.				IS, 0°, CL, PR, S, 10 mm IS, 0°, CL, PR, S, 25 mm IS, 0°, CL, PR, S, 5 mm IS, 0°, CL, PR, S, 10 mm JT, 20°, FE SN, PR, RF
			11.95m 2 Is(50) d=0.01 a=0.3 MPa		-10.0	12						IS, 0°, CL, PR, S, 15 mm
			13.05m 3 Is(50) d=0.2 a=0.3 MPa		-11.0	13						
		99	13.95m 4 Is(50) d=0.1 a=0.4 MPa		-12.0	14						JT, 45°, KL, PR, RF JT, 30°, KL, PR, RF
			14.80m 6 Is(50) a=0.4 MPa									

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.02.1 LIB.GLB Log PSM AU CORE BH PSM2808.GPJ <<DrawingFile>> 10/05/2019 16:51 10.0.000 Datgel Fence and Map Tool | Lib: PSM 3.02.1 2019-03-06 Prj: PSM 3.02.1 2019-03-06

Engineering Log - Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331557.0 m E 6245383.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	2.05 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information							Rock Substance					Rock Mass Defects	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ● - Axial O - Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000		Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
								Hole Terminated at 15.02 m Target depth. Standpipe installed					
					-14.0	16							
					-15.0	17							
					-16.0	18							
					-17.0	19							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

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Pells Sullivan Meynink

Goodman Limited	
1 - 3 Burrows Road, St Peters	
Geotechnical Investigation	
BOREHOLES CORE PHOTO	
BH01 From 11.1 m to 15.02 m	
PSM2808-005R	Appendix C

Borehole ID

BH02

Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331729.0 m E 6245470.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	2.30 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT		N								Concrete: 200 mm thick.				
						1.3	1			Sandy GRAVEL: to 30 mm, sub-angular, dark grey to black; sand coarse grained; some metal, rubber, ceramics, copper and plastic observed.				0.20: Inferred FILL.
														1.00: Numerous bricks observed
AD/V		N	Observed at 3.84 m in standpipe			0.3	2				W	L to F		
						-0.7	3							
						-1.7	4		SW-SM	Silty SAND with clay: fine to medium grained, grey; clay low plasticity.	W	D to VD		4.00: Inferred alluvial soil. 4.20: Some shells observed

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
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Ce - Cemented
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See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

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Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331729.0 m E 6245470.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	2.30 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Observed at 3.84 m in standpipe			-3.7	6		SW-SM	Silty SAND with clay: fine to medium grained, grey; clay low plasticity. *(continued)*				
						-4.7	7				W	D to VD		
						-5.7	8							
						-6.7	9		CH	CLAY: high plasticity, pale grey-brown.	M	St to VSt		

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
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SPT - Standard Penetration Test
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Moisture Condition
D - Dry
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Consistency/Relative Density
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Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331729.0 m E 6245470.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	2.30 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								***Soil Description***				***Observations***
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Observed at 3.84 m in standpipe			-8.7	11		CH	CLAY: high plasticity, pale grey-brown. *(continued)*	M	St to VSt		
						-9.7	12			Becomes dark grey				12.20: Becomes harder to drill
						-10.7	13							
										Continued on cored borehole sheet				
						-11.7	14							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
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See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

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Engineering Log - Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR/NTH
Hole Position:	331729.0 m E 6245470.0 m N	Checked By:	AS

Drill Model and Mounting: Track Mounted — Inclination: -90° — RL Surface: 2.30 m
Barrel Type and Length: NMLC 3m — Bearing: — Datum: AHD — Operator: Rockwell

Drilling Information | **Rock Substance** | **Rock Mass Defects**

Method	Water	RQD (%)	SAMPLES & FIELD TESTS	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering (XW HW MW SW FR)	Strength Is(50) ● - Axial O - Diametral (VL 0.1 L 0.3 M 1 H 3 VH 10 EH)	Defect Spacing (mm) (<20 60 200 600 1000)	Defect Descriptions / Comments: Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					-8.7	11						
					-9.7	12						
					-10.7	13		Continued from non-cored borehole sheet				13.20: V-bit refusal.
NMLC	Observed at 3.84 m in standpipe	100			-11.7	14		SHALE: dark grey and brown, extremely weathered, very low to low strength.	XW	VL–L		
			14.35m 1 Is(50) d=0 a=0 MPa					SHALE: dark grey, thinly laminated, well developed bedding.	MW	VL–L		

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.02.1 LIB.GLB Log PSM AU CORE BH PSM2808.GPJ <<DrawingFile>> 10/05/2019 14:34 10.0.000 Datgel Fence and Map Tool | Lib: PSM 3.02.1 2019-03-06 Prj: PSM 3.02.1 2019-03-06

Engineering Log - Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	23/04/2019
Project Name:	Burrows Road	Completed:	23/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331729.0 m E 6245470.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	2.30 m		
Barrel Type and Length:	NMLC 3 m	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information							***Rock Substance***								***Rock Mass Defects***	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ●- Axial ○- Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
		100	15.05m 2 Is(50) d=0.1 a=0.1 MPa									
					-13.7	16		Hole Terminated at 15.18 m Target depth. Standpipe installed				
					-14.7	17						
					-15.7	18						
					-16.7	19						

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.02.1 LIB.GLB Log PSM AU CORE BH PSM2808.GPJ <<DrawingFile>> 10/05/2019 16:51 10.0.000 Datgel Fence and Map Tool | Lib: PSM 3.02.1 2019-03-06 Prj: PSM 3.02.1 2019-03-06

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Goodman Limited	
1 - 3 Burrows Road, St Peters	
Geotechnical Investigation	
BOREHOLES CORE PHOTO	
BH02 From 13.2 m to 15.18 m	
PSM2808-005R	Appendix C

Borehole ID

BH03

Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	24/04/2019
Project Name:	Burrows Road	Completed:	24/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331679.9 m E 6245385.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	3.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
DT		N								Concrete: 250 mm thick.				
AD/V		N	Observed at 2.87 m in standpipe			2.5	1			Sandy GRAVEL: to 30 mm, sub-angular, black; sand fine to medium grained; some metal, ceramics observed.	M	L to F		0.25: Inferred FILL.
						1.5	2			Silty SAND: fine to medium grained, grey.				
						0.5	3			Some clay with medium plasticity at 3.0m	W	L to F		
						-0.5	4		SW-SM	Silty SAND with clay: fine to medium grained, grey; clay low plasticity.	W	D to VD		4.40: Inferred alluvial soil.

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

PSM 3.02.1 LIB.GLB Log PSM AU NONCORE BH NZ AU PSM2808.GPJ <<DrawingFile>> 10/05/2019 16:52 10.0.000 Datgel Fence and Map Tool | Lib: PSM 3.02.1 2019-03-06 Prj: PSM 3.02.1 2019-03-06

Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	24/04/2019
Project Name:	Burrows Road	Completed:	24/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331679.9 m E 6245385.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	3.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Observed at 2.87 m in standpipe			-2.5	6		SW-SM	Silty SAND with clay: fine to medium grained, grey; clay low plasticity. *(continued)*	W	D to VD		
						-3.5	7		CH	CLAY: high plasticity, pale grey-brown.	M	St		
						-4.5	8		SM-SC	Silty SAND: fine to medium grained, grey.	W	D to VD		
						-5.5	9		CH	CLAY: high plasticity, pale grey-brown.	M	VSt to H		

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
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VD - Very dense
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See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

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Engineering Log - Non Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	24/04/2019
Project Name:	Burrows Road	Completed:	24/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331679.9 m E 6245385.0 m N	Checked By:	AS

Drill Model and Mounting:	Track Mounted	Inclination:	-90°	RL Surface:	3.50 m		
Hole Diameter:	100 mm	Bearing:		Datum:	AHD	Operator:	Rockwell

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure, Zoning, Origin, Additional Observations
AD/V		N	Observed at 2.87 m in standpipe			-7.5	11		CH	CLAY: high plasticity, pale grey-brown. *(continued)* Becomes pale grey-brown and red	M	VSt to H		11.50: V-bit refusal. 11.90: Cleaning by washing borehole
						-8.5	12			Continued on cored borehole sheet				
						-9.5	13							
						-10.5	14							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube
AS - Auger Screwing

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled
LB - Large Disturbed Sample

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

See Explanatory Notes for details of abbreviations and basis of descriptions.

Soil and rock descriptions in accordance with AS 1726:2017

PSM 3.02.1 LIB.GLB Log PSM AU NONCORE BH NZ AU PSM2808.GPJ <<DrawingFile>> 10/05/2019 16:52 10.0.000 Datgel Fence and Map Tool | Lib: PSM 3.02.1 2019-03-06 Prj: PSM 3.02.1 2019-03-06

Engineering Log - Cored Borehole

Project No.: PSM2808

Client:	Goodman Group	Commenced:	24/04/2019
Project Name:	Burrows Road	Completed:	24/04/2019
Hole Location:	1-3 Burrows Rd St Peters	Logged By:	JsR
Hole Position:	331679.9 m E 6245385.0 m N	Checked By:	AS

Drill Model and Mounting: Track Mounted | Inclination: -90° | RL Surface: 3.50 m
Barrel Type and Length: NMLC 3 m | Bearing: | Datum: AHD | Operator: Rockwell

Drilling Information							Rock Substance				Rock Mass Defects	
Method	Water	RQD (%)	SAMPLES & FIELD TESTS	WPT (Lugeons)	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable), inclusions and minor components	Weathering XW HW MW SW FR	Strength Is(50) ●- Axial ○- Diametral VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Defect Spacing (mm) <20 60 200 600 1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
					-7.5	11						
					-8.5	12		Continued from non-cored borehole sheet				
NMLC	Observed at 2.87 m in standpipe	97	12.95m 1 Is(50) d=0.1 a=0.1 MPa		-9.5	13		SHALE: dark grey, thinly laminated, well developed bedding.				IS, 0°, CL, PR, RF, 80 mm IS, 0°, CL, PR, RF, 10 mm BP, 0°, CN, PR, RF IS, 0°, CL, PR, RF, 50 mm BP, 0°, CN, PR, RF BP, 0°, FE SN, PR, RF CZ, RF, PR, RF, 60 mm JT, 60°, RF, PR, RF
			13.96m 2 Is(50) d=0.3 a=0.3 MPa		-10.5	14						
			14.94m 3 Is(50) d=0.1 a=0.1 MPa					Hole Terminated at 15.00 m. Target depth. Standpipe installed				JT, 60°, RF, PR, RF

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
XW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
FR - Fresh

Strength
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

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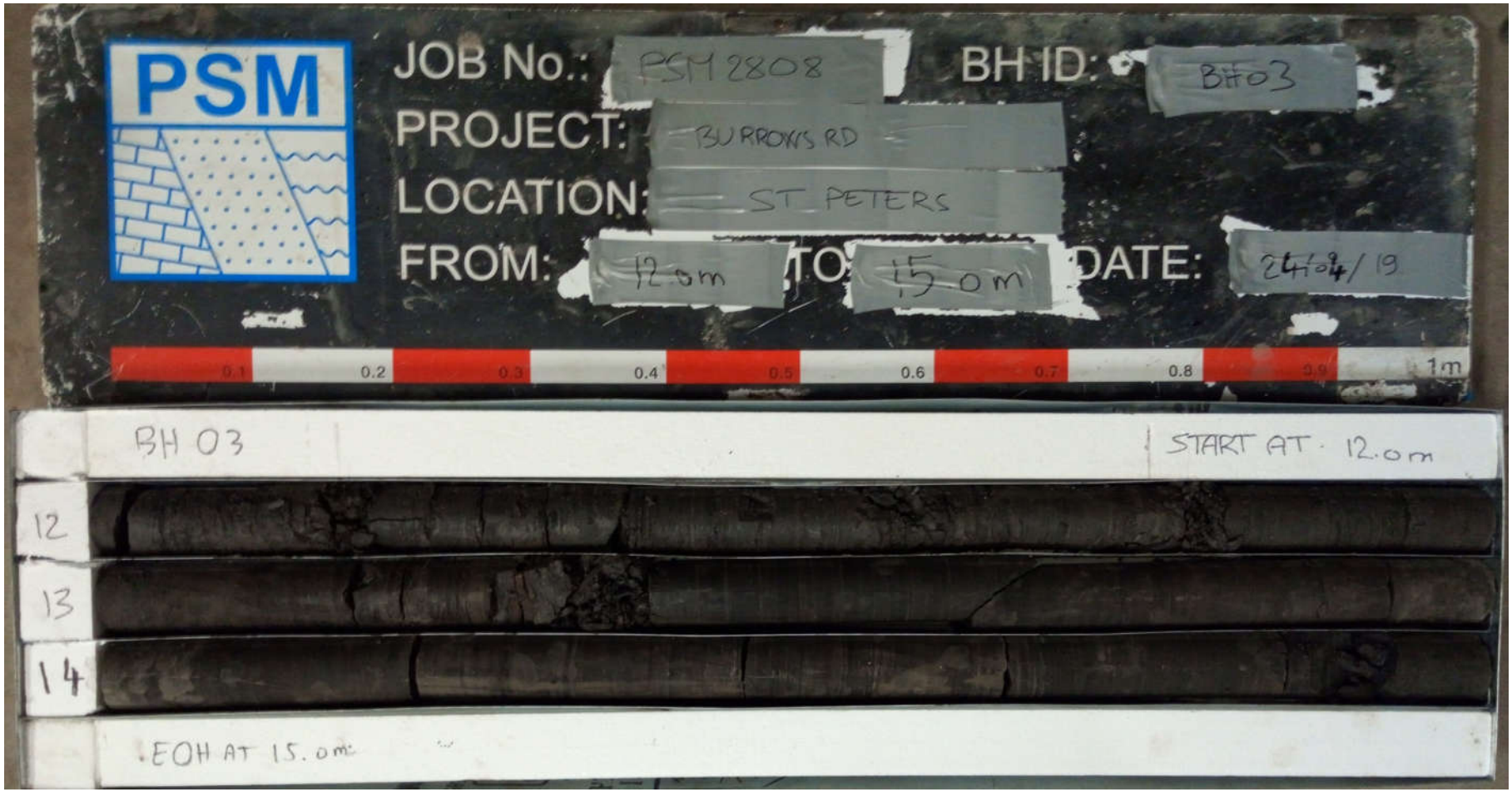


Pells Sullivan Meynink

Goodman Limited	
1 - 3 Burrows Road, St Peters	
Geotechnical Investigation	
BOREHOLES CORE PHOTO	
BH03 From 12.0 m to 15.0 m	
PSM2808-005R	Appendix C

EXPLANATION SHEET
BOREHOLE LOG

GENERAL

Method

Non-Cored Borehole
Auger
Hand Auger
Diamond Rotary
Percussion
Other

Coring Size

Cored Borehole	Nominal Core Diameter (mm)
NMLC	51.9
BQ	36.5
BQ3	33.5
NQ	47.6
NQ3	45.1
HQ	63.5
HQ3	61.1
PQ	85
PQ3	83.1
Diatube	Variable
Other	-

Testing

Symbol	Description
UCS	Uniaxial Compressive Strength
TXL	Triaxial Test
BT	Brazilian Test
DT	Direct Tensile
SD	Slake Durability
Packer	Rock Mass Permeability

Samples

Symbol	Description
U50	50 mm undisturbed tube sample
D	Disturbed sample
Bs	Bulk sample

Water

Symbol	Description
	Water level
	Water inflow
	Complete water loss
	Partial water loss

SOIL DESCRIPTIONS

Unified Soil Classification System (USCS)

Major Divisions			Symbol	Typical Names
Coarse-Grained Soils More than 50% coarser than 0.075mm	Gravels (more than 50% coarser than 2mm)	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.
		Gravels With Fines	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels. gravel-sand-clay mixtures.
	Sands (more than 50% of coarse fraction finer than 2mm)	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines.
			SP	Poorly graded sands and gravelly sands, little or no fines.
		Sand With Fines	SM	Silty sands, sand-silt mixture.
			SC	Clayey sands, sand-clay mixtures.
Fine-Grained Soils 50% or more finer than 0.075mm	Silts and Clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour silty or clayey fine sands.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and silty clays of low plasticity.
	Silts and Clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity.
Highly Organic Soils			PT	Peat etc.

Moisture Condition

Term	Symbol
Dry	D
Moist	M
Wet	W
Wet at Plastic Limit	WP
Wet at Liquid Limit	WL

Strength

COHESIVE SOILS are described in terms of undrained shear strength, colour and structure with comments on minor constituents or apparent special features. Undrained shear strength is measured by hand penetrometer or determined by laboratory testing or estimated from experience. Classification in terms of undrained shear strength is as follows:

Term	Symbol	Description for Field Estimation	Shear Strength (kPa)	UCS (kPa)
Very Soft	VS	Easily penetrated several centimetres by fist.	<12	<25
Soft	S	Easily penetrated several centimetres by thumb. Can be moulded by light finger pressure.	12-25	25-50
Firm	F	Can be penetrated by thumb with moderate effort. Can be moulded by strong finger pressure.	25-50	50-100
Stiff	ST	Readily indented by thumb.	50-100	100-200
Very Stiff	VST	Readily indented by thumbnail.	100-200	200-400
Hard	H	Indented with difficulty by thumbnail	>200	>400

NON-COHESIVE SOILS are described in terms of density, colour, with comments on minor constituents or special features. Density (density index) is generally based on standard penetration testing (AS1289 Method 6.3.1), or other forms of penetration testing. Terms used in describing density are set out below:

Term	Symbol	Density Index	SPT N Values
Very Loose	VL	<15%	<5
Loose	L	15-35 %	5-10
Medium Dense	MD	35-65 %	10-30
Dense	D	65-85 %	30-50
Very Dense	VD	>85 %	>50

ROCK DESCRIPTIONS

Weathering

Term	Symbol	Description
Fresh	FR	Rock substance unaffected by weathering.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Moderately Weathered	MW	Rock substance affected by weathering to the extent staining extends throughout whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and signs of chemical or physical decomposition of individual minerals are usually evident. Porosity and strength may be increased or decreased when compared to the fresh rock substance, usually as a result of the leaching or deposition of iron. The colour and strength of the original fresh rock substance is no longer recognisable.
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties, i.e. it can be remoulded and can be classified according to the Unified Soil Classification System, but the texture of the original rock is still evident.

Strength

Term	Symbol	Description for Field Estimation	Point Load Index I_s50 (MPa)
Very Low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30 mm thick can be broken by finger pressure.	<0.1
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show with firm blows of a pick point; has a dull sound under hammer. Pieces of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1 to 0.3
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3 to 1.0
High	H	A piece of core 150mm long by 50mm cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.	1 to 3
Very High	VH	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.	3 to 10
Extremely High	EH	Specimen requires many blows with geological pick to break; rock rings under hammer.	>10

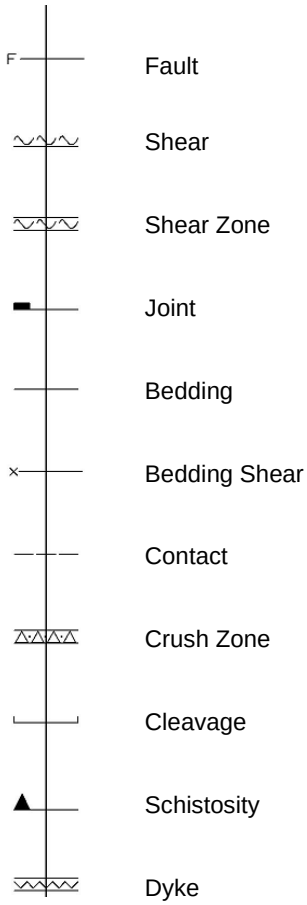
Defect Description

Order of description: type, inclination, shape, roughness, infill type, infill thickness, number

Defect Type

Symbol	Description
CL	Clay Seam
FL	Fault - fracture along which displacement is recognisable.
SR	Shear - a fracture along which movement has taken place but no displacement is recognisable. Evidence for movement may be slickensides, polishing and/or clay gouge.
SH	Sheared Zone - zone of multiple closely spaced fracture planes with roughly parallel planar boundaries usually forming blocks of lenticular or wedge shaped intact material. Fractures are typically smooth, polished or slickensided; and curved.
BG	Bedding parting - arrangement in layers of mineral grains or crystals parallel to surface of deposition along which a continuous observable parting occurs.
BSH	Bedding plane shear - a shear formed along a bedding plane
JN	Joint - a single fracture across which rock has little or no tensile strength and is not obviously related to rock fabric.
CN	Contact - surface between two lithologies.
SC	Schistosity - plane formed by the preferred orientation of the constituent minerals in a parallel arrangement in a coarse grained rock which has undergone regional metamorphism (schist).
CV	Cleavage - plane of mechanical fracture in a rock normally sufficiently closely spaced to form parallel-sided slices.
FO	Foliation
CZ	Crushed Zone - zone with roughly parallel, planar boundaries (commonly slickensided) containing disoriented usually angular rock fragments of variable size often in a soil matrix.
VN	Vein - fracture in which a tabular or sheet-like body of minerals have been intruded.
DK	Dyke - Igneous intrusion - often weathered and altered to a clay like substance.
DZ	Decomposed Zone - zone of any shape but commonly with parallel planar boundaries containing moderately to gradational boundaries into fresher rock.
FZ	Fractured Zone - a zone of closely spaced defects (mainly joints, bedding, cleavage and/or schistosity) comprised of core lengths in the order of 50 mm or less.

Standard Defect Symbols



Roughness Colour Code (for summary log)

Ro1
Ro2
Ro3
Ro4
Ro4

Shape

Term	Symbol	Description
Planar	PL	Forms a continuous plane without variation in orientation.
Curved	CU	Has a gradual change in orientation.
Undulating	UN	Has a wavy surface shape.
Stepped	ST	Has one or more well defined steps
Irregular	IR	Many changes of orientation.

Roughness

Term	Symbol	Description
Slickensided or polished	Ro1	Very smooth, reflects light.
Smooth	Ro2	Roughness not detected with finger.
Defined ridges	Ro3	Sandpaper feel (fine to medium sandpaper).
Small steps	Ro4	Sandpaper feel (medium to coarse sandpaper).
Very rough	Ro5	Very well defined ridges and/or steps.

Infill Type

Symbol	Description
KL	Clean
CA	Calcite
CB	Carbonaceous
CHL	Chlorite
FE	Iron oxide
QZ	Quartz
MG	Manganese
SU	Sulphides
SE	Sericite
RF	Rock fragments
G	Gravel
S	Sand
Z	Silt
CL	Clay

Infill Thickness

Where infilling is present, the thickness of infill is recorded using the following convention:

ST Iron oxide staining of less than 1 mm
VN Veneer coating of less than 1 mm

If the infilling is greater than 1 mm, the actual thickness of infill is recorded in millimeters.

If infill is not present, a dash (-) is recorded

Number

Number of defects with similar characteristics.

APPENDIX D

POINT LOAD TEST RESULTS

Pells Sullivan Meynink

POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. *PSM1541* **Sheet** 1 of 1

Project *1-3 Burrows Rd - St Peters*

Test Method	*AS 4133.4.1 - 1993 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique	*NLMC*	Sampling Date	*23-24/04/2019*
		Storage History	*North Ryde office indoor core storage area*	Testing Date	*04/2019*
Test Machine	*GSA 6500*	Moisture Condition	*Natural*	Tested By	*JsR*
Calibration Date	*16/8/2018*	Loading Rate	*< 30 seconds*		

Rock Type	Location	Depth (m)	Diametral Tests					Axial, Block, and Irregular Lump Tests							AS 1726 Strength Class
			D (mm)	L (mm)	P (kN)	$I_{s(50)}$ (MPa)	Failure Mode	W (mm)	D (mm)	L (mm)	P (kN)	I_s (MPa)	$I_{s(50)}$ (MPa)	Failure Mode	
Shale	***BH01***	***11.05***	*50*	*62*	*0*	***0***	*Parallel to bedding*	*50*	*44*		*0*	*0*	***0***	*Through substance*	
Shale	***BH01***	***11.95***	*50*	*100*	*0.1*	***0***	*Parallel to bedding*	*50*	*46*		*1*	*0.3*	***0.3***	*Through substance*	***VL / M***
Shale	***BH01***	***13.05***	*50*	*101*	*0.5*	***0.2***	*Parallel to bedding*	*50*	*48*		*0.9*	*0.3*	***0.3***	*Bad break*	***L***
Shale	***BH01***	***13.95***	*50*	*96*	*0.2*	***0.1***	*Parallel to bedding*	*50*	*43*		*1*	*0.4*	***0.4***	*Bad break*	***VL / M***
Shale	***BH01***	***14.90***					*Parallel to bedding*	*50*	*45*		*1.2*	*0.4*	***0.4***	*Through substance*	***M***
Shale	***BH02***	***14.35***	*50*	*82*	*0.1*	***0***	*Parallel to bedding*	*50*	*50*		*0.2*	*0*	***0***	*Through substance*	***VL***
Shale	***BH02***	***15.05***	*50*	*121*	*0.2*	***0.1***	*Parallel to bedding*	*50*	*50*		*0.2*	*0.1*	***0.1***	*Through substance*	***VL***
Shale	***BH03***	***12.95***	*50*	*76*	*0.2*	***0.1***	*Parallel to bedding*	*50*	*42*		*0.3*	*0.1*	***0.1***	*Through substance*	***VL / L***
Shale	***BH03***	***13.96***	*50*	*70*	*0.8*	***0.3***	*Parallel to bedding*	*50*	*40*		*0.8*	*0.3*	***0.3***	*Through substance*	***M***
Shale	***BH03***	***14.94***	*50*	*74*	*0.4*	***0.1***	*Parallel to bedding*	*50*	*46*		*0.4*	*0.2*	***0.2***	*Bad break*	***L***

By: *JsR* **Checked:** **Date:** *1/5/2019*

APPENDIX E

PIEZOMETER INSTALLATION RECORDS

Pells Sullivan Meynink
Engineering Consultants
Rock - Soil - Water

JOB no.: PSM2808

PROJECT: **Burrows Road**

PIEZOMETER CONSTRUCTION RECORD

HOLE NUMBER:	BH01	DRILLING CONTRACTOR:	Rockwell Drilling
PIEZOMETER:		DRILLING RIG:	Hanjin
COLLAR EASTING:	331557	DEPTH OF HOLE (m):	15 m
COLLAR NORTHING:	6245383	BOREHOLE INCLINATION:	Vertical
COLLAR RL(m):	2.1	PIEZO INSTALLATION DATE:	23/04/2019
DATUM:	MGA 56	SUPERVISED BY:	JsR

Tick boxes

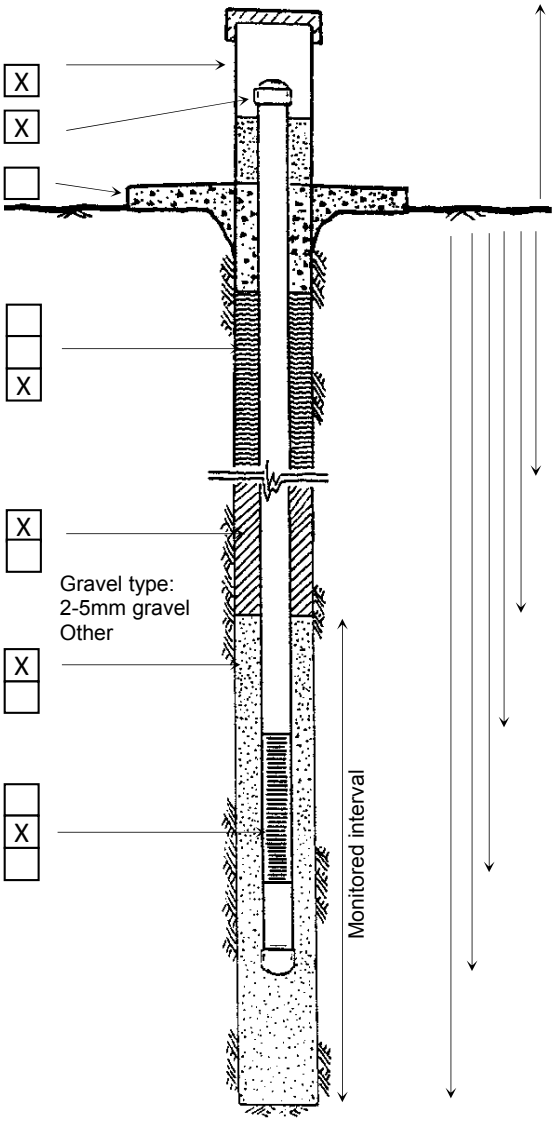
Steel protective **well cover** [X]
PVC cap [X]
Concrete Colar [ ]

Back Fill type
Cement bentonite [ ]
Soil [ ]
None [X]

Seal
Bentonite Pellets [X]
Other [ ]

Gravel type:
2-5 mm gravel [X]
Other [ ]

Perforation type:
Drill holes [ ]
Hack saw cuts [X]
40um machine slots [ ]



Complete dimensions if appropriate

Height of stickup (m)	
Diameter of PVC (mm)	50
Depth to top of seal	0.3 m
Depth to top of gravel pack	1.5 m
Depth to top of screen	6 m
Depth to base of screen	12 m
Depth to base of piezo	15 m
Depth to base of gravel	15 m

COMMENTS: Gatic cover were used for the protection

Pells Sullivan Meynink
Engineering Consultants
Rock - Soil - Water

JOB no.: PSM2808

PROJECT: **Burrows Road**

PIEZOMETER CONSTRUCTION RECORD

HOLE NUMBER:	BH02	DRILLING CONTRACTOR:	Rockwell Drilling
PIEZOMETER:		DRILLING RIG:	Hanjin
COLLAR EASTING:	331729	DEPTH OF HOLE (m):	15 m
COLLAR NORTHING:	6245470	BOREHOLE INCLINATION:	Vertical
COLLAR RL(m):	2.3	PIEZO INSTALLATION DATE:	24/04/2019
DATUM:	MGA 56	SUPERVISED BY:	JsR

Tick boxes

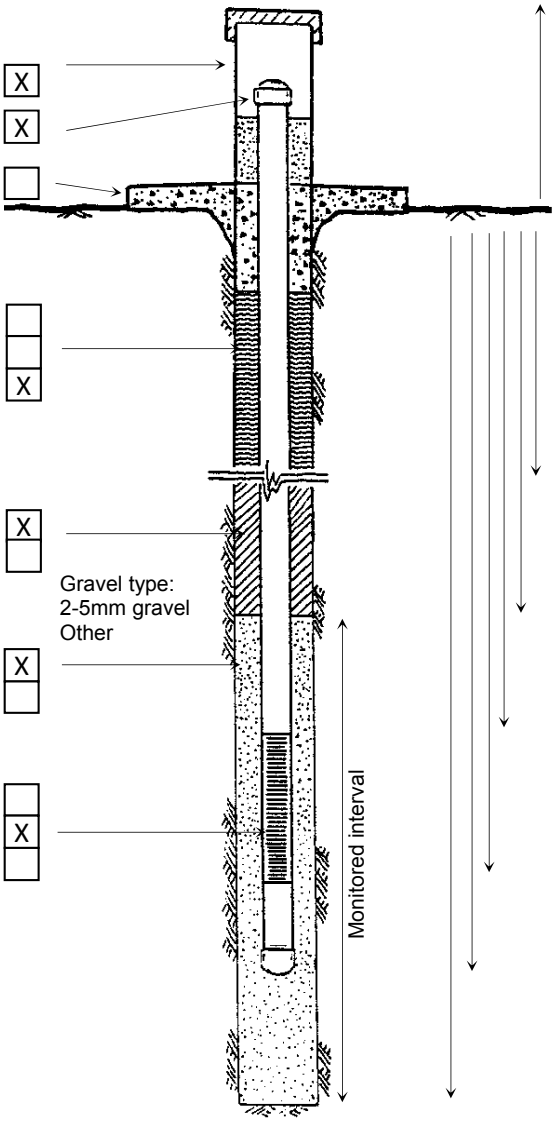
Steel protective **well cover** [X]
PVC cap [X]
Concrete Colar [ ]

Back Fill type
Cement bentonite [ ]
Soil [ ]
None [X]

Seal
Bentonite Pellets [X]
Other [ ]

Gravel type:
2-5 mm gravel [X]
Other [ ]

Perforation type:
Drill holes [ ]
Hack saw cuts [X]
40um machine slots [ ]



Complete dimensions if appropriate

Height of stickup (m)	
Diameter of PVC (mm)	50
Depth to top of seal	0.3 m
Depth to top of gravel pack	1.5 m
Depth to top of screen	6 m
Depth to base of screen	12 m
Depth to base of piezo	15 m
Depth to base of gravel	15 m

COMMENTS: Gatic cover were used for the protection

Pells Sullivan Meynink
Engineering Consultants
Rock - Soil - Water

JOB no.: PSM2808

PROJECT: **Burrows Road**

PIEZOMETER CONSTRUCTION RECORD

HOLE NUMBER:	BH03	DRILLING CONTRACTOR:	Rockwell Drilling
PIEZOMETER:		DRILLING RIG:	Hanjin
COLLAR EASTING:	331680	DEPTH OF HOLE (m):	15 m
COLLAR NORTHING:	6245385	BOREHOLE INCLINATION:	Vertical
COLLAR RL(m):	3.5	PIEZO INSTALLATION DATE:	24/04/2019
DATUM:	MGA 56	SUPERVISED BY:	JsR

Tick boxes

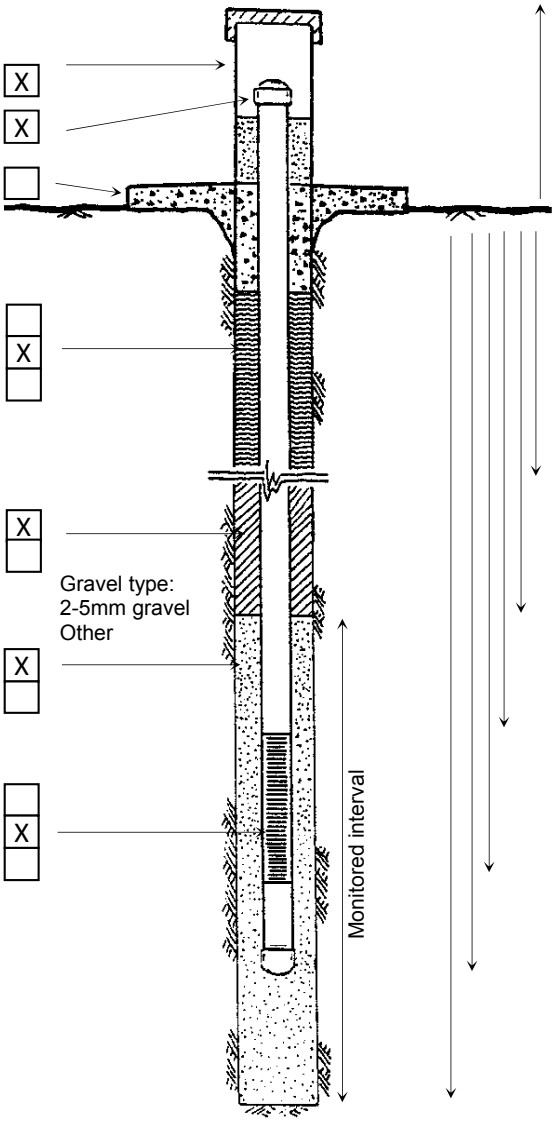
Steel protective **well cover** [X]
PVC cap [X]
Concrete Colar [ ]

Back Fill type
Cement bentonite [ ]
Soil [X]
None [ ]

Seal
Bentonite Pellets [X]
Other [ ]

Gravel type:
2-5 mm gravel [X]
Other [ ]

Perforation type:
Drill holes [ ]
Hack saw cuts [X]
40um machine slots [ ]



Complete dimensions if appropriate

Height of stickup (m)	
Diameter of PVC (mm)	50
Depth to top of seal	5 m
Depth to top of gravel pack	7 m
Depth to top of screen	9 m
Depth to base of screen	15 m
Depth to base of piezo	15 m
Depth to base of gravel	15 m

COMMENTS:	Gatic cover were used for the protection