Lay Lech, Centre Manager
Revelop Pty Ltd
E: lay@revelop.com.au
A: Suite 506, Level 5, 55 Phillip Street
Parramatta, NSW 2150

Site Location: Forestway Shopping Centre
Reference: GR23239
Report Date: 22/11/2023

RE: Geotechnical Investigation Report Review - Forestay Shopping Centre, Frenchs Forest, NSW

1. Introduction

CEC Geotechnical Pty Ltd, has been engaged by Revelop Pty Ltd to prepare a response to the existing Geotechnical Report prepared by Coffey Services Australia Pty Ltd (Coffey) SYDGE2) 17641AB 26 October 2018 for proposed development at the above-mentioned address. CEC Geotechnical carried out the site walkover for the assessment to confirm if there were any changes in the ground conditions.

From the information provided by client, it is understood that the proposed development will be carried out in two construction stages. The first stage will include the demolition of the existing carpark area on the east side of the development, and the construction of 5,400 m2 retail floor space over a two-level basement carpark.

1.1 Previous Geotechnical Investigation Report

This report is provided in accordance with the relevant standards and procedures. The summary of the Geotechnical Report by Coffey Services Australia Pty Ltd (Coffey) SYDGE2) ref: 17641AB 26 October 2018, are provided below:

- Four boreholes (BH01 to BH04) were drilled as shown in Figure 1; and
- The soil and rock profiles encountered during the investigation have been characterised into the following geotechnical units as shown in Table 1.

Figure 1: Site Location Plan

Table 1: Subsurface conditions

Unit	Origin	Description(d)	Approximate Depth to Top of Unit (m bgl)	Range of Unit Thickness (m) [a]
P1	PAVEMENT	Pavement over sands, gravel and clay	0	0.13 to 0.4 [b]
F1	TOPSOIL/FILL	CLAY of low to medium plasticity and SAND of fine to coarse grained with cement, and sub angular gravel	0 to 0.40 to 0.4	0.3 to 0.77
R1	RESIDUAL	SAND of fine to medium grained and CLAY of medium to high plasticity with silt, EXTREMELY WEATHERED ROCK	0.4 to 0.90.4 to 0.9	0.1 to 1.5
B1	BEDROCK	Extremely- Highly weathered SILTSTONE, High Strength. Class III Shale or better [c]	0.6	3.3 to Unproven
B2		Extremely- Highly weathered SANDSTONE, Low to medium strength. Class IV Sandstone [c]	3.9	3.80 to Unproven
B3		Slightly weathered to Fresh SANDSTONE, High Strength Class III Sandstone or better [c]	2.0 to 7.66	Unproven

For detailed descriptions of the materials and sub-surface conditions encountered at each borehole, and geotechnical design parameters please refer to the existing Geotechnical Investigation Report presented within the attachments.

2. Recommended Additional Geotechnical Works

We, CEC Geotechnical, recommend an additional geotechnical investigation should be carried out to verify the data presented in the existing report and optimise the design parameters. The following scope of works should be carried out:

- 4 deep boreholes drilled to TC-bit refusal by a machine drilling rig and then drilled with NMCL coring up to approx. 10m deep.
- Installation of 3 groundwater wells and monitoring for 1 month.

3. Limitations

This letter and associated documentation and the information herein have been prepared solely for the use of and Revelop Pty any reliance assumed by third parties on this letter shall be at such parties' own risk. Any ensuing liability resulting from use of the report by third parties cannot be transferred to CEC Geotechnical Pty Ltd, its directors or employees. The conclusions and recommendations of this report should be read in conjunction with the entire report.

For and on behalf of CEC Geotechnical Pty Ltd

Shyam Ghimire

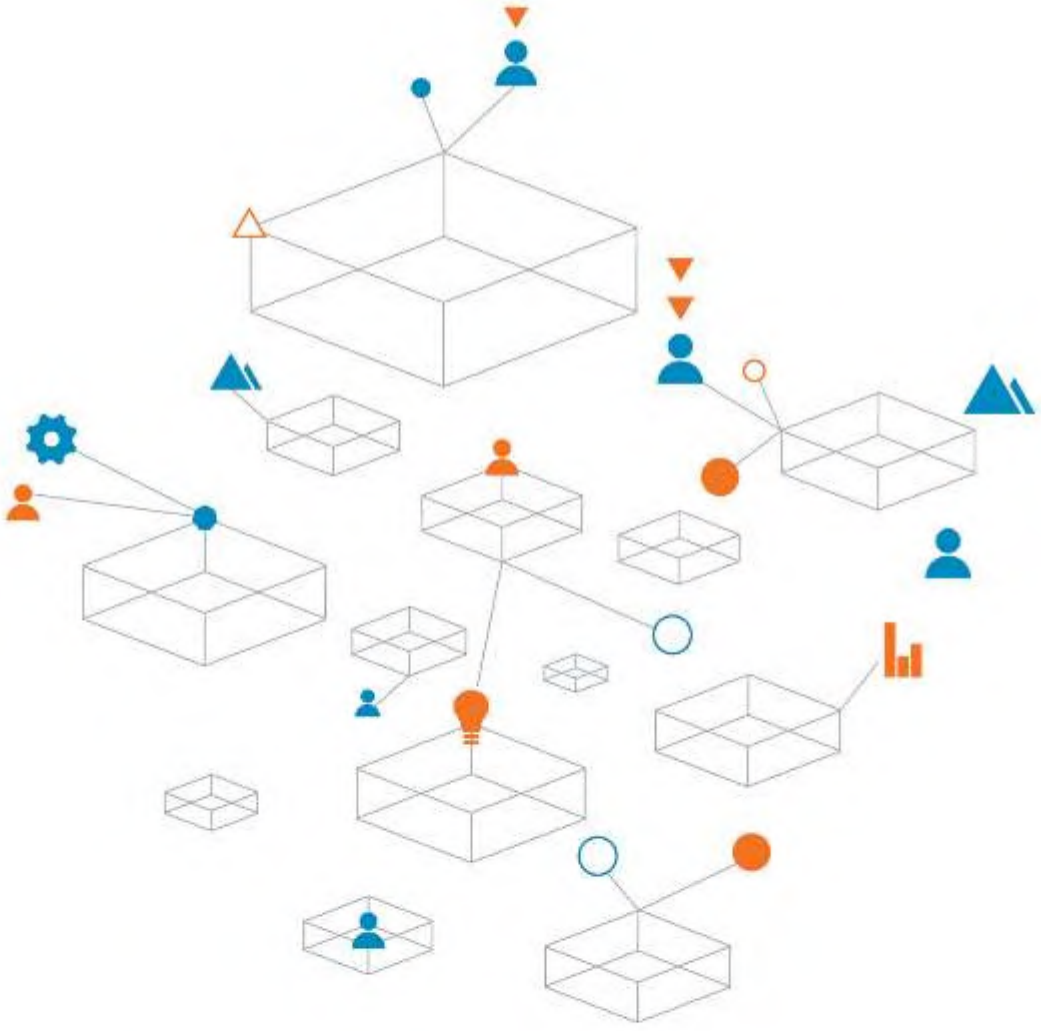
Principal Engineering Geologist
B.Sc. M.Sc. AIG. RPgeo (Geotechnical Engineering)

Attachments:

- Geotechnical investigation Report by Coffey Services Australia Pty Ltd (Coffey) SYDGE2)17641AB 26 October 2018

Point Polaris
Forestway Shopping Centre
SYDGE217641

26 October 2018



Trust is the cornerstone of all our projects

This page has been left intentionally blank

Forestway Shopping Centre

Prepared for
Point Polaris

Prepared by
Coffey Services Australia Pty Ltd
Level 19, Tower B, Citadel Tower, 799 Pacific Highway
Chatswood
NSW 2067 Australia
t: +61 2 9406 1000 f: +61 2 9415 1678
ABN 55 139 460 521

26 October 2018

SYDGE217641AB

SYDGE217641

Quality information

Revision history

Revision	Description	Date	Originator	Reviewer	Approver
0 draft	For comments	10 Aug 2018	Lily Parchizadeh	Viet Nguyen	Viet Nguyen
1	Final	26 Oct 2018	Lily Parchizadeh	Viet Nguyen	Viet Nguyen

Distribution

Report Status	No. of copies	Format	Distributed to	Date
0 draft	1	PDF	Rob Han (Point Polaris)	10 Aug 2018
1 final	1	PDF	Rob Han (Point Polaris)	26 Oct 2018

Table of contents

1. Introduction 1
2. Site description 1
3. Investigation Methodology 2
   3.1. Site Investigation 2
   3.2. Laboratory Testing 3
4. Result of Investigation 3
   4.1. Local Geology 3
   4.2. Geotechnical model 3
   4.3. Groundwater Condition 4
   4.4. Laboratory Test Results 5
      4.4.1. Geotechnical Laboratory Test Results – Soil 5
      4.4.2. Geotechnical Laboratory Test Results – Rock 6
      4.4.3. Aggressivity Soil Testing Results 6
5. Discussion and Recommendations 7
   5.1. Basement Excavation 7
      5.1.1. Excavation works 7
      5.1.2. Excavation induced ground movement 7
      5.1.3. Unsupported temporary excavations 7
      5.1.4. Temporary and permanent excavation support 8
   5.2. Building Foundations 9
      5.2.1. Shallow Foundations 9
      5.2.2. Pile Foundation 10
      5.2.3. Soil Aggressivity 10
   5.3. Earthworks 10
      5.3.1. Subgrade preparation 10
      5.3.2. Engineered Fill compaction 11
6. Pavements 11
7. Limitations 11

Tables

Table 1 - Summary of Subsurface Conditions and Inferred Geotechnical Units
Table 2 - Summary of geotechnical laboratory test results - soil
Table 3 - Summary of geotechnical laboratory test results - Rock
Table 4 - Summary of aggressivity laboratory test results
Table 5 – Recommended Batter Slopes for exposed material
Table 6 – Recommended Parameters for retaining wall design
Table 7 - Recommended bond stresses for ground anchors
Table 8 – Recommended ground vibration limits for structures
Table 9 - Recommended pile foundation design parameters for pile design

Figures

Figure 1 - Site Location Plan

Appendices

Appendix A - Borehole Location Plan
Appendix B – Borehole Logs
Appendix C – Monitoring Wells
Appendix D – Laboratory Testing Results

1. Introduction

Coffey Services Australia Pty Ltd (Coffey) was commissioned by Point Polaris to undertake a geotechnical investigation for the proposed redevelopment at the Forestway Shopping Centre, Frenchs Forest, NSW. The investigation was carried out in general accordance with our fee proposal (Ref: SYDGE217641AA, dated 18 April 2018) which was prepared at the request of Point Polaris.

Coffey was advised that that the proposed site redevelopment will be carried out in two construction stages. The first stage will include the demolition of the existing carpark area on the east side of the development, and the construction of 5,400 m^2 retail floor space over a two-level basement carpark. In the second stage, additional 11,500 m^2 retail floor space may be added by raising the rooftop carpark one level and converting the present carpark to retail floor area.

The purpose of this geotechnical investigation was to obtain geotechnical information on subsurface conditions and to provide comments and recommendations on the following:

- Subsurface conditions and geotechnical model;
- Basement excavation and subgrade preparation;
- Excavatability of the ground, excavation batters and stability, and trafficability of the subgrade,
- Temporary retention systems and relevant geotechnical design parameters;
- building footing types and geotechnical design parameters;
- Soil aggressivity to buried steel and concrete;
- Relevant geotechnical recommendations for construction phase.

Please note that this report must be read in accordance with the “Important Information about your Coffey Report” attached with this document.

2. Site description

The site location plan is shown in Figure 1. It is located within the existing Forestway shopping centre at the corner of Forest way and Russell avenue, Frenchs forest. The site is bounded by Forest way to the east, Grace avenue to the west and Russell avenue to the North. It is relatively flat, situated on a local high plateau. To the west of the site, beyond Grace avenue the ground slopes steeply (between 15° to 20°) west towards Lane Cove river. The southern section of the site, comprising the residential area, has a gentle (<5°) slope to the south, towards Warringah road.

Figure 1 - Site Location Plan

3. Investigation Methodology

3.1. Site Investigation

The fieldwork was carried out from 26 July to 30 July 2018 and comprised the drilling of four boreholes numbered BH1 to BH4. The borehole locations, as shown on the attached borehole location plan in Appendix A, were nominated by the client and determined on site by Coffey after the clearance of underground services at the drilling locations.

The boreholes were drilled using a combination of a track mounted drilling rigs, Geoprobe 7822 DT, Comacchio 405 and Cross Country. The boreholes were commenced using rotary flight augers in soils up to a maximum depth of 2 m. Disturbed soil samples were collected during drilling.

Upon the refusal of augering in rock, the boreholes were then extended into the rock using NMLC sized diamond coring equipment to reach the required target depths. The recovered rock core was logged, boxed and photographed. To assist in assessing rock strength, the recovered rock core was Point Load Index tested at a nominal spacing of 1 meter.

On completion of the drilling, standpipe piezometers were installed at BH1 and BH3 for groundwater level monitoring.

A Coffey Geotechnical Engineer was present throughout the drilling operations to sample, record test results and log materials encountered. The Engineering Borehole Logs are presented in Appendix B, with Coffey soil and rock explanations sheets.

3.2. Laboratory Testing

Collected soil samples and rock cores were sent NATA accredited laboratories for testing. Selected samples were chosen for the following tests:

- Three moisture contents,
- One Atterberg Limits and Linear Shrinkage tests,
- Three California Bearing Ratio (CBR) and compaction tests; and
- Six soil aggressivity tests including PH, Sulphate and Chloride tests,
- Point load index testing at every 1m length of rock cores.

The results of the laboratory testing are detailed in Appendices D, E and F and summarised in section 4.

4. Result of Investigation

4.1. Local Geology

The 1:100,000 Sydney Geological Sheet indicates that the site locality is underlain by Hawkesbury Sandstone comprising medium to coarse grained quartz sandstone, with very minor shale and laminate lenses which is of Middle Triassic Age. The lenses are slightly carbonaceous and often laminated with fine sandstone. An igneous dyke is shown on the Geological Sheet tending north west to south east, approximately 500 m from the site.

4.2. Geotechnical model

For geotechnical characterisation of the subsurface conditions, the soil and rock profiles encountered during the investigation have been characterised into the following geotechnical units as shown in Table 1 below.

Table 1 - Summary of Subsurface Conditions and Inferred Geotechnical Units

Unit	Origin	Description(d)	Approximate Depth to Top of Unit (m bgl)	Range of Unit Thickness (m) [a)]
P1	PAVEMENT	Pavement over sands, gravel and clay	0	0.13 to 0.4 [b)]
F1	TOPSOIL/FILL	CLAY of low to medium plasticity and SAND of fine to coarse grained with cement, and sub angular gravel	0 to 0.40 to 0.4	0.3 to 0.77
R1	RESIDUAL	SAND of fine to medium grained and CLAY of medium to high plasticity with silt, EXTREMELY WEATHERED ROCK	0.4 to 0.90.4 to 0.9	0.1 to 1.5
B1	BEDROCK	Extremely- Highly weathered SILTSTONE, High Strength. Class III Shale or better [c)]	0.6	3.3 to Unproven
B2		Extremely- Highly weathered SANDSTONE, Low to medium strength. Class IV Sandstone [c)]	3.9	3.80 to Unproven
B3		Slightly weathered to Fresh SANDSTONE, High Strength Class III Sandstone or better [c)]	2.0 to 7.66	Unproven

Notes:

a) The depths and unit thicknesses are based on the boreholes and may not represent the stratigraphy or the maximum or minimum depths and thicknesses of stratigraphic units across the entire site.

b) Deeper fill was observed in the northern portion of the site.

c) Rock classification is based on "Foundations on Sandstone and Shale in the Sydney Region" Aust. Geomech. Jnl, Dec 1998, Pells et al (1998).

For detailed descriptions of the materials and sub-surface conditions encountered at each borehole, reference should be made to the boreholes logs and core photographs presented within Appendix B.

4.3. Groundwater Condition

Groundwater was not encountered in soil and upper levels of the very low strength rock during auger drilling (which extended to depths up to 2 m). It was not possible to assess groundwater conditions over the depth of NMLC coring because water was used to lubricate and cool the drill bit while drilling.

It shall be noted that groundwater levels may vary due to seasonal changes and other factors, such as prolonged periods of high rainfall or localised events such as failures of service lines.

After drilling, standpipe piezometers were installed at BH1 and BH3 for the purposes of groundwater level monitoring. Standpipe construction sketches are presented in Appendix C. At the time when this report was prepared no readings were taken for the standpipe.

4.4. Laboratory Test Results

4.4.1. Geotechnical Laboratory Test Results – Soil

Laboratory test results are summarised in Table 2 below. For further detail reference should be made to the laboratory test certificates presented in Appendix D.

Table 2 - Summary of geotechnical laboratory test results - soil

Location ID	Details			Atterberg limits				CBR and Compaction			Moisture Content
	Depth (m)	Origin	Material	LS (%)	LL (%)	PL (%)	PI (%)	CBR (%)	MDD (t/m^3)	OMC (%)	
BH1	0.9 – 1.0	Residual	Sand	-	-	-	-	-	-	-	10.9
BH2	0.0 – 0.4	Fill	Gravelly Clayey Sand	-	-	-	-	25	1.98	10.5	-
BH2	0.4 – 0.9	Fill	Sand	-	-	-	-	8	1.92	13.2	-
BH3	0.4 – 0.6	Residual	Clay	10.5	43	15	28	-	-	-	13.1
BH4	0 – 0.9	Fill	Gravelly Sandy Clay	-	-	-	-	12	1.97	10.6	-
BH4	0.9 – 1.0	Residual	Sand	-	-	-	-	-	-	-	13.6

4.4.2. Geotechnical Laboratory Test Results – Rock

Table 3 - Summary of geotechnical laboratory test results - Rock

BH ID	Sample depth (m)	Rock Type	Point Loadex ($I_{s(50)}$)	
			Diametral (MPa)	Axial (MPa)
BH1	2.69	Sandstone	2.18	2.48
BH1	3.60	Sandstone	1.63	1.98
BH1	4.68	Sandstone	1.70	2.37
BH1	5.74	Sandstone	2.22	4.25
BH1	6.11	Sandstone	1.58	3.21
BH1	7.85	Sandstone	0.56	1.06
BH1	8.40	Sandstone	1.16	1.96
BH1	9.16	Sandstone	2.43	2.59
BH3	1.70	Interbedded Siltstone and Ironstone	2.58	3.23
BH3	2.10	Interbedded Siltstone and Ironstone	1.47	2.19
BH3	3.63	Interbedded Siltstone and Ironstone	2.04	2.59
BH3	4.40	Interbedded Sandstone and Ironstone	0.55	1.29
BH3	5.83	Interlaminated Sandstone and Siltstone	0.17	0.43
BH3	6.15	Interlaminated Sandstone and Siltstone	0.08	0.23
BH3	7.72	Interlaminated Sandstone and Siltstone	4.12	7.29
BH3	8.55	Interlaminated Sandstone and Siltstone	1.59	2.71
BH3	9.45	Interlaminated Sandstone and Siltstone	1.66	1.78

4.4.3. Aggressivity Soil Testing Results

Aggressivity soil testing results are summarised in Table 4. The testing certificates are presented in Appendix D.

Table 4 - Summary of aggressivity laboratory test results

Location-ID	Top Depth (m)	Bottom Depth (m)	% Moisture	Chloride (mg/kg)	Conductivity (1:5 aqueous extract at 25Â°C) (uS/cm)	pH (1:5 Aqueous extract) (pH Units)	Resistivity (ohm.m)	Sulphate (as SO_4) (mg/kg
BH1	0.9	1.0	9.5	72	110	6.5	470	98
BH2	0.4	0.9	12	100	200	6.0	250	260
BH2	0.9	1.0	8.3	40	81	5.6	620	100
BH3	0.4	0.6	9.6	21	130	6.8	380	180
BH4	0.9	1.0	12	<10	23	6.8	2200	28
BH4	1.0	1.1	7.0	<10	23	5.8	2200	46

5. Discussion and Recommendations

5.1. Basement Excavation

5.1.1. Excavation works

Based on subsurface conditions, the proposed excavations are likely expected to encounter the existing Fill, Residual Soil and Sandstone Bedrock.

Excavations of soil strength materials and highly weathered rock should be able to be excavated using conventional earthmoving equipment such as a tracked excavator with toothed bucket or tracked excavator. Light ripping may be used to excavate extremely and highly weathered bedrock. Where moderately weathered or better bedrock is present, hard rock excavation techniques such as large dozers fitted with rippers, or large excavators fitted with rock saws, rock grinders and rock hammers may be used. The use of hard rock excavation techniques will cause vibrations that could damage vibration sensitive structures, infrastructure and underground services. Assessment of the potential impacts of excavation induced vibrations should be considered as part of the detailed design and excavation planning.

5.1.2. Excavation induced ground movement

Excavation will cause some ground movements adjacent to the excavation site. Many factors can influence the size of these movements, from ground conditions to design and construction quality. Documented data has shown that for well-designed and constructed shoring, vertical and lateral movements can be about 0.1% to 0.3% of the retained height at the excavation face.

Lateral ground movements can occur at distances up to twice the basement depth from the edge of excavations. This affects adjacent properties and services. At a lateral distance equal to the excavation depth, the typical movement can be up to 30% of the displacement, at the excavation perimeter.

If this aspect is critical, we can assess (possibly by numerical analysis) the likely ground movements during design of the temporary retaining wall. Such cases should be specifically addressed by Coffey during detailed design when more design information becomes available.

5.1.3. Unsupported temporary excavations

Batter slopes or bench excavation may be possible where excavations are set back sufficiently from adjacent structures and boundary. The batter slopes or benches should be scaled following excavation to remove all loose material which could slide or topple from the face during construction and hence pose a risk to construction personnel.

Table 5 below provides a summary of the recommended batter slopes for each geotechnical unit expected within the depth of excavation. It should be noted that the proposed batters in rock are subject to assessment by a geotechnical engineer during construction. If adverse joints or other defects are present, flatter batters or stablisation may be required.

Table 5 – Recommended Batter Slopes for exposed material

Unit	Brief Description	Maximum short-term batter slope	Maximum long-term batter slope
F1	Gravelly, sandy clays and clayey sands of fine to coarse grained sand with low to medium plasticity clay and fine to coarse grained sub angular gravel	2H:1V	3H:1V
R1	Dense to very dense sand or clayey sands and very stiff clays of fine to medium grained sand and medium to high plasticity clay with silt	1.5H:1V	2H:1V
B1	Extremely-Highly weathered SILTSTONE, High Strength, Class III Shale	1H:1V	1.5H:1V
B2	Extremely-Highly weathered SANDSTONE, Low to medium strength. Class IV Sandstone	1H:1V	1.5H:1V
B3	Slightly weathered to Fresh SANDSTONE, High Strength, Class III Sandstone	0.5H:1V	1H:1V

5.1.4. Temporary and permanent excavation support

Where unsupported, open excavations are impracticable, a temporary retaining wall, such as cantilever walls, soldier pile walls with infill panels (usually shotcrete, timber planks or precast concrete panels) or anchored pile walls can be considered.

A triangular lateral earth pressure distribution may be assumed for the retention system design. As a guide Table 6 below presents recommended design parameters that can be adopted for retaining wall design where there is a level retained ground surface

Table 6 – Recommended Parameters for retaining wall design

Unit	Bulk Density γ (kN/m3)	Effective Cohesion c' (kPa)	Effective Friction Angle Φ' (degrees)	Coefficient of Active Earth pressure, Ka	Coefficient of Earth pressure at rest, Ko	Coefficient of Passive Earth pressure, Kp	Elastic Modulus (MPa)
Fill / Residual Soils	20	2	33	0.3	0.5	3.33	30
Shale Class III	21	10	35	0.3	0.5	2.5	150
Sandstone Class IV	22	25	35	0.2	4	2	200
Sandstone Class III	22	50	35	0.1	5	2	500

The K_o value in Table 6 assumes that some wall movement and relaxation of horizontal stress will occur due to the excavation. Actual in-situ K_o values may be higher, particularly in the rock units. Retaining wall analyses will need to consider surcharges, footing loads from adjacent structures and hydrostatic pressure.

Ground anchors can be considered in to limit adjacent ground movement induced by excavation. The ground anchor designs should be based on allowing effective anchorage to be developed by locating the bond length behind an 'active zone', determined by drawing a line at 45° from the base of the wall

to intersect the ground surface behind the excavated face. The following ultimate bond stresses presented in Table 7 below can be adopted for anchors with the provision that bond lengths are between 3 m to 5 m anchors are to be proof loaded to at least 1.5 times their design working load. A minimum factor of safety of 2 should be applied for assessment of allowable bond stress.

Table 7 - Recommended bond stresses for ground anchors

Unit / Material Description	Ultimate Bond Stress (kPa)
R1: Residual Sand/ Clay	75
B1: High strength, extremely-highly weathered Siltstone Class III Shale or better	200
B2: Low to medium, extremely-highly weathered Sandstone Class IV Sandstone	150
B3: High strength, slightly weathered to fresh Sandstone Class III Sandstone or better	250

For anchors in the soil units, high bond stresses are possible with the use of pressure grouts or post grouts anchors. Advice should be sought from specialist ground anchor contractors for proprietary systems.

The use of excavation plant such as impact hammers will generate vibrations that may affect any surrounding sensitive structures and buried services. Measures to mitigate the risks associated with construction vibration such as the use of jack hammer and excavator for existing building demolition should be considered. The vibration limits in Table 8 below are commonly recommended to reduce the risk of vibration damage to sensitive receptors.

Table 8 – Recommended ground vibration limits for structures

Type of Structure	Peak Particle Velocity (mm/s)
Residential or low-rise buildings in good condition	10
Reinforced concrete commercial and industrial buildings in good condition	25

5.2. Building Foundations

Design of the proposed structure foundations should be undertaken in accordance with the requirements of the following:

- AS 2870 (2011) Residential Slabs and Footings
- AS 2159 (2009) Piling – Design & Instillation
- Other relevant Australian and international standards
- Engineering principals

5.2.1. Shallow Foundations

Based on the subsurface conditions encountered in the boreholes, footings for the proposed development may be founded within rock material. It is recommended that within the subsurface materials over the sandstone layer, an allowable bearing pressure of 200 kPa be adopted for the design of spread footings up to 3 m wide.

All footings should be inspected by a geotechnical engineer to confirm that a suitable founding stratum has been reached.

5.2.2. Pile Foundation

Table 9 presents recommended geotechnical design parameters for pile design at the site.

Table 9 - Recommended pile foundation design parameters for pile design

Unit	Material Description	Ultimate End Bearing Value (MPa) (a,b)	Limit State Design Values	
			Ultimate Shaft Adhesion (kPa)(b)	Vertical Young's Modulus (MPa)
B1	Class III Shale or better Extremely-highly weathered SILTSTONE, High Strength.	12	400	700
B2	Class IV Sandstone Extremely-highly weathered SANDSTONE, Low to medium strength.	8	500	400
B3	Class III Sandstone or better Slightly weathered to Fresh SANDSTONE, High Strength	40	1500	1200

Notes:

a) Assumes a minimum embedment depth of at least 0.5 m into the relevant bearing stratum.
b) Shaft adhesion assumes a rough socket (at least grooves of depth 1 mm to 4 mm and width greater than 5 mm at spacing of 50 mm to 200 mm).
c) For ultimate limit state design, serviceability should be assessed using the elastic modulus value to check that settlements are within tolerable limits.

For limit state design, the design ultimate geotechnical pile capacity is derived by applying a geotechnical strength reduction factor (Φ_g) to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 9. In accordance with AS2159-2009, Φ_g is dependent on an Average Risk Rating (ARR) which considers various geotechnical uncertainties, foundation system redundancy, construction supervision, quantity and type of pile testing. To assist you with preliminary design we recommend Φ_g of 0.5 be adopted assuming some pile testing will be specified.

5.2.3. Soil Aggressivity

Based on laboratory test results summarised in Table 5, the soil could be classified as *TBC* according to AS2159-2009 for concrete and steel.

5.3. Earthworks

5.3.1. Subgrade preparation

Prior to constructing subgrade layers by engineered fill, the pavement layer and the underlying fill should be removed and stockpiled separately for appropriate reuse. The exposed material should be proof rolled with at least four passes of a non-vibratory smooth drum roller of minimum 12 tonne dead weight. Any soft or heaving areas should be excavated and replaced with engineered fill, compacted as specified in Section 5.4.2.

Trafficability in silty and clayey materials for wheeled vehicles can be expected to be difficult during and following rainfall due to surface heaving and / or rutting.

5.3.2. Engineered Fill compaction

For bulk earthworks using modern purpose-built earthmoving plant, fill material should be placed in layers not exceeding 300mm loose thickness and moisture conditioned to Standard Optimum Moisture Content (SOMC) ± 2%.

All engineered fill should be compacted to achieve a minimum dry density ratio of 98% SMDD (Standard Maximum Dry Density and moisture conditioned to SOMC ± 2% at the time of compaction.

Earthworks construction should be constructed under Level 1 geotechnical inspection and testing as defined in AS3798-2007.

6. Pavements

Onsite fill materials may be reused for the construction of road pavements. Based on the results of the site investigation and laboratory testing results listed in Table 2, a minimum design CBR of 5 is recommended for the gravely clayey sand or sand fill material. It should be noted that the design CBR value will depend on the provision of adequate surface and subsoil drainage to maintain the subgrade as close as SOMC as possible. Preparation of subgrade surfaces should be such that adequate cross-falls for surface drainage purposes are achievable across the final pavement.

7. Limitations

Subsurface conditions can be complex and may vary over relatively short distances – and over time. The inferred geotechnical model and recommendations in this report are based on limited subsurface investigations at discrete locations. The engineering logs describe subsurface conditions only at the investigation locations. Further investigations may be required to support detailed design if there are scope limitations or changes to the nature of the project. We can assist with detailed design and/or to review designs and verify that the conditions exposed are consistent with design assumptions during construction. The attached document entitled “Important information about your Coffey report” forms an integral part of this report and presents additional information about its uses and limitations.

Appendix A - Borehole Location Plan


BH1
BH2
BH3
BH4
FOREST WAY
FOREST WAY
SORLIE PLACE
SORLIE PLACE
20
DP 1209801
20
DP 1209801
20
DP 1209801
20

This page has been left intentionally blank

Appendix B – Borehole Logs

coffey
A TETRA TECH COMPANY

Engineering Log - Borehole

Borehole ID.	**BH1**
sheet:	1 of 2
project no.	**754-SYDGE217641**
client:	**Point Polaris**
date started:	**26 Jul 2018**
principal:	
date completed:	**26 Jul 2018**
project:	**Forestway Shopping Centre Development**
logged by:	**LP**
location:	**Corner of Russell Avenue and Grace Avenue**
checked by:	

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 52/125

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
AD/T, CASING		Not Observable	D		0.0			**SILTY SAND**: fine - medium grained, brown, with silt and fine-coarse grained gravel, trace of rootlets.	M	MD		**TOPSOIL**
								SAND: fine - medium grained, brown, trace of silt and gravel.		MD - D		**FILL**
			D		1.0			**SAND**: fine - medium grained, pale yellow-orange, trace of silt with low-medium plasticity clay.	D	D		**RESIDUAL SOIL**
					2.0			**CLAYEY SAND**: fine grained, pale grey-white, with medium plasticity clay (Extremely weathered sandstone).		VD		**EXTREMELY WEATHERED ROCK**
								Borehole BH1 continued as cored hole				
					3.0							
					4.0							
					5.0							
					6.0							
					7.0							

CDF_0_9_06_LIBRARY.GLB rev:AO Log COF BOREHOLE: NON CORED 754-SYDGE217641.GPJ <<DrawingFile>> 26/10/2018 16:57

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- * bit shown by suffix
- e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH1**
sheet:	2 of 2
project no.	**754-SYDGE217641**
client:	**Point Polaris**
date started:	**26 Jul 2018**
principal:	
date completed:	**26 Jul 2018**
project:	**Forestway Shopping Centre Development**
logged by:	**LP**
location:	**Corner of Russell Avenue and Grace Avenue**
checked by:	

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 52/125 | vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC	Not Observable				start coring at 2.00m						
					SANDSTONE: fine - medium grained, massive, pale grey, with occasional laminaes of red-orange sandstone at 0-10°.	SW - FR		a=2.48 d=2.18			**BEDROCK** JT, 15°, PL, RO, SN
			3.0		3.00 m: with indistinct laminaes at 10-20°						JT, 10°, UN, RO, SN
									95%		JT, 10°, PL, SO, CO, 1 mm JT, 25°, PL, SO, CO, 1 mm PT, 0°, UN, SO, CO, 1 mm
								a=1.98 d=1.63			
			4.0		4.18 m: incipient parting						PT, 0°, PL, SO, CO PT, 15°, UN, RO, CO PT, 0°, PL, SO, CO
								a=2.37 d=1.70			
			5.0								JT, 20°, UN, RO, CN
					5.30 m: distinctly laminated medium-coarse grained, orange SANDSTONE with white/black quartz	HW - MW					PT, 15°, UN, RO, SN
								a=4.25 d=2.22			JT, 25°, PL, SO, CO JT, 25°, PL, SO, CO
			6.0		6.00 m: angle of laminaes changes to 20-30°			a=3.21 d=1.58	99%		
					6.20 m: angle of laminaes changes to 0-10°						SM, SO, Clayey sand CO, 40 mm
											SM, SO, cementitious CO, 20 mm, pale grey SM, SO, cementitious CO, 5 mm PT, 0°, PL, SO, CN PT, 15°, PL, SO, CN
			7.0			MW					
								a=1.06 d=0.56			
			8.0		8.00 m: distinctly laminated medium-coarsegrained, pale grey-grey SANDSTONE at 15-20°, with quartz	FR					PT, 10°, PL, RO, CO, 1 mm, trace of quartz PT, 10°, PL, SO, CO, 1 mm
								a=1.96 d=1.16	100%		
			9.0								JT, 5°, UN, RO, CO, black quartrz coating
								a=2.59 d=2.43			
					Borehole BH1 terminated at 9.20 m Target depth						

CDF_0_9_06_LIBRARY.GLB rev:AO Log COF BOREHOLE: CORED 754-SYDGE217641.GPJ <<DrawingFile>> 26/10/2018 16:58

method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn
- RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

PointID : BH1 Depth Range: 2.00 - 7.00 m

drawn	**LP**
approved	**VN**
date	**10/08/2018**
scale	**N.T.S.**
original size	**A4**

coffey
A TETRA TECH COMPANY

client: Point Polaris

project: Forestway Shopping Centre Development
Forestway Shopping Centre

title: **CORE PHOTOGRAPH**
BH1

project no: 754-SYDGE217641 | fig no: **FIGURE 1** | rev:

PointID : BH1 Depth Range: 7.00 - 9.20 m

drawn	**LP**
approved	**VN**
date	**10/08/2018**
scale	**N.T.S.**
original size	**A4**

coffey
A TETRA TECH COMPANY

client: Point Polaris

project: Forestway Shopping Centre Development
Forestway Shopping Centre

title: **CORE PHOTOGRAPH**
BH1

project no: 754-SYDGE217641 | fig no: **FIGURE 2** | rev:

coffey
A TETRA TECH COMPANY

Engineering Log - Borehole

Borehole ID.	***BH2***
sheet:	1 of 1
project no.	***754-SYDGE217641***
client:	***Point Polaris***
date started:	***26 Jul 2018***
principal:	
date completed:	***26 Jul 2018***
project:	***Forestway Shopping Centre Development***
logged by:	***LP***
location:	***Adjacent to Russell Avenue***
checked by:	

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 405, Track mounted | drilling fluid: | hole diameter : 200 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
AD/T		Not Encountered	B					**ASPHALT**: dark grey.	D	D		**ASPHALT**
								Gravelly CLAYEY SAND: fine - coarse grained, dark grey, with medium plasticity clay and fine - coarse grained subangular gravel, trace of red ironstone.		MD - D		**ROADBASE**
								CLAYEY SAND: fine - coarse grained, grey/pale grey/dark grey, with medium plasticity clay and fine to medium grained gravel.				
			B		0.5			**SAND**: fine - medium grained, pale grey, cementitious (Exteremely weathered sandstone).	M	D - VD		**FILL**
			D									**EXTREMELY WEATHERED ROCK**
					1.0			Borehole BH2 terminated at 1.0 m Target depth				
					1.5							

CDF_0_9_06_LIBRARY.GLB rev:AO Log COF BOREHOLE: NON CORED 754-SYDGE217641.GPJ <<DrawingFile>> 26/10/2018 16:58

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
A TETRA TECH COMPANY

Engineering Log - Borehole

Borehole ID.	***BH3***
sheet:	1 of 3
project no.	***754-SYDGE217641***
client:	***Point Polaris***
date started:	***30 Jul 2018***
principal:	
date completed:	***30 Jul 2018***
project:	***Forestway Shopping Centre Development***
logged by:	***LP***
location:	***Adjacent to Forest Way***
checked by:	

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Cross Country, Track mounted | drilling fluid: Water | hole diameter : 52/125

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T — CASING		Not Observable	D					**SILTY SAND**: fine to coarse grained, brown, with silt and fine to coarse grained gravel, trace of rootlets (organics).	D	MD		**TOPSOIL**
									~Wp	St		**FILL**
			D					**Gravelly CLAY**: low to medium plasticity, brown-red, with medium to coarse subangular grey-brown gravels, trace of red sandstone (Ironstone) and silt.	>Wp	VSt		**RESIDUAL SOIL**
					1.0			**CLAY**: medium to high plasticity, red-orange, with fine subangular gravel and silt.				
								Borehole BH3 continued as cored hole				
					2.0							
					3.0							
					4.0							
					5.0							
					6.0							
					7.0							

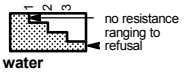
CDF_0_9_06_LIBRARY.GLB rev:AO Log COF BOREHOLE: NON CORED 754-SYDGE217641.GPJ <<DrawingFile>> 26/10/2018 16:59

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

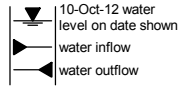
* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration



water



samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH3**
sheet:	2 of 3
project no.	**754-SYDGE217641**
client: **Point Polaris**	date started: **30 Jul 2018**
principal:	date completed: **30 Jul 2018**
project: **Forestway Shopping Centre Development**	logged by: **LP**
location: **Adjacent to Forest Way**	checked by:

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Cross Country, Track mounted | drilling fluid: Water | hole diameter : 52/125 | vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description (ROCK TYPE: grain characterisics, colour, structure, minor components)	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC	Not Observable		0.0		start coring at 0.60m						
					NO CORE: 0.20 m						
			1.0		**INTERBEDDED SILTSTONE AND IRONSTONE**: pale grey, white, with dark hard red ironstone surrounding the low strength siltstone, thinly bedded (60-200mm) beds at 5-25°.	HW		a=3.23 d=2.58	42%		**BEDROCK** FZ, IR, RO, SN, 100 mm JT, 30°, UN, RO, SN, 2 mm JT, 5°, UN, RO, SN, 1 mm CS, IR, RO, SN, 100 mm
			2.0					a=2.19 d=1.47	81%		CS, IR, SO, CO, 100 mm JT, 45°, PL, SO, CL Clay CO, 2 mm JT, 0°, IR, RO, SN
			3.0		**NO CORE:** 0.10 m						
					INTERBEDDED SILTSTONE AND IRONSTONE: continued.	HW		a=2.59 d=2.04	60%		
			4.0		**INTERBEDDED SANDSTONE AND IRONSTONE**: fine to coarse grained, pale grey, white, with dark red, orange ironstone, thin to medium bedding at 20-30°.	HW		a=1.29 d=0.55			CS, IR, RO, CN, 30 mm CS, IR, SO, Clay CO, 20 mm
					NO CORE: 0.04 m						
					INTERBEDDED SANDSTONE AND IRONSTONE: continued.						PT, 5°, PL, SO, Clay CO
			5.0		**INTERLAMINATED SANDSTONE AND SILTSTONE**: medium to coarse grained, grey, with dark red/orange ironstone thinly laminated at 10-20°.	MW			90%		JT, 20°, UN, RO, CO PT, 5°, PL, SO, CA CO, 1 mm, incipient JT, 30°, PL, SO, SN, <1 mm, incipient JT, 20°, UN, RO, SN, <1 mm, incipient
			6.0		6.00 to 6.27 m: with pale grey/white silt (low strength/ calcite?)			a=0.43 d=0.17 a=0.23 d=0.08			PT, 5°, PL, RO, SN, <1 mm, incipient PT, 5°, PL, RO, CN
									58%		SM, IR, SO, CO, 40 mm
			7.0								70°
								a=7.29 d=4.12	90%		SM, PL, SO, CO, 10 mm
			8.0								PT, 15 - 20°, PL, RO, CN

Defects are: PT, 10 - 20°, PL, SO - RO, CN, unless otherwise described

Defects are: JT, 25 - 45°, PL, SO - RO, CN, unless otherwise described

method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	***BH3***
sheet:	3 of 3
project no.	***754-SYDGE217641***
client:	***Point Polaris***
date started:	***30 Jul 2018***
principal:	
date completed:	***30 Jul 2018***
project:	***Forestway Shopping Centre Development***
logged by:	***LP***
location:	***Adjacent to Forest Way***
checked by:	

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Cross Country, Track mounted | drilling fluid: Water | hole diameter : 52/125 | vane id.:

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC	Not Observable		9.0		**INTERLAMINATED SANDSTONE AND SILTSTONE**: medium to coarse grained, grey, with dark red/orange ironstone thinly laminated at 10-20°. *(continued)*	SW - FR		a=2.71 d=1.59	100%		**BEDROCK**
					Borehole BH3 terminated at 9.50 m Target depth			a=1.78 d=1.66			
			10.0								
			11.0								
			12.0								
			13.0								
			14.0								
			15.0								
			16.0								

method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

PointID : BH3 Depth Range: 0.60 - 5.00 m

drawn	LP
approved	VN
date	10/08/2018
scale	N.T.S.
original size	A4

coffey
A TETRA TECH COMPANY

client:	Point Polaris
project:	Forestway Shopping Centre Development Forestway Shopping Centre
title:	**CORE PHOTOGRAPH** **BH3**
project no:	754-SYDGE217641
fig no:	**FIGURE 3**
rev:	

PointID : BH3 Depth Range: 5.00 - 9.50 m

drawn	LP
approved	VN
date	10/08/2018
scale	N.T.S.
original size	A4

coffey
A TETRA TECH COMPANY

client: Point Polaris

project: Forestway Shopping Centre Development
Forestway Shopping Centre

title: **CORE PHOTOGRAPH**
BH3

project no: 754-SYDGE217641 | fig no: **FIGURE 4** | rev:

coffey
A TETRA TECH COMPANY

Engineering Log - Borehole

Borehole ID.	***BH4***
sheet:	1 of 1
project no.	***754-SYDGE217641***
client:	***Point Polaris***
date started:	***26 Jul 2018***
principal:	
date completed:	***26 Jul 2018***
project:	***Forestway Shopping Centre Development***
logged by:	***LP***
location:	***Adjacent to Grace Avenue***
checked by:	

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: Comacchio 405, Track mounted | drilling fluid: | hole diameter : 200 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
AD/T		Not Encountered	B					**ASPHALT**: dark grey.	D	VSt - H		**ASPHALT**
								Gravelly Sandy CLAY: low - medium plasticity, dark grey/brown, with fine to coarse grained sand and fine to coarse grained gravel.	~Wp			**ROADBASE**
					0.5			**Gravelly Sandy CLAY**: medium - high plasticity, brown/grey, with fine to coarse grained sand and fine to coarse grained gravel, with cement.				**FILL**
			D					**SAND**: fine - coarse grained, pale orange, trace of cement, with low to medium plasticity clay.	M	VD		**RESIDUAL SOIL**
			D		1.0			**SAND**: fine - medium grained, pale orange/red, with medium plasticity clay (Extremely weathered sandstone).				**EXTREMELY WEATHERED ROCK**
								Borehole BH4 terminated at 1.1 m Target depth				
					1.5							

CDF_0_9_06_LIBRARY.GLB rev:AO Log COF BOREHOLE: NON CORED 754-SYDGE217641.GPJ <<DrawingFile>> 26/10/2018 17:00

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

This page has been left intentionally blank

Appendix C – Monitoring Wells

coffey
A TETRA TECH COMPANY

DRAFT

Piezometer Installation Log

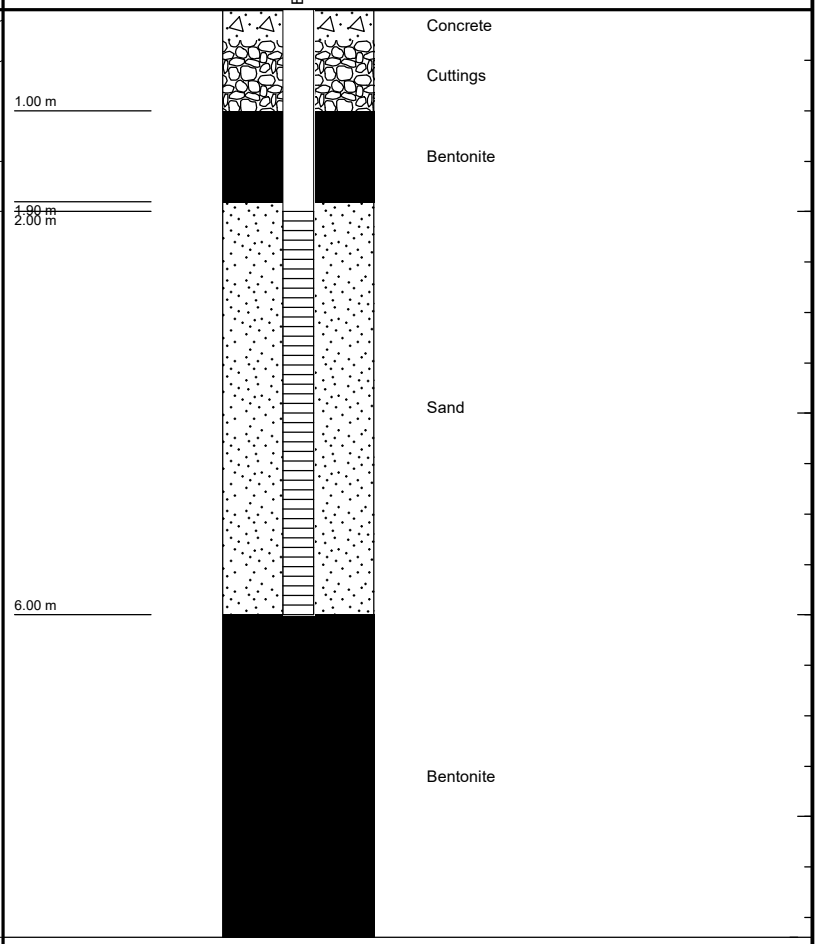
Hole ID.	**BH1**		
sheet:	1 of 1		
project no.	**754-SYDGE217641**		
client:	**Point Polaris**	date started:	**26 Jul 2018**
principal:		date completed:	**26 Jul 2018**
project:	**Forestway Shopping Centre Development**	logged by:	**LP**
location:	**Corner of Russell Avenue and Grace Avenue**	checked by:	

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

equipment type: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 52/125

drilling information | **material substance** | **piezometer construction details**

method & support	water	RL (m)	depth (m)	graphic log	material name
AD/T, CASING	Not Observable		0		**TOPSOIL**
					FILL
					RESIDUAL SOIL
			1		
					EXTREMELY WEATHERED ROCK
			2		**BEDROCK**
NMLC			3		
			4		
			5		
			6		
			7		
			8		
			9		
			10		
			11		



bore construction license:
drilling company: Terratest
driller:
driller's permit no.:

method & support
see engineering log for details

water
- 10-Oct-12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25 — water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

ID	type	installation date	stickup (m)	tip depth (m)	water level (m)	Relative Levels (AHD) stickup	tip	water level
BH1MW	standpipe	26-07-2018		6.00 m				

coffey
A TETRA TECH COMPANY

Piezometer Installation Log

client:	***Point Polaris***	Hole ID.	***BH3***
principal:		sheet:	1 of 1
project:	***Forestway Shopping Centre Development***	project no.	***754-SYDGE217641***
location:	***Adjacent to Forest Way***	date started:	***30 Jul 2018***
		date completed:	***30 Jul 2018***
		logged by:	***LP***
		checked by:	

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

equipment type: Cross Country, Track mounted | drilling fluid: Water | hole diameter : 52/125

drilling information | **material substance** | **piezometer construction details**

method & support	water	RL (m)	depth (m)	graphic log	material name
AD/T CASING	Not Observable		0		TOPSOIL
					FILL
					RESIDUAL SOIL
			1		BEDROCK
			2		
			3		
			4		
NMLC			5		
			6		
			7		
			8		
			9		
			10		
			11		

bore construction license:
drilling company: Terratest
driller:
driller's permit no.:

BH3MW

0.20 m — Concrete
Bentonite
0.90 m
1.80 m
Sand
5.80 m
Bentonite

method & support
see engineering log for details

water
- 10-Oct-12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25 — water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

ID	type	installation date	stickup (m)	tip depth (m)	water level (m)	Relative Levels (AHD) stickup	tip	water level
BH3MW	standpipe	30-07-2018		5.80 m				

CDF_0_9_07_LIBRARY.GLB rev:AU Log COF PIEZOMETER ONE PAGE SUMMARY 754-SYDGE217641.GPJ <<DrawingFile>> 10-08-2018 11:30

Appendix D – Laboratory Testing Results

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

A TETRA TECH COMPANY

Material Test Report

Report No: SYDN18S-06169-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00212AA
Project Name:	754-SYDGE217641 - 754-FORESTWAY SHOPPING CENTRE
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Renni Cetinich
(GeoTechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 20/08/2018

Sample Details

Sample ID:	SYDN18S-06169
Client Sample:	-
Date Sampled:	26/07/2018
Source:	(none)
Material:	
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Forestway Shopping Centre
Sample Location:	BH1 0.9 - 1.0

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.9	
Date Tested		3/08/2018	

Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

A TETRA TECH COMPANY

Material Test Report

Report No: SYDN18S-06170-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00212AA
Project Name:	754-SYDGE217641 - 754-FORESTWAY SHOPPING CENTRE
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Renni Cetinich
(GeoTechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 20/08/2018

Sample Details

Sample ID:	SYDN18S-06170
Client Sample:	-
Date Sampled:	26/07/2018
Source:	(none)
Material:	Clay Silt
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Forestway Shopping Centre
Sample Location:	BH2 0.0 - 0.4

Test Results

Description	Method	Result	Limits
CBR At 5.0mm (%)	AS 1289.6.1.1	**25**	
Maximum Dry Density (t/m³)		1.98	
Optimum Moisture Content (%)		10.5	
Dry Density before Soaking (t/m³)		1.99	
Density Ratio before Soaking (%)		100	
Moisture Content before Soaking (%)		10.4	
Moisture Ratio before Soaking (%)		99	
Dry Density after Soaking (t/m³)		1.99	
Density Ratio after Soaking (%)		100	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		12.6	
Moisture Content of Remaining Depth (%)		13.0	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		7.7	
Curing Time (Hrs)		72.0	
Method of Plasticity Used		-	
Date Tested		10/08/2018	

Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

A TETRA TECH COMPANY

Material Test Report

Report No: SYDN18S-06174-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00212AA
Project Name:	754-SYDGE217641 - 754-FORESTWAY SHOPPING CENTRE
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Renni Cetinich
(GeoTechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 20/08/2018

Sample Details

Sample ID:	SYDN18S-06174
Client Sample:	-
Date Sampled:	26/07/2018
Source:	(none)
Material:	
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Forestway Shopping Centre
Sample Location:	BH4 0.9 - 1.0

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.6	
Date Tested		3/08/2018	

Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

A TETRA TECH COMPANY

Material Test Report

Report No: SYDN18S-06173-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00212AA
Project Name:	754-SYDGE217641 - 754-FORESTWAY SHOPPING CENTRE
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Renni Cetinich
(GeoTechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 20/08/2018

Sample Details

Sample ID:	SYDN18S-06173
Client Sample:	-
Date Sampled:	26/07/2018
Source:	(none)
Material:	Silty Clay
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Forestway Shopping Centre
Sample Location:	BH4 0.0 - 0.9

Test Results

Description	Method	Result	Limits
CBR At 5.0mm (%)	AS 1289.6.1.1	**12**	
Maximum Dry Density (t/m³)		1.97	
Optimum Moisture Content (%)		10.6	
Dry Density before Soaking (t/m³)		1.97	
Density Ratio before Soaking (%)		100	
Moisture Content before Soaking (%)		10.5	
Moisture Ratio before Soaking (%)		98	
Dry Density after Soaking (t/m³)		1.96	
Density Ratio after Soaking (%)		100	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		12.1	
Moisture Content of Remaining Depth (%)		12.3	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		2.4	
Curing Time (Hrs)		72.0	
Method of Plasticity Used		-	
Date Tested		10/08/2018	

Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

A TETRA TECH COMPANY

Material Test Report

Report No: SYDN18S-06172-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00212AA
Project Name:	754-SYDGE217641 - 754-FORESTWAY SHOPPING CENTRE
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Renni Cetinich
(GeoTechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 20/08/2018

Sample Details

Sample ID:	SYDN18S-06172
Client Sample:	-
Date Sampled:	26/07/2018
Source:	(none)
Material:	CH Clay
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Forestway Shopping Centre
Sample Location:	BH3 0.4 - 0.6

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.1	
Date Tested		3/08/2018	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	10.5	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	43	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	28	
Date Tested		9/08/2018	

Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 8876 0500

A TETRA TECH COMPANY

Material Test Report

Report No: SYDN18S-06171-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00212AA
Project Name:	754-SYDGE217641 - 754-FORESTWAY SHOPPING CENTRE
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Renni Cetinich
(GeoTechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 20/08/2018

Sample Details

Sample ID:	SYDN18S-06171
Client Sample:	-
Date Sampled:	26/07/2018
Source:	(none)
Material:	Silty Clay
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Forestway Shopping Centre
Sample Location:	BH2 0.4 - 0.9

Test Results

Description	Method	Result	Limits
CBR At 5.0mm (%)	AS 1289.6.1.1	**8**	
Maximum Dry Density (t/m³)		1.92	
Optimum Moisture Content (%)		13.2	
Dry Density before Soaking (t/m³)		1.90	
Density Ratio before Soaking (%)		99	
Moisture Content before Soaking (%)		13.2	
Moisture Ratio before Soaking (%)		100	
Dry Density after Soaking (t/m³)		1.89	
Density Ratio after Soaking (%)		99	
Swell (%)		0.5	
Moisture Content of Top 30mm (%)		15.9	
Moisture Content of Remaining Depth (%)		14.5	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		1.3	
Curing Time (Hrs)		72.0	
Method of Plasticity Used		-	
Date Tested		10/08/2018	

Comments

N/A

eurofins | mgt

30 years Testing For Life 1987–2017
Celebrating 30 years Testing and Protecting Human Health

Certificate of Analysis

Coffey Geotechnics Pty Ltd Chatswood
Level 18, Tower B, Citadel Tower 799 Pacific Highway
Chatswood
NSW 2067

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Renni Cetinich**

Report **610814-S**
Project name FORESTWAY SHOPPING CENTRE
Project ID SYDGE217641
Received Date Aug 03, 2018

Client Sample ID			**BH1 0.9-1.0**	**BH2 0.4-0.9**	**BH2 0.9-1.0**	**BH3 0.4-0.6**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au05667**	**S18-Au05668**	**S18-Au05669**	**S18-Au05670**
Date Sampled			**Jul 25, 2018**	**Jul 25, 2018**	**Jul 25, 2018**	**Jul 30, 2018**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	72	100	40	21
Conductivity (1:5 aqueous extract at 25°C as rec.)	5	uS/cm	110	200	81	130
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	6.5	6.0	5.6	6.8
Resistivity*	0.5	ohm.m	470	250	620	380
Sulphate (as SO4)	10	mg/kg	98	260	100	180
% Moisture	1	%	9.5	12	8.3	9.6

Client Sample ID			**BH4 0.9-1.0**	**BH4 1.0-1.1**
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Au05671**	**S18-Au05672**
Date Sampled			**Jul 25, 2018**	**Jul 25, 2018**
Test/Reference	LOR	Unit		
Chloride	10	mg/kg	< 10	< 10
Conductivity (1:5 aqueous extract at 25°C as rec.)	5	uS/cm	23	23
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	6.8	5.8
Resistivity*	0.5	ohm.m	2200	2200
Sulphate (as SO4)	10	mg/kg	28	46
% Moisture	1	%	12	7.0

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chloride	Sydney	Aug 09, 2018	28 Day
- Method: E045 /E047 Chloride			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	Aug 09, 2018	7 Day
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	Aug 09, 2018	7 Day
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Sydney	Aug 09, 2018	28 Day
- Method: E045 Anions by Ion Chromatography			
% Moisture	Sydney	Aug 06, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

This page has been left intentionally blank