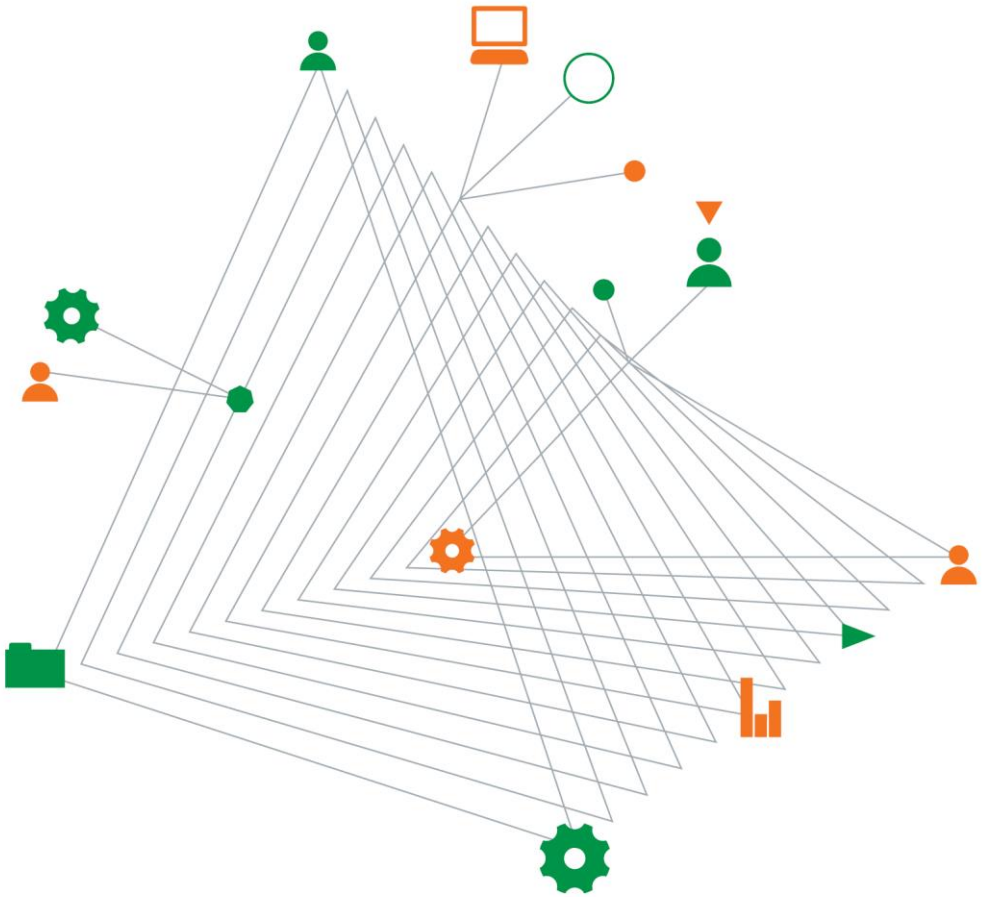
SH Gosford Residential Pty Ltd

Central Coast Quarter, 26 Mann Street Gosford

Geotechnical Interpretative Report



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Central Coast Quarter, 26 Mann Street Gosford

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Document authorisation

Our ref: SYDGE214942 Rev 3

For and on behalf of Coffey

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Quality information

Revision history

Revision	Description	Date	Author	Reviewer	Signatory
0	Initial Issue for Review	03/04/2018	Alex Condor	Patrick Wong	Ali Mohiti
1	Issue for DA Submission	12/08/2019	Ali Mohiti	Pawan Sethi	Ali Mohiti
2	Amend client name and Dwg references	16/08/2019	Alex Condor	Ali Mohiti	Ali Mohiti
3	Include About This Report	20/08/2019	Alex Condor	Ali Mohiti	Ali Mohiti

Distribution

Report Status	No. of copies	Format	Distributed to	Date
0	1	PDF	Joseph Risitano	03/04/2018
1	1	PDF	Frank Katsanevas	12/08/2019
2	1	PDF	Frank Katsanevas	16/08/2019
3	1	PDF	Frank Katsanevas	20/08/2019

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About This Report

This geotechnical and groundwater assessment report has been prepared to satisfy the item 18 of the Secretary's Environmental Assessment Requirements (SEARs). It is understood that this report will be submitted for Concept State Significant Development Application (SSDA) for the Central Coast Quarter development located at 26 Mann St, Gosford. It should be noted this concept SSDA does not cover construction activities and no construction work is currently proposed. Construction related works will be separately addressed at detailed Development Application (DA) stage as appropriate.

This geotechnical Interpretative Report has been prepared to assist in the design and construction of the proposed commercial and residential structures and as such the recommendations of this report should be considered at relevant DA stage.

Based on the results of our geotechnical assessment and subject to the adoption of the geotechnical recommendations of this report, the site could be made suitable for the proposed mixed use residential and commercial development.

1. Introduction

1.1. Overview

This report documents the results of the geotechnical investigation conducted by Coffey for the proposed mixed use commercial and residential structures at 26 Mann St, Gosford.

The geotechnical investigation has been conducted in accordance with Coffey's proposal (Ref No. SYDGE214942-AA, dated 31/01/2018) and was commissioned by Joseph Cummings of SH Gosford Residential Pty Ltd (St Hilliers) on 8 February 2018.

The current revision of the report has been prepared considering the latest architectural drawings as part of the Development Application (DA) submission to the Department of Planning and Environment NSW.

This geotechnical interpretative report has been prepared to assist in the design and construction of the proposed commercial and residential structures. A Detailed (contamination) Site Investigation (DSI) is also being prepared by Coffey for the proposed development and will be issued as a separate report (Ref No SYDGE214942-AC).

1.2. Supplied Data

A site survey plan (SP) has been prepared by Veris Limited (Job No. 173672, Issue C, dated 12/2/218) and provided by St Hilliers to assist with the geotechnical investigation.

Cardno Pty Ltd have previously conducted a preliminary geotechnical investigation (Ref No. 851686, Rev 1, dated 23 December 2015) of the previous Gosford High School site to assist with the Development Application.

In addition, Douglas partners have conducted a geotechnical investigation (Ref No. 83186.00, dated June 2017) for an adjacent structure located to the north-east of the proposed site. These reports have been provided by St Hilliers to assist with the Coffey's current assessment and are summarised in Section 3.5 of this report.

Architectural drawings prepared by DKO, dated 13/08/2019 have also been prepared, which outline the general floor layout and basement finish levels.

1.3. Proposed Development

A review of the Architectural Plans (AP) prepared by DKO Architecture (dated 13 August 2019) indicates that the development is to comprise the following:

- Construction of a basement carpark with a finished floor level of 1.6 AHD covering the entire site. The basement level includes a number of retail stores fronting Baker Street to the south west and residential units to the north west; and
- Three multi-storey residential/commercial structures situated above the basement with building heights of between 21 and 27 stories.

Excavations for the proposed basement carpark are expected to extend to depths of up to 8.5m below existing ground levels (BGL) along the south-eastern boundary adjacent to Mann St and reducing to grade or less than 1.5m for a large portion of the site.

1.4. Objectives

This geotechnical report outlines the investigation findings, provides comments on the implications of the geotechnical conditions as well as design and construction implications comprising:

- Recommendations for earthwork procedures and guidelines;
- Information regarding foundation conditions and design strategy requirements including deep foundation design parameters;
- Aggressively assessment to buried structural steel and concrete elements; and
- Advice on the excavation requirements and design parameters for retaining structures.

2. Site Description

2.1. General Site Description

The site is legally identified as Lot 1 in DP 1235203 and Lots 2-7 on DP 14671. The site is located at 32 Mann St, Gosford and is irregular in shape with an approximate area of 8,700m^2 which is bounded by Mann St to the east, the unformed extension of Baker St and Gosford City Park to the West, Georgina Terrace and the newly constructed Australian Taxation Office (ATO) building to the north, and Vaughan Ave to the south. This area forms the current developmental of the previous Gosford High School Site which now includes the ATO building to the north and mixed-use commercial structure situated to the north and north-east.

Reference to the SP, site elevations across the site ranges from 2.57m AHD within the south-western portion of the site, to 9.33m AHD within the eastern boundary of the site adjacent to Mann St.

The following features were observed at the time of investigation:

- The site is currently used as construction storage area, carparking and site offices for the construction of the mixed use commercial structure.
- Topographically, the eastern portion of the site is situated on the foot slopes of a hill to the east with the remaining portion of the site situated within the generally flat alluvial floodplains and reclaimed lands of Brisbane Waters to the west.
- Site surfacing typically comprise gravel hardstand within the majority of the site.
- A concrete crib retaining wall is situated along the eastern boundary of Lots 3, 2 and 1 with an approximate height of 2.0 m. No indication of instability was observed along the retaining wall.
- Site surfaces are generally flat with slopes of between 1 and 2º within the central and western portion of the site. Site slopes increase up to 7º towards the base of the crib wall within the eastern portion of the site and steepen to between 18-20º from top of wall to the site boundary with Mann St.
- Large mature trees were observed within the eastern portion of the site between the crib wall and Mann St.

3. Published Data and Background Information

3.1. Soil Landscape Maps

A review of the Office and Environment and Heritage, Electronic Soil Profiling Maps (eSPADE) V2.0 [1] indicates that the majority of the site is situated within Disturbed Terrain (9131xx) and is known to comprise land reclamation activities of the Brisbane Waters Bay to the west. The eastern portion of the site is situated within the Erina soil landscape (9131er) which typically comprises undulating to rolling rises and low hills on the Terrigal Formation. The soil profile is expected to comprise brownish-black fine sandy loam topsoil overlying brown sandy clay loam and yellowish-brown sandy clay situated over Terrigal Formation sandstones. These soils are known to be slightly to moderately acidic with pH values of between 4.5-6.0 and include small angular to sub-angular sandstone rock fragments.

3.2. Geological & Quaternary Maps

Reference to the 1:100,000 Central Coast Coastal Quaternary Geological Map [2] indicates that the eastern portion of the site is generally underlain by Terrigal Formation (Rnt) comprising residual clays overlaying interbedded siltstone, shale and fine to coarse grained quartz-lithic sandstone with minor claystone lenses.

3.3. Acid Sulfate Soil Risk Maps

A review of the Department of Land and Water Conservation, Acid Sulfate Soil Risk Map [3] indicates that the site is situated within disturbed terrain to depths of typically between 1.0-2.0m BGL which is resultant from reclamation of the low-lying swamps of the Brisbane Water foreshore for urban development.

Further review of the Gosford City Council (now Central Coast Council) Local Environmental plan (LEP), Acid Sulfate Soils Risk Map [4] indicates that the site is situated within Class 2 Terrain. Class 2 terrain indicates that development consent is required where works are expected to occur below the natural ground surface, or by which the water table is likely to be lowered.

3.4. Local Groundwater Maps

Data obtained from the NSW Department of Primary Industries, Office of Water, Groundwater map [5] indicates that there are two groundwater bores situated within 500m of the proposed development. The following summarises the information derived from the Work Summary report sheets.

Table 3-1 Summary of Local Groundwater Monitoring Wells

Bore ID	Location	Date of drilling	Total Depth (m)	Subsurface Profile	Standing Water Level (m)
GW21893	100m North	8/8/2004	78	Sandy CLAY and CLAY with minor SANDSTONE bands to 20m underlain by interbedded SANDSTONE and SHALE to depth of hole.	Not Recorded
GW21679	125m North	2/9/2004	102	SAND and CLAY to 25m underlain by interbedded SANDSTONE and SHALE to depth of hole.	Not Recorded

3.5. Previous Geotechnical Reports

3.5.1. Cardno

A preliminary geotechnical investigation of the site has previously been conducted by Cardno to support the Development Application of the previous Gosford High School site for submission for the site to Gosford City Council (now Central Coast Council). This report provided a preliminary assessment of the entire site bounded by Georgina Terrace, Mann St, Vaughan Ave and Baker Street.

The geotechnical investigation comprised a review of available published information as well as an investigation which included drilling of six boreholes (BH001-BH006) across the site using a drill rig with spiral flight auger and V-bit techniques. Two 50mm standpipe piezometers were installed in two boreholes (BH003 and BH006) to allow for groundwater level monitoring and sampling of the groundwater. Laboratory testing comprised Atterberg Limit and Particle Size Distribution tests for material classification, aggressively tests for steel and concrete element durability as well as a limited testing for Acid Sulfate Soils.

The following summarises the key findings of the preliminary geotechnical investigation:

- The subsurface profile typically comprised up to 1.6m of fill comprising sands with some gravel and clays within the central and western portion of the site, reducing in depth towards the east. This was underlain by alluvial profiles comprising interbedded clayey sand, sandy clay and silty clay to depths of 2.7m BGL. This material was typically soft to firm (clays) or very loose to medium dense (sands) in consistency. These profiles were generally underlain by residual clay and sandy clays varying from stiff to hard in consistency underlain by extremely weathered, extremely low strength sandstone bedrock.
- Standing Water Levels encountered within the groundwater wells varied between 1.25-1.72m AHD within the central and western portion of the site.
- Soils encountered were typically non-aggressive towards structural steel elements, and mildly aggressive towards buried concrete elements.
- A Slope Risk Assessment in accordance with Council and Australian Geomechanics Society guidelines [6] was conducted and indicated a low to very low risk to property where appropriate engineering controls were implemented.

3.5.2. Douglas Partners

A geotechnical investigation and report has previously been conducted by Douglas Partners to support the design and construction of the proposed multi-storey commercial structure located to the north-east of the current development site.

The geotechnical investigation and report comprised a review of available published information as well as drilling of six boreholes (Bores A-F) within the building envelope of the proposed structure. Drilling comprised spiral flight auger and V-Bit techniques as well as NMLC rock coring to depth of between 10-20m BGL. Laboratory testing comprised point load testing on selected sections of rock core to assess bedrock strength.

The following summarises the key finding of the geotechnical investigation.

- The subsurface profile encountered within the building envelope of the proposed structure typically comprised silt, sand and clay fill up to 0.7m BGL underlain by firm to stiff clays to depths of up to 7.8m BGL. These layers are, in turn, underlain by extremely weathered and extremely to very low strength sandstone and siltstone to depths of up to 11.1m BGL, and by moderate weathered to fresh sandstone, siltstone and conglomerates of low to high strength to the depth of investigation at 20m BGL.
- Groundwater levels encountered during drilling varied between -0.6m to 4.8m AHD.

Ultimate and serviceability end bearing pressures, together with recommendations on safe batter slopes and geotechnical parameters for retaining structures were provided in the Douglas Partners Report for high level and piled footings.

Douglas Partners have also previously conducted a Preliminary Site Investigation (PSI) for the entire site as well as a Detailed Site Investigation (DSI) and Acid Sulfate Soil Management Plan (ASSMP) for the adjacent mixed-use development which are summarised in Coffey's DSI report for this site.

4. Investigation Methodology

4.1. Site Investigation

Prior to the investigation, the intrusive test locations were cleared of underground services. Test locations were then adjusted if required to minimise the risk of damage to underground assets.

Coffey's site investigation was conducted between the dates of 22 February and 6 March 2018 and comprised the following:

- A site walkover and visual inspection by a geotechnical engineer from Coffey including site mapping and logging of significant site features.
- Drilling of nine boreholes across the site using a track mounted drill rig utilising a combination of push tube, spiral flight auger and NMLC rock coring techniques comprising:
  - BH1 drilled within the central portion of the site. Push tube sampling was conducted to a depth of 3.0m BGL and then advanced using AD/TC bit with spiral flight auger to the depth of investigation at 8.7m BGL (-6.2m AHD).
  - BH2 drilled within the central portion of the site. Push tube sampling was conducted to a depth of 3.0m BGL and then advanced using AD/TC bit with spiral flight auger to the depth of investigation at 15.06m BGL (-12.56m AHD).
  - BH3 drilled within the south-eastern portion of the site at the toe of the crib wall and adjacent to Mann St and Vaughen Ave. Push tube sampling was conducted to a depth of 3.0m BGL and then advanced using AD/TC bit with spiral flight auger to a depth of 5.5m BGL. Washboring was then conducted to a depth of 6.7m BGL and followed by NMLC rock coring techniques to the depth of investigation at 15.1m BGL (-11.1m AHD).
  - BH4 drilled within the north-western corner of the site adjacent to Baker St. Push tube sampling was conducted to a depth of 3.0m BGL and then advanced using AD/TC bit with spiral flight auger to a depth of 5.95m BGL. Washboring was then conducted to a depth of 13.2m BGL and followed by NMLC rock coring techniques to the depth of investigation at 15.0m BGL (-12.2m AHD).
  - BH5 drilled within the central portion of the site. Push tube sampling was conducted to a depth of 2.5m BGL and then advanced using AD/TC bit with spiral flight auger to a depth of 5.5m BGL. Washboring was then conducted to a depth of 9.4m BGL and followed by NMLC rock coring techniques to the depth of investigation at 15.0m BGL (-12.3m AHD).
  - BH6 drilled within the eastern portion of the site at the toe of the crib wall and adjacent to Mann St. Push tube sampling was conducted to a depth of 3.0m BGL and then advanced using AD/TC bit with spiral flight auger to a depth of 5.6m BGL. Washboring was then conducted to a depth of 6.9m BGL and followed by NMLC rock coring techniques to the depth of investigation at 16.0m BGL (-12.0m AHD).
  - BH7 drilled within the southern portion of the site adjacent to Vaughan Ave. Push tube sampling was conducted to a depth of 3.0m BGL and then advanced using AD/TC bit with spiral flight auger to a depth of 8.6m BGL. This was followed by NMLC rock coring techniques to the depth of investigation at 15.2m BGL (-12.7m AHD).
  - BH8 drilled within the central portion of the site. Push tube sampling was conducted to a depth of 3.0m BGL and then advanced using AD/TC bit with spiral flight auger to a depth of 8.57m BGL (-6.07m AHD) where refusal on rock was encountered.
  - BH9 drilled within the northern portion of the site. Push tube sampling was conducted to a depth of 3.0m BGL and then advanced using AD/TC bit with spiral flight auger to a depth of 14.5m BGL (-11.9m AHD) where refusal was encountered.
- All rock core samples were stored in designated core boxes for further assessment and laboratory testing.

- Eight additional push tubes tests were conducted across the site to a depth of 3.0m BGL to aid in the DSI investigation and sampling requirements.
- Standard penetration Tests (SPT) were conducted at regular intervals within the boreholes to assess soil strength and consistency until V-bit refusal was encountered.
- Disturbed and bulk samples of soil were taken for further laboratory assessment and future reference.

A geotechnical engineer from Coffey carried out all fieldwork including logging of subsurface profiles, collection of samples and construction of piezometer wells. Approximate test locations are shown in Figure 1, attached in Appendix A. Subsurface conditions are summarised in Section 5.1 and detailed in the borehole and push tube logs attached in Appendix B together with the explanatory notes and rock core photographs.

A recent site visit was undertaken by a senior geotechnical engineer from Coffey on 6 August 2019 to record the current groundwater levels and observe changes to the site's geotechnical conditions for the current revision of the report.

4.2. Laboratory Testing

Laboratory testing on selected samples recovered during the geotechnical investigation comprised the following:

- Five sets of Atterberg Limits and Particle Size Distribution (PSD) tests to aid in material classification.
- Five soil aggressivity tests including pH, Electrical Conductivity (EC), Sulphate and Chloride to aid in assessment of aggressivity to buried structural elements.
- Four Uniaxial Compressive Strength (UCS) tests on selected sections of rock core; and
- Point load testing on selected sections of rock core.

The results of the laboratory tests are detailed in the report sheets attached in Appendix C and summarised in Section 9.

5. Geotechnical Characteristics and Model

5.1. Geotechnical Soil and Rock Units

For the purpose of geotechnical characterisation of the subsurface conditions, the soil and rock profiles encountered during the investigation have been characterised into the following geotechnical units and shown below in **Table 5-1**.

Table 5-1 Generalised Geotechnical Units

Origin	Unit (1)	Description (USC Group)	Consistency Range / Rock Strength (1)	Moisture Condition / Rock Weathering
FILL	F1	SP-SC (2) Gravelly SAND, Gravelly Clayey SAND, Gravelly Silty SAND, Clayey SAND and SAND of fine to coarse grained and low to medium plasticity clay	-	Dry-Moist
TOPSOIL / COLLUVIUM	C1	SM-ML (2) Silty CLAY and Silty SAND with trace of organics, fine to medium grained, low to medium plasticity	Firm clays and loose sands	Dry-Moist
ALLUVIAL	A1	CL-CH & SM-SC (2) Sandy CLAY and Silty CLAY of low to high plasticity interbedded with, fine to medium grained Silty SAND, Clayey SAND and SAND	Generally firm to stiff clays interbedded with very loose to loose sands. Increasing to Very Stiff in BH2 Very soft to soft clay in BH5 and BH7	Moist clays with interbedded moist to wet sands
RESIDUAL	R1	CL (2) CLAY and Sandy CLAY of medium to high plasticity	Firm to Stiff	Moist-Wet
	R2	CL (2) CLAY, Sandy CLAY, Clayey SAND and extremely weathered Class V SANDSTONE bedrock (3)	Very Stiff to Hard Very low strength bedrock	Moist-wet Extremely weathered
BEDROCK (Terrigal Formation)	T1	Fine grained SANDSTONE with interbedded SILTSTONE Inferred Rock Class: Class IV Sandstone (3)	Medium strength bedrock	Extremely to slightly weathered
	T2	Fine to medium grained SANDSTONE with interbedded SILTSTONE Inferred Rock Class: Class III Sandstone (3)	Medium to high strength	Distinctly to slightly weathered

Notes to table:
(1) Inferred from Standard Penetration Tests (SPT)
(2) Refer to AS 1726-2017 [7], Table A1 for group symbols.
(3) The rock classification is based on the requirements presented in P.J.N Pells et al [8] , Foundations on Sandstone and Shale in the Sydney Region

Table 5-2 below provides a summary of the depth to base of each unit encountered within the borehole and push tube test locations.

Table 5-2 Summary of Depth to Base of Geological Units

Hole ID	Surface level (m) AHD	Depth to Base of Unit (m) BGL							Groundwater Level (m) BGL		
		Unit F1	Unit C1	Unit A1	Unit R1	Unit R2	Unit T1	Unit T2	At time of drilling	Following well installation	6 August 2019
BH1	2.5	1.3	-	2.0	5.3	> 8.7	-	-	5.2	-	-
BH2	2.7	1.2	-	5.0	-	>15.06	-	-	4.0	-	-
BH3	4.0	-	1.0	1.9	5.5	8.0	-	>15.1	-	-	-
BH4	2.8	1.6	-	5.0	10.0	14.51	-	>15.0	4.0	2.03	Covered under the newly constructed concrete driveway
BH5	2.7	0.5	-	4.0	5.5	9.4	>15.0	-	2.5	-	
BH6	4.0	-	0.3	2.7	-	8.0	-	>16.0	-	1.7	Could not be located due to vegetation overgrowth, potentially destroyed during construction
BH7	2.5	1.0	-	2.0	4.8	8.6	11.41	>15.2	2.45	2.0	2.1
BH8	2.5	0.3	-	2.5	4.0	>8.57	-	-	2.8	-	-
BH9	2.6	0.5	-	2.8	4.0	>14.5	-	-	2.2	-	-
P1	2.9	0.1	-	>3.0	-	-	-	-	-	-	-
P2	2.6	0.7	-	1.9	>3.0	-	-	-	-	-	-
P3	2.7	0.2	-	1.1	>3.0	-	-	-	-	-	-
P4	2.7	0.5	-	2.0	>3.0	-	-	-	-	-	-
P5	2.7	0.7	-	2.5	>3.0	-	-	-	-	-	-
P6	2.7	0.2	-	1.0	>3.0	-	-	-	-	-	-
P7	2.5	0.5	-	1.8	>3.0	-	-	-	-	-	-
P8	2.6	0.6	-	>3.0	-	-	-	-	-	-	-

Notes to table:
BGL: Below Ground Level
AHD: Australian Height Datum
"-": Not Encountered

5.2. Groundwater

Groundwater levels encountered during drilling varied between 0.2m to -2.7m AHD across the site apart from BH3 and BH6 where groundwater was not observed at the time of investigation. In addition, no groundwater levels were identified within the push tube holes.

Following drilling, groundwater wells were installed and developed in BH4, BH6 and BH7 for groundwater monitoring as well as to aid in additional groundwater sampling for the purpose of contamination investigation. Further groundwater sampling was undertaken on 19 March 2018 and

groundwater levels were measured at depths between 1.7-2.03m BGL which corresponds to elevations of between 0.8-2.3m AHD across the site.

On 6 August 2019, the groundwater level in the existing standpipe piezometers in BH7 was measured at 2.1m BGL, as summarised in **Table 5-2**. This result indicates minor change in groundwater levels recorded previously at the time of investigation.

It should be noted that groundwater levels are likely to fluctuate with site and climatic conditions.

6. Laboratory Test Results

6.1. Material Quality Test Results

The results of the Atterberg Limit and Particle Size Distribution test results are summarised in **Table 6-1** below with the laboratory report sheets attached in Appendix C.

Table 6-1 Summary of Material Quality Test Results

Hole ID	Depth (m)	Passing 2.36mm (%)	Passing 0.75µm (%)	LL (%)	PL (%)	PI (%)	Material Classification
BH1	2.0 - 2.45	100	50	24	11	13	Sandy CLAY, low plasticity (CL)
BH3	1.0 - 1.45	100	35	22	16	6	Clayey SAND, fine to medium grained, low plasticity, (CL)
BH4	3 - 3.45	100	44	27	13	14	Sandy CLAY, low plasticity (CL)
BH6	5.5 - 5.95	100	85	37	18	19	Silty CLAY, low plasticity, trace of sand (CI)
BH7	5.5 - 5.95	88	44	29	17	12	Sandy CLAY, low plasticity, trace of fine gravel (CL)

Notes to table:
LL: Liquid Limit
PL: Plastic Limit
PI: Plasticity Index

6.2. Soil Aggressivity Test Results

The results of the soil aggressivity test results are summarised below in **Table 6-2** with the laboratory report sheets attached in Appendix C.

Table 6-2 Summary of Soil Aggressivity Test Results

Hole ID	Depth (m)	Soil Type and (Groundwater Condition)	pH (1:2) (1) for concrete pile	EC (µS/cm)	Resistivity (Ωcm) (2)	Sulphate (mg/kg), Classification for concrete piles	Chloride (mg/kg), Classification for concrete piles
BH1	3.0-3.45	Sandy CLAY (B)	7.8	52	960	43	16
BH1	5.5-5.95	Sandy CLAY (B)	7.3	42	1200	29	24
BH1	7.0-7.34	SANDSTONE (B)	7.2	35	1400	20	26
BH2	8.5-8.61	Sandy CLAY (B)	7.2	39	1300	<10	19
BH4	5.5-5.95	Sandy CLAY (B)	6.4	82	610	120	22

Notes to table:
(1) Exposure classification for concrete piles based on pH, the exposure classification for steel piles are slightly different based on pH values and has been discussed in the respective section of this report
(2) Aggressivity classification for Steel Piles based on resistivity
Scale of aggressivity obtained from AS2159 – 2009 [9] for concrete piles in soil

Non Aggressive
Mildly Aggressive
Moderately Aggressive
Severely Aggressive
Very Severely Aggressive
– Not Tested/ Not Applicable

6.3. Point Load Test Results

The results of the axial and diametric point load testing conducted on selected sections of rock core samples obtained from the boreholes are presented in Appendix D.

The results of the point load tests indicated that the sandstone and siltstone formations varied from medium to high strength, with lenses of very high strength rock.

6.4. Uniaxial Compressive Strength Test Results

The Uniaxial Compressive Strength (UCS) tests conducted on representative samples of rock core are summarised below in **Table 6-3** and detailed in the laboratory report sheets attached in Appendix C.

Table 6-3 Summary of Uniaxial Compressive Strength Test Results

Hole ID	Depth (m)	Unit	Rock Type and Structure	Density (t/m^3)	Uniaxial Compressive Strength (MPa)
BH3	11.0 – 11.16	T2	Sandstone, pale grey-grey	2.4	28.2
BH5	10.49 - 10.64	T2	Sandstone, red	2.3	19.1
BH6	9.0 - 9.18	T2	Sandstone, grey	2.4	25.9
BH7	12.42 - 12.55	T2	Sandstone, pale grey	2.3	34.1

7. Earthworks

A review of the design levels presented in the AP indicates that the proposed multi-storey structures basement finished floor level is situated at approximately 1.6m AHD and as such, excavations are required with excavation depths ranging from 1.0m within the western portion of the site, and up to 8.5m along the eastern boundary adjacent to Mann St.

Subsurface material present within the depth of excavation is expected to comprise:

- Silty sand and silty clay topsoil/colluvium present within the eastern slopes of the site adjacent to Mann St. (Unit C1)
- Gravelly, silty and clayey sand filling generally encountered across the entire site (Unit F1)
- Firm to stiff alluvial silty and sandy clays interbedded with loose silty and clayey sands generally encountered across the entire site (Unit A1)
- Firm to stiff residual clay and sandy clays (Unit R1) within the eastern portion of the site with some very stiff to hard residual clay and sandy clays (Unit R2) expected at depths close to the basement excavation along the eastern boundary.

7.1. Excavations

Based on the subsurface profile encountered, excavations to basement levels are expected to be readily conducted using conventional earthmoving equipment. Considering the site's surficial soil profile, tracked machinery would be required to conduct the bulk earthworks.

A construction platform should be designed by a qualified geotechnical engineer considering the construction equipment types and track pressures following the preparation of a construction strategy by the principal contractor.

Loss of strength in alluvial sands and clays are expected following repetitive trafficking of heavy construction machinery. Trafficking of machinery over the excavated sections or areas with elevated moisture conditions present must be minimised. Construction of a temporary construction platform will be required if this cannot be avoided as well as to assist with heavy equipment loading.

It is recommended that contractors for the piling and detailed footing excavations should undertake an assessment of the rock core samples summarised in this report to make their own assessment on excavatability/drillability with regards to the type of equipment they propose to use.

7.2. Site Preparation Measures

The following site preparation measures are recommended during the earthworks:

- Construct a working platform where required to minimise softening of foundation material and improve trafficability.
- It is recommended to grade the floor of the bulk excavations to the west to allow surface drainage to be collected and pumped into sedimentation tanks/ponds prior to discharge.

Earthworks construction procedures should be in accordance with AS3798-2007 Guidelines for Earthworks for Commercial and Residential Developments [10].

7.3. Cutting and Batters

It is expected that the underlying clay soils will not remain stable when cut vertically without support and could result in slope failure which would impact neighbouring properties such as Mann St.

Therefore, it is necessary that excavations be battered to a safe batter slope or supported by an engineer designed retaining structure or shoring system.

Recommendations for retaining structures and shoring systems designs are provided in Section 9.2. The below recommendations should be adopted for all remaining excavations when not subject to construction loading and less than 3.0m in height.

Table 7-1 below provides a summary of the maximum batter slopes for each geotechnical unit expected within the depth of excavation for the proposed structures. All long-term batters to be protected by vegetation or similar to withstand erosion. Where batters steeper than those are required, these should be designed by an engineered retaining structure.

Table 7-1 Maximum Allowable Batter Slopes

Unit	Brief Description	Maximum short term batter slope	Maximum long term batter slope
F1	Gravelly, silty and clayey sand filling of fine to coarse grained	2H:1V	3H:1V
C1	Firm silty clay and loose silty sand topsoil/colluvium	2H:1V	3H:1V
A1	Firm to stiff alluvial silty and sandy clays with interbedded loose silty and clayey sands	2H:1V	3H:1V
R1	Firm to stiff residual sandy clays of medium to high plasticity	1H:1V	2H:1V
R2	Very Stiff to hard residual clays and extremely weathered sandstone bedrock	0.75H:1V (1)	1.5H:1V (1)

Notes to table:
(1) Subject to geotechnical inspection and assessment as bedrock stability depends on defect spacing and dip and as such, angle may need to be reduced

The above batter slopes assume that no groundwater seepage occurs along the battered face. Where water seepage occurs in layers with sandy material such as Unit C1 and A1 or where adverse weather conditions extend for a period of time, advice should be obtained from a geotechnical consultant and batter slopes may need to be revised or retained by retaining structures. It is recommended to install diversion drains above the crests of all batters to direct upslope runoff away from the batter face to limit erosion.

It is recommended to prepare an earthworks management plan to consider the stability of the batter and excavated faces during the piling and temporary works.

7.4. Dewatering

Groundwater levels encountered within the boreholes generally varied between 0.4 to -2.7m AHD across the site and as such, are situated below within the depth of excavation in some areas across the site. However, higher groundwater levels may be expected along the eastern boundary of the site adjacent to Mann St following an extended period of rainfall.

It is expected that the majority of the groundwater inflows would be captured by strip drains installed behind any shoring system or retaining walls and diverted into the stormwater system. Where additional inflows are encountered, pump-and-sump methods could be adopted to dewater the excavation for the minor inflow.

Considering our experience with the 32 Mann St site's development, long-term dewatering treatment and discharge system for a drained basement should be considered.

The groundwater should be directed and stored in sedimentation tank/basins, analysed and potentially treated prior to release into the Council stormwater or sewerage system, depending on consultation with Council. Water quality testing should be undertaken in accordance with The Liquid

Trade Waste Quality Standards to Gosford City Council Sewerage System [11] requirements prior to the discharge into Council assets.

7.5. Suitability of Cut Materials for Reuse or Disposal

7.5.1. Requirements for Waste Classification

Classification of the site in-situ material in accordance with EPA Guidelines “Waste Classification Guidelines, Part 1: Classifying Waste [12]” will be required prior to removal off site. In addition, his should consider the results of acid sulfate soils assessment conducted by Coffey as part of the DSI. Reference to Coffey’s DSI report SYDGE214942-AC must be made regarding the requirements of transporting material off the site.

7.5.2. Requirements for Reuse in Reconstruction

All excavation material with the exception of Unit C1, topsoil and colluvium material could be used as controlled filling on site following appropriate moisture reconditioning and compaction control.

8. Foundation Conditions and Footing Design Recommendations

Based on a review of the borehole logs and expected geotechnical conditions at the foundation levels, pile foundations are expected to be required to ensure embedment into strata of similar stiffness to limit differential settlements.

General design parameters and recommendations are presented in the following sections and should be used as guidance for the design. The detailed design of the foundations should consider the structural loads against serviceability and ultimate limit state criteria.

8.1. Aggressivity

Based on the summary of analytical results presented in **Table 6-2** and on the bases of Chlorides, pH and resistivity, it was found that the sandy clay and weathered sandstone soil encountered within the boreholes were non-aggressive towards buried concrete piles, and mildly to moderately aggressive towards buried steel elements.

8.2. Foundation Design

8.2.1. Design Criteria

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

> AS 2159 (2009) Piling – Design & Instillation [9]

> AS 5100 (2007) Bridge Design Set (Parts) [13]

> Other relevant Australian and international standards

> Engineering principles

For the pile foundations, AS 2159-2009 [9] requires that the ultimate design geotechnical strength ($R_{d,g}$) is not less than the design action effect (E_d). The design geotechnical strength is calculated as the ultimate geotechnical strength ($R_{d,ug}$) multiplied by a geotechnical strength reduction factor (ϕ_g).

The value of the geotechnical strength reduction factor is influenced by the following factors:

> ϕ_{gb} – Basic geotechnical strength reduction factor, which is influenced by an assessment of the various risk factors relating to the site, design methodology and the method of pile instillation.

> ϕ_{tf} – Intrinsic testing factor based on the type of pile testing to be undertaken; and

> K – Testing benefit factor dependant on the percentage of piles to be tested.

The assessment of individual risk ratings for risk factors as set out in Table 4.3.2 (A) of AS 2159-2009 [9] will need to be undertaken by the designer of the foundations. However, to assist in the design of foundations, an assessment of the average risk rating has been undertaken based on the following factors and assumptions:

> A level and quality of the geotechnical investigation that has been undertaken to date which includes in-situ and laboratory testing on the weathered rock profile;

> A low-redundancy foundation system (i.e. isolated piles set out at large spacing's);

> No pile testing will be undertaken;

> Similar experience with the design of foundations into residual soils and weathered bedrock; and

> A competent and experienced piling contractor to install the piles.

Based on the assessment of the above factors and assumptions, an Average Risk Rating (ARR) for the design of the foundations into the weathered bedrock of 3.14 could be adopted.

Based on Table 4.3.2 (C) of AS 2159-2009 [9], an ARR of 3.14 is defined as low to moderate risk. The basic geotechnical strength reduction factor (ϕ_{gb}) for single isolated piles founded into the residual soil and weathered bedrock profile within the site is assessed to be 0.48.

An increase in the geotechnical strength reduction factor could be adopted by adopting the following procedures:

> Inspection of the foundation conditions by a geotechnical engineer

> Pile testing regime depending on the type and extent of the testing.

For all piles where the basic geotechnical strength reduction factor is greater than 0.4, AS2159-2009 [9] requires the integrity of the pile shaft to be assessed by testing and inspection.

Ultimate and serviceability limit state of the piles or pile groups should be undertaken during the detailed design phase of the proposed development.

8.2.2. Foundation Conditions

Figure 8-1 below provides a comparison between SPT “N” values with respect to elevation for the SPT test undertaken on site on a log plot. Trendlines have also been added to indicate the general trend of the SPT data.

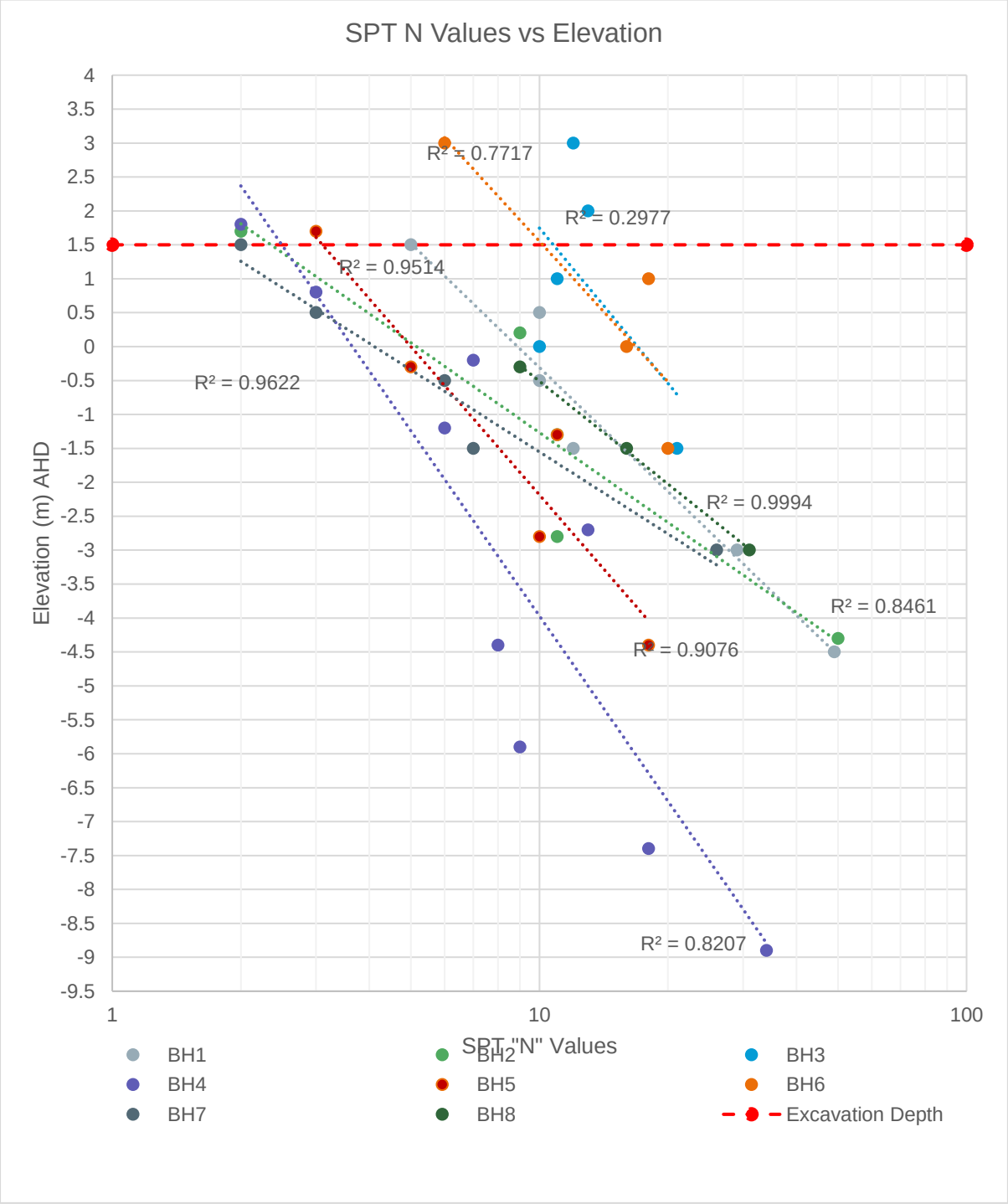


Figure 8-1 Comparison of SPT "N" Values vs Elevation

The results of the SPT tests indicate that the soil consistency generally improves with depth across the site until bedrock is encountered. Based on a basement finished floor level of 1.6m AHD, SPT N values of between 2-10 are expected at the base of the excavation, indicating soft to stiff clays along with loose sands.

Figure 8-2 below provides a comparison of point load testings axial $Is_{(50)}$ values with respect to elevations for the rock core samples recovered from BH3, BH5, BH6 and BH7.

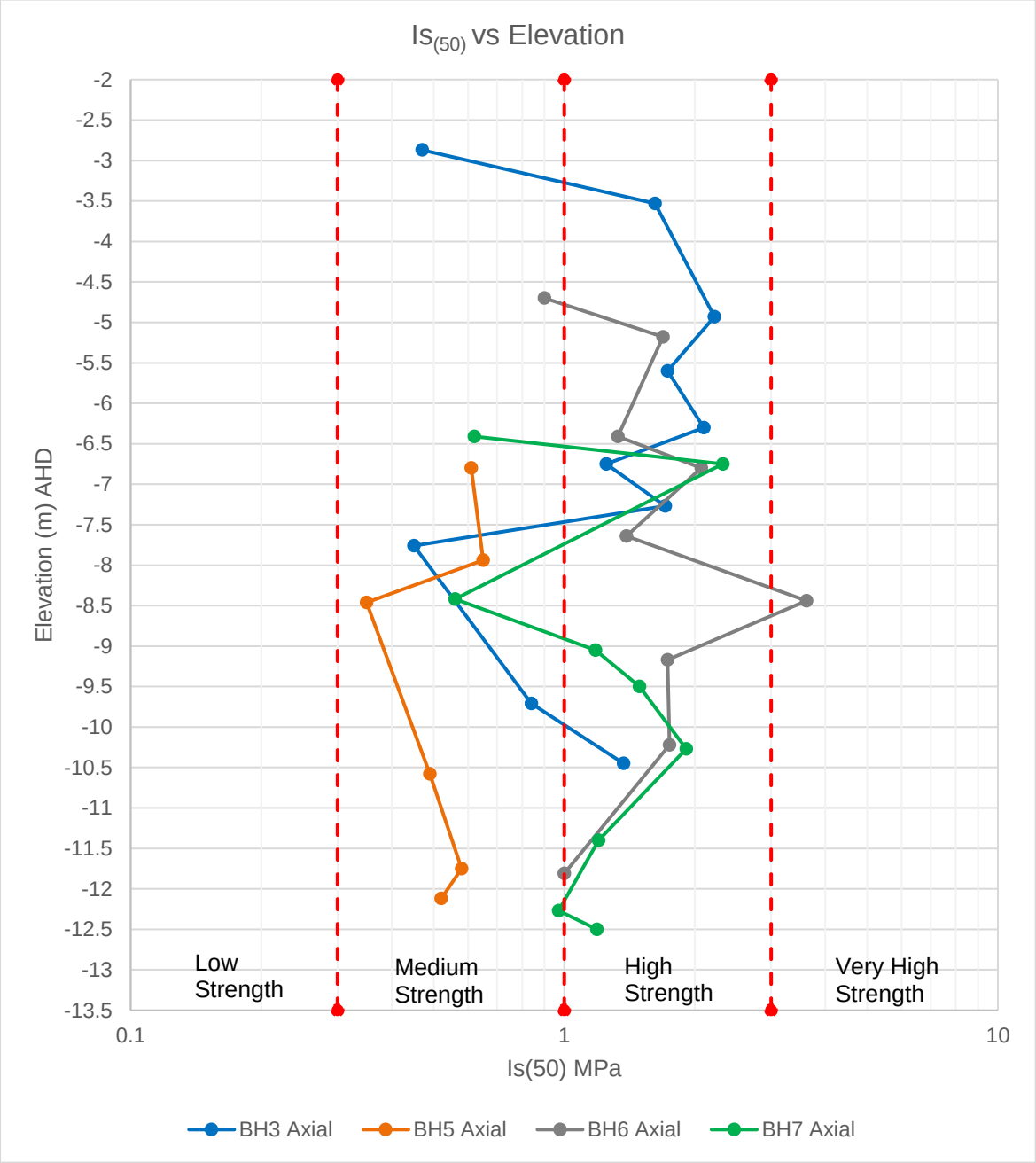


Figure 8-2 Comparison of $I_{s(50)}$ Values vs Elevation

The above assessment indicates that there is no direct relation between $Is_{(50)}$ values and elevation across the site. $I_{s(50)}$ values for the sandstone and siltstone typically range between 0.35-2.2 MPa to the depth of investigation with the exception of some minor very high strength bands.

Based on previous experience with greater Sydney basin sandstone and siltstone/shales , and reference to *Substance and Mass Properties of Engineering Structures in Hawksbury Sandstone* by Pells (P.J.N Pells) [14], Unconfined Compressive Strength (UCS) of Sydney basin sandstone is generally between 15 to 35 times the point load $I_{S(50)}$ values. Although this correlation has been suggested based on the laboratory testing of Hawksbury Sandstone, it has been widely used for correlation of UCS and point load testing results of sandstones and siltstone/shale of other geological formations.

Considering UCS values of between 19-34 MPa for the sandstone with $I_{S(50)}$ values generally in the range of 0.65-1.49 MPa respectively, a point load $I_{S(50)}$ to UCS correlation factor of 30 could be adopted for the site sandstone.

Based on this correlation, a representative UCS value for the Unit T1 and T2 sandstone of 18 and 25 MPa respectively could be adopted. Note that this value is recommended for foundation design only. Higher UCS values may need to be used for assessment of rock socket drillability.

Considering the basement floor finished design level of 1.6m AHD, the following materials are expected to be present at levels below the basement level.

- Unit A2 & R1: Firm to stiff alluvial and residual clays are expected at basement level across the site. These materials were assessed to be unsuitable to support any significant loads and as such, foundations should extend beyond these materials.
- Unit R2: Very stiff to hard residual clay and extremely weathered Class V sandstone is expected to encounter at depths close to excavation level within the eastern portion of the site adjacent to Mann St and is expected at depths generally below -1.5m to -3.0m AHD across the remaining portion of the site, increasing towards the west. Deep residual R1 profiles were encountered in BH4 to a depth of -7.2m AHD.
- Unit T1: Class IV sandstone bedrock was encountered at depths below -6.6m AHD within the western portion of the site and between -8.9m to -6.1m AHD within the south-western portion of the site. This layer was underlain by Unit T2 profiles.
- Unit T2: Class III sandstone bedrock was encountered at depths from approximately -4.0m AHD within the eastern portion of the site adjacent to Mann St and increasing in depth to between -8.9m to -12.3mAHD within the western portions of the site. Based on a review of the borehole logs from the previous report by DP, it is expected that this unit is encountered at depths below approximately -6.0m AHD along the boundary with the mixed-use development situated to the north-east of the proposed site.

8.2.3. Foundation Parameters

Considering the subsurface conditions summarised in Section 5 of this report and due to the potential differential ground movement risk that could result from settlement and seasonal moisture variations, it is recommended to place all the foundations in material of similar strata. This will require foundations to comprise pile foundations extending to Unit R2 and embedded into Unit T1 and T2 profile.

Design values presented in **Table 8-1** assumes that:

> Pile foundations comprise centrally loaded piles suitably embedded into Class III Sandstone or Siltstone (Unit T1) bedrock constructed using appropriate construction practice considering socket roughness and cleaning of pile base.

> Serviceability limit state design is undertaken for the foundation to consider the settlement of the various foundation types and structural tolerances.

General design parameters are presented in the following sections and should be used as guidance for the design.

Isolated piles required to support the structure could be designed using the parameters presented in **Table 8-1** below. Reference to AS 2159-2009 *Piling Design and Installation* [9] a basic geotechnical reduction factor (ϕ_{gb}) of 0.48 is recommended for the below geotechnical ultimate values. The reduction factor has been estimated utilising the procedure outlines in AS 2159-2009 Table 4.3.2 (A) with Individual Risk Rating (IRR) nominated based on the site conditions, design procedure and assumed construction control monitoring procedures as outlined in Section 8.2.1.

Table 8-1 Geotechnical Design Parameters for Pile Foundations

Unit	Description	Inferred Rock Class [1] / Soil Consistency	Average UCS [2] (MPa)	Serviceability End Bearing Pressure [3] (MPa)	Ultimate End Bearing Pressure [4] (MPa)	Ultimate Shaft Adhesion [5] (Compression[6]) within layer (MPa)	Elastic Modulus (MPa)
R2	Very stiff to hard residual clays and extremely weathered sandstone bedrock	Very Stiff-Hard Class V Sandstone	-	-	-	0.06	30
T1	Medium strength sandstone with interbedded siltstone	Class IV Sandstone	15	3.5	10	0.6	600
T2	Medium to high strength sandstone with interbedded siltstone	Class III Sandstone	25	6	30	1.2	1000

Notes:
1- The inferred rock classifications are based on P.J.N Pells et al [8].
2- Average UCS values are based on interpretation of $I_{s(50)}$ values and representative rock samples UCS values based on an assumed correlation factor of 30.
3- Serviceability bearing pressure is expected to cause settlement of <1% of footing dimension for foundations embedded in weathered rock. Serviceability end bearing pressure may be increased subject to specific foundation settlement analyses and assessment of tolerable settlement and differential settlement.
4- At ultimate bearing pressure large settlements greater than 5% of the minimum foundation dimensions are expected.
5- The shaft adhesion value is based on clean socket roughness of R2 [8] or better which must comprise grooves of depth 1-4mm, width greater than 2mm at spacing 50mm to 200mm
6- For uplift loads, reduce the ultimate shaft adhesion values by 30% subject to confirmation of shaft roughness and cleanness by geotechnical engineer during the construction. Pile uplift design should also take into consideration the cone pull-out failure assuming a cone angle of 90˚ in rock utilising submerged unit weight for long-term. This should also consider the pile group affect and reduced cone volume.

The above preliminary design parameters are subject to inspection of the foundation conditions by experienced geotechnical engineer to confirm the founding conditions. All foundation excavations should be kept free of fall-ins and water ponding.

An estimation of the required pile sockets and expected settlement estimation should be undertaken as part of the detail design of the piles.

9. Retaining Structures

9.1. Design Criteria

This section outlines design criteria and parameters for the purpose of retaining structures design. Based on the AP, excavations of up to 7.9m would be required within the eastern portion of the site adjacent to Mann St and as such, appropriate shoring system should be constructed prior to the excavations.

The following design criteria should be adopted for the design of the retaining structures:

- AS 4678 (2002) – Earth Retaining Structures [9];
- AS 5100 (2007) – Bridge Design Set (Parts) [13];
- AS 3798 (2007) – Guideline on Earthworks for Commercial and Residential Developments [10]; and
- An accepted industry practice for global stability factors of safety (FOS) for slopes of 1.5 for long-term conditions and 1.3 for short term construction conditions.

For a simplified or preliminary design, flexible walls such as cantilever or gravity walls may adopt a triangular earth-pressure distribution. During detailed design, the designer should select earth pressure coefficients based on the specific geotechnical and geometrical situation under consideration. The retaining walls design should comprise assessment of foundation bearing capacity, sliding, overturning and global stability checks.

9.2. Temporary Excavation Shoring

Soil profiles expected to be retained along the eastern boundary would comprise surficial topsoil (Unit C1) overlying firm to hard (Unit R1 & R2) residual sandy clay and clayey sand profiles. The remaining portion of the site's basement level retaining structures within the central and western portion of the site are expected to retain surficial fill (Unit F1) overlying soft to firm alluvial sands and clays (Unit A1) to the depth of excavation.

Considering subsurface profile, soldier piles laterally restrained by temporary anchors with shotcrete panel could be utilised for the shoring system.

Based on previous experience with design and construction of similar shoring walls, the geotechnical design and stability of the retaining structure is critical and would require in-depth understanding of the geotechnical strength and material failure modes. The retaining wall design parameters in the following section should be used for preliminary checks only and as such should not be justified for over-simplification of the design problem. As a minimum, the following procedure should be followed for the shoring wall design:

- Geotechnical model to be adjusted for various wall sections as a simplified model could result in over or under designing different wall sections. This should also consider variations in groundwater levels across the site as well as seasonal variations in short and long term.
- The design should also incorporate surcharge loading from the road and neighbouring structures.
- Considering the risks associated with potential shoring wall failure to the construction workers and neighbouring structures residence and road users, design should be undertaken using an appropriate 2D/3D finite element analysis package capable of estimating the deflections along the pile and ground surface behind the wall. This will enable the design to be checked for the serviceability criteria considering the expected deflection tolerances of the neighbouring structures.

- Design of the temporary and permanent anchors should consider anchor bond material and apply the appropriate reduction factors as per as AS4678 – 2002 [15] (or similar codes such as BS8081, 1989: British Standard Code of Practice for Ground Anchorage [16]. Understanding of the potential geotechnical failure mode/plane of the retaining structure would be required to determine the appropriate anchor free and bond length.
- The design should consider both serviceability design criteria such as wall and surface deflections as well as ultimate limit state. This should include analysis of the wall global stability using finite element strength reduction or limit equilibrium analysis.
- The shoring wall embedment depths below the finish excavation levels should consider the location of the future foundation/trenches excavations. The embedment depth should be selected to minimise the balance the anchor requirements by providing sufficient length to transfer a portion of the lateral loads to the foundations.
- The design should develop required construction procedures such as excavation, anchoring and shotcreting sequences.
- Shotcrete design loads should consider the soil arching effect and hydrostatic pressure as well as the rock defects spacing and orientations.
- Where temporary anchors are utilised, long term stability of the structure should consider redistribution of the anchor loads to floor slabs as well as the long term hydrostatic loads.
- The design should be accompanied with a monitoring and instrumentation procedure as well as a safety in design register to qualify the potential construction and long-term risks to be considered by the contractor/future users.

9.3. Retaining Wall Design Parameters

The subsurface profile to be retained by the shoring structure along the eastern boundary is generally expected to comprise:

- Unit C1 to depths up to 1.0 m BGL overlying,
- Unit R1 residual soils to depths up to 6.0m BGL over,
- Unit R2 residual soils to a depth of 8.0m BGL.

Retaining structures required to support the partially embedded basement levels across the remainder of the site are expected to retain up to 1.0m of filling (Unit F1) overlying soft to stiff alluvial sands and clays to a depth of between 2-5m BGL across the site, increasing in depth towards the west. This is expected to be underlain by Unit R1 and Unit R2 residual clays.

It should be noted that the above conditions are inferred from the discrete borehole locations and variation of the subsurface conditions should be considered in the design.

It is recommended to calculate the lateral earth coefficient values based on the wall geometry, type and backfill slopes using the values provided in the following table. The earth coefficients presented in the following table have been calculated for level backfill/ground surface and vertical wall arrangements. The designer should reference to the requirements of AS 4678 (2002) – Earth Retaining Structures [9] for the selection of appropriate groundwater level for the design purpose, however, groundwater was encountered at elevations of between 0.4 to -2.7m AHD (on average) at the time of investigation.

Recommended design parameters for retaining walls are presented below in **Table 9-1**

Table 9-1 Retaining Wall Design Parameters

Unit	Description	Density (t/m^3)	Effective Friction Angle Φ' (Degrees)	Effective Cohesion C' (kPa)	Effective Elastic Modulus E' (MPa)	Active Earth Pressure Coefficient K_A(1)	Passive Earth Pressure Coefficient K_P(1)	At Rest Earth Pressure Coefficient K_o(2)
C1	Firm silty clays and clayey sand topsoil/colluvium	18	24	0	4	0.42	2.3	0.5
F1	Gravelly, silty and clayey sands	18	28	0	10	0.36	2.7	0.5
A1	Firm to stiff alluvial silty and sandy clays with interbedded loose clayey sands	18	26	0	10	0.39	2.5	0.5
R1	Firm to stiff residual clay and sandy clay	18	25	4	6	0.4	2.4	0.5
R2	Very stiff to hard residual clays and extremely weathered sandstone	21	28	10	15	0.36	2.7	0.5
T1	Medium strength Class IV Sandstone	23	40	120	800	0.21	4.6	1.0(3)
T2	Medium to high strength Class III Sandstone	23	50	200	1000	0.13	7.5	1.0(3)

Notes to table:

(1) Coefficients stated above to be used with effective stress calculation
(2) K_o of 0.5 assumes minor wall movement will occur
(3) In-situ K_o value for sandstone may be significantly higher due to platonic locked-in horizontal stresses. The use of lower value in this case is not critical as the bulk excavation level is above the sandstone bedrock level.

9.4. Construction Recommendations

- Retaining wall backfill should comprise granular free-draining material with appropriate separation geofabric placed between the wall and granular backfill;
- All foundations should be founded on similar strata to limit the effects of differential settlement;
- Subsurface drainage lines should be placed behind the permanent and temporary (depending on the type) retaining wall, to direct seepage to appropriate points of discharge. Subsurface lines should be installed with consideration of maintenance and flush-out points; and
- Retaining wall foundations as well as anchor bond material should be inspected by experienced geotechnical and engineer.

10. References

[1] NSW Office of Environment and Heritage, "eSPADE V2.0," NSW Office of Environment and Heritage, December 2016. [Online]. Available: http://www.environment.nsw.gov.au/eSpade2Webapp.

[2] A. L. Troedson, *Central Coast Area 1:100,000 and 1:25,000, Coastal Quaternary Geology Map Series,* Maitland: Geological Survey of New South Wales, 2016.

[3] Department of Land And Water Conservation, "Acid Sulfate Soil Risk Map (Edition 2)," NSW Department of Natural Resources, 1997.

[4] Gosford City Council, "Local Environmental Plan (LEP) Acid Sulfate Soil Risk map".

[5] NSW Department of Primary Industries, Office of Water, "Groundwater Map," Office of Water, [Online]. Available: http://allwaterdata.water.nsw.gov.au/water.stm.

[6] Austraslian Geomechanics Society, "Practice Note Guidelines for Landslide Risk Management (c)," *Journal and News of hte Australian Geomechanics Society,* vol. 42, no. 1, pp. 63-158, 2007.

[7] Australian Standards AS1726-2017, "Geotechnical Site Investigations," Standards Australia, 2017.

[8] P. J. Pells, G. Mostyn and B. F. Walker, "Foundations on Sandstone and Shale in the Sydney Region," Australian Geomechanics, Dec 1998.

[9] Australian Standard AS2159-2009, "Piling - Design & Installation," Standards Australia, 2009.

[10] Australian Standard AS3798-2007, "Guidelines on Earthworks for Commercial and Residential Structures," Standards Australia, 2007.

[11] Gosford City Council, "Discharge of Liquid Trade Waste and Septic Waste to the Gosford City Council Sewerage System," Gosford City Council, 28 July 2015.

[12] NSW Department of Environment and Climate Change (DECC), "Waste Classification Guidelines, Part 1 - Classifying Waste," Department of Environment and Climate Change NSW, December 2009.

[13] Australian Standard AS5100-2007, "Bridge Design Set," Standards Australia, 2007.

[14] P. Pells, "Substance and Mass Properties of Engineering Structures in the Hawksbury Sandstone," Australian Geomechanics Journal Vol 39 No 3, 2004.

[15] Australian Standard AS4678-2002, "Earth Retaining Structures," Standards Australia, 2002.

[16] British Standards BS8081-1989, "Ground Anchorages," British Standards Institution, 1989.

[17] G. H. McNally, Soil and Rock Construction Materials, London: E. & F. N. Spon, 1998.

Important information about your Coffey Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples.

These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

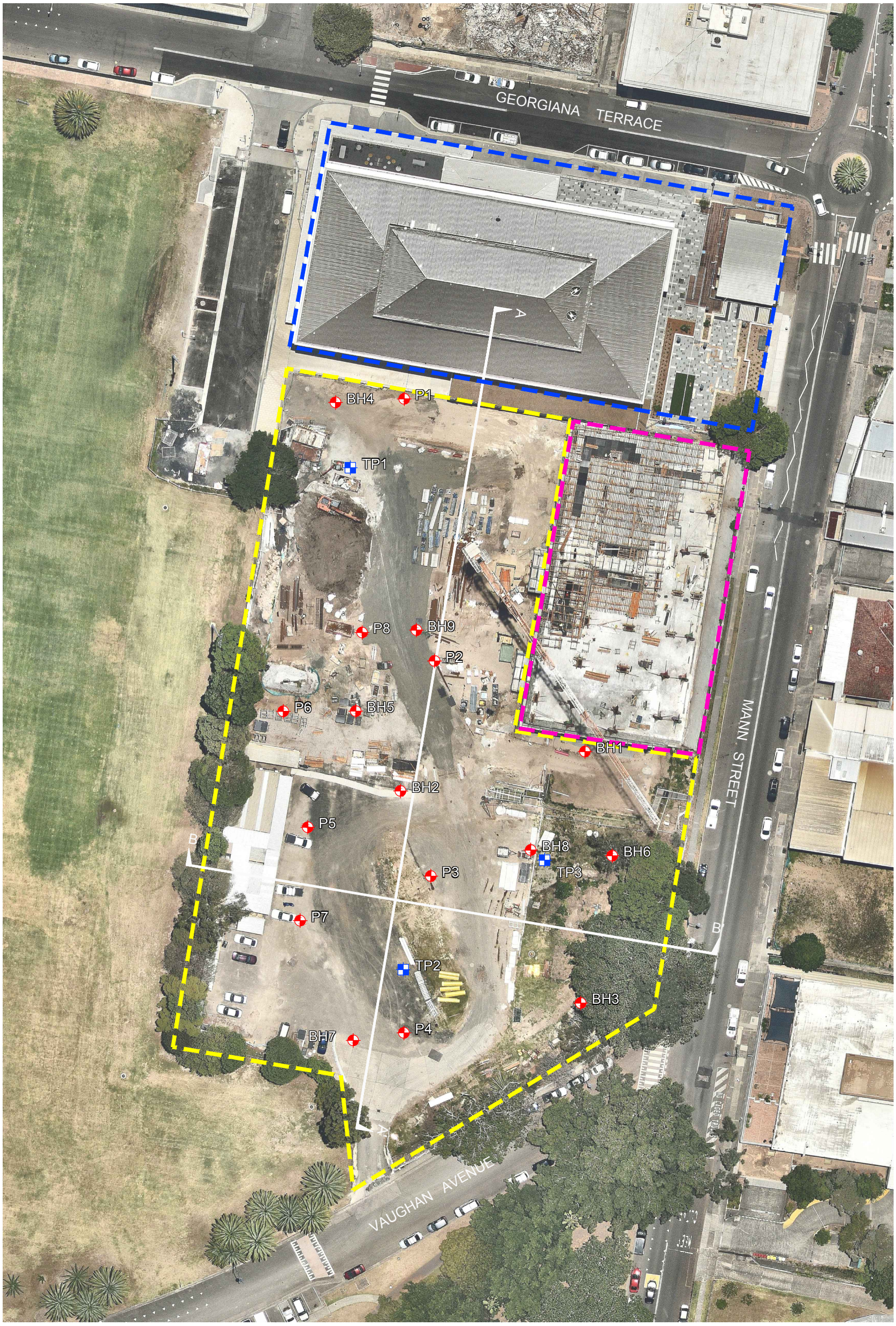
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Appendix A - Investigation Drawings



revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	AM	AM	29/03/18

LEGEND

- SITE BOUNDARY - CURRENT STAGE
- SITE BOUNDARY - PREVIOUS STAGE
- SITE BOUNDARY - PREVIOUS STAGE
- APPROXIMATE BOREHOLE LOCATION
- APPROXIMATE TEST PIT LOCATION
- SECTION LINE

10 0 10 20 30 40

Scale (metres) 1:800

IMAGE SOURCE: NEARMAPS

drawn	AM / AW
approved	AM
date	29 / 03 / 18
scale	AS SHOWN
original size	A3

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A TETRA TECH COMPANY

client: ST HILLIERS

project: GEOTECHNICAL AND ENVIRONMENTAL ASSESSMENT
32 MANN STREET, GOSFORD, NSW

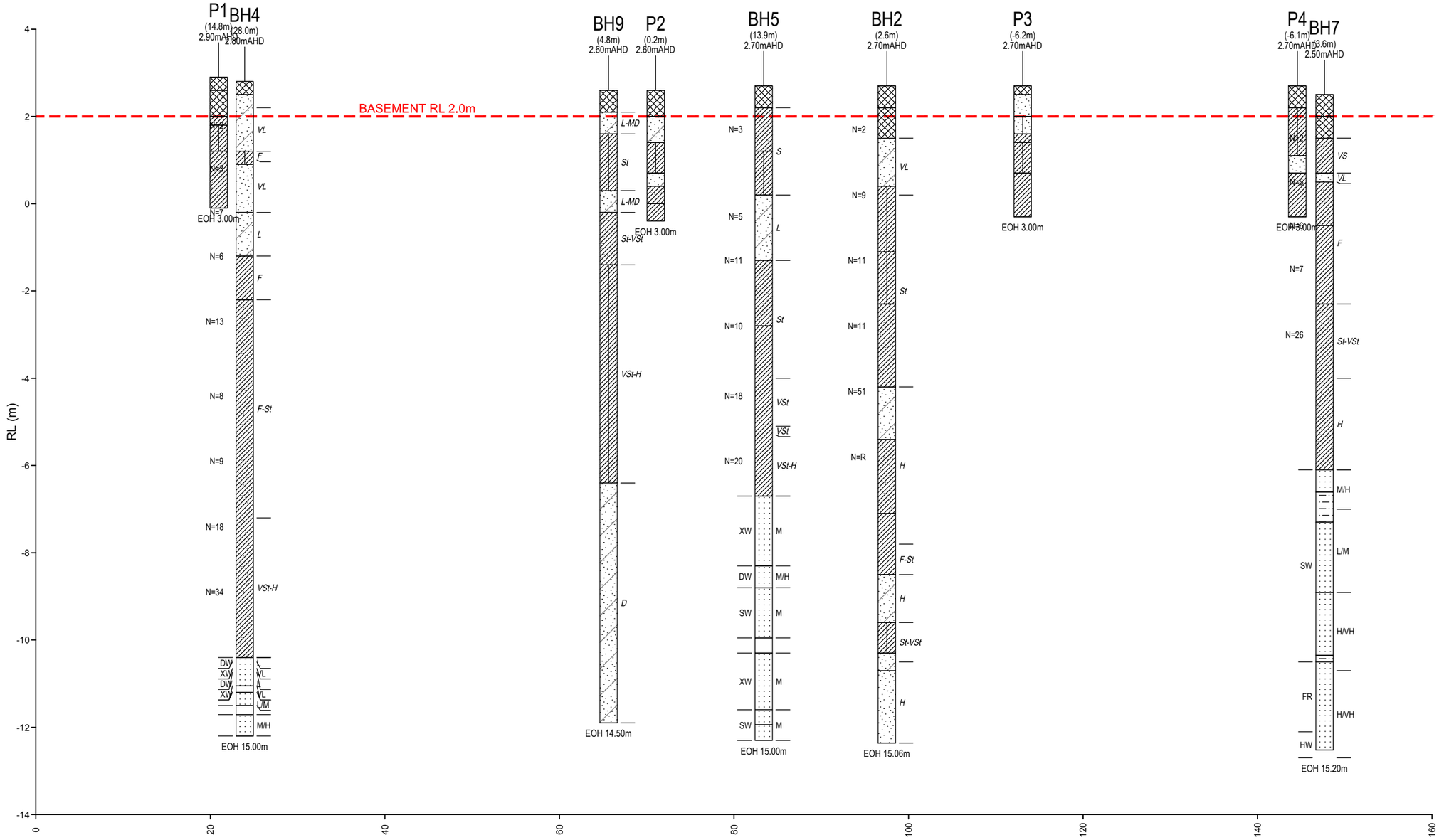
title: BOREHOLE AND TEST PIT LOCATION PLAN

project no: 754-SYD214942-AB | figure no: FIGURE 1 | rev: A

PLOT DATE: 29/03/2018 4:10:41 PM DWG FILE: F:\1. PROJECTS\4. SYD-GEOTECHNICS\2018\SYDGE214942 32 MANN ST GOSFORD\12. CAD\754-SYDGE214942-AB.DWG

NORTH

SOUTH



SECTION A-A'

LEGEND

- FILL
- CLAYEY SAND
- SANDY CLAY
- CLAY
- SILTY CLAY
- SAND
- TOPSOIL
- SANDSTONE
- CLAYSTONE
- SILTSTONE
- NO CORE
- SILTY SAND
- ASPHALT
- SANDY SILTY CLAY

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	AM	AM	29/03/18

Horizontal Scale (metres) 1:500

Vertical Scale (metres) 1:100

drawn	AM / AW
approved	AM
date	29 / 03 / 18
scale	AS SHOWN
original size	A3

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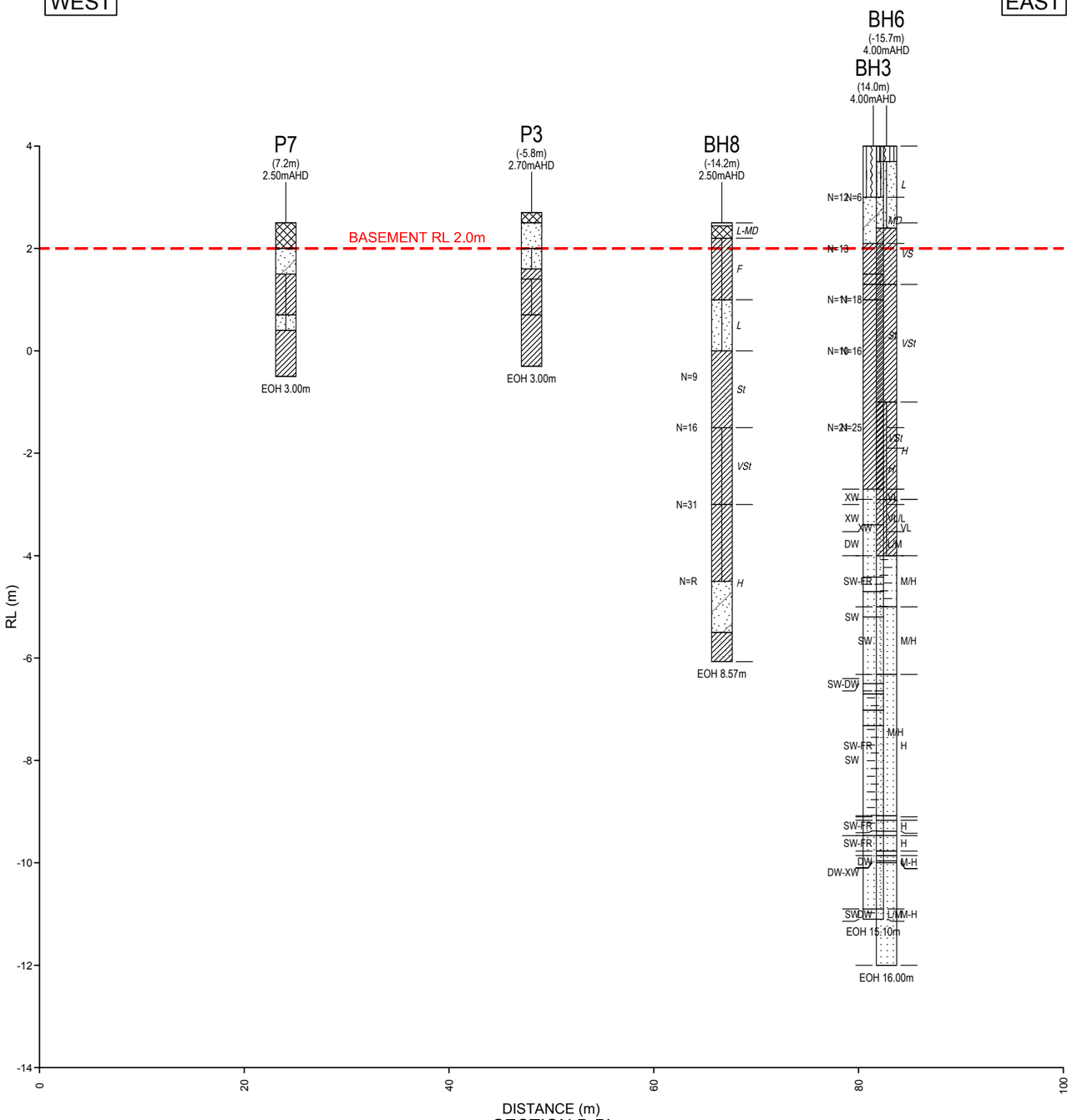
project: GEOTECHNICAL AND ENVIRONMENTAL ASSESSMENT
32 MANN STREET, GOSFORD, NSW

title: SECTION A-A'

project no: 754-SYD214942-AB | figure no: FIGURE 2 | rev: A

WEST

EAST



SECTION B-B'

LEGEND

- FILL
- CLAYEY SAND
- SANDY CLAY
- CLAY
- SILTY CLAY
- SAND
- TOPSOIL
- SANDSTONE
- CLAYSTONE
- SILTSTONE
- NO CORE
- SILTY SAND
- ASPHALT
- SANDY SILTY CLAY

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	AM	AM	29/03/18

5 0 5 15 25
Horizontal Scale (metres) 1:500

1 0 1 3 5
Vertical Scale (metres) 1:100

drawn	AM / AW
approved	AM
date	29 / 03 / 18
scale	AS SHOWN
original size	A3

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A TETRA TECH COMPANY

client: ST HILLIERS

project: GEOTECHNICAL AND ENVIRONMENTAL ASSESSMENT
32 MANN STREET, GOSFORD, NSW

title: SECTION B-B'

project no: 754-SYD214942-AB | figure no: FIGURE 3 | rev: A

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Appendix B - Explanatory Notes, Borehole Logs & Core Box Photographs

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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 μm to 2.36 mm
	medium	200 μm to 600 μm
	fine	75 μm to 200 μm

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH s_u (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

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Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)								USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.36 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.				GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.				GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)				GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)				GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.36 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes				SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.				SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).				SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).				SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.						
				DRY STRENGTH	**DILATANCY**	**TOUGHNESS**			
		SILTS & CLAYS Liquid limit less than 50		None to Low	Quick to slow	None		ML	SILT
				Medium to High	None	Medium		CL	CLAY
				Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50		Low to medium	Slow to very slow	Low to medium		MH	SILT
				High	None	High		CH	CLAY
				Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.					Pt	PEAT

• Low plasticity – Liquid Limit w_L less than 35%. • Medium plasticity – w_L between 35% and 50%. • High plasticity – w_L greater than 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

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Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance	In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.
Defect	Discontinuity or break in the continuity of a substance or substances.
Mass	Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	**RS**	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	**XW**	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	**HW**	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	**MW**	The whole of the rock substance is discoloured, usually by iron staining or bleaching , to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	**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.
Fresh Rock	**FR**	Rock substance unaffected by weathering.

Notes on Weathering:

1. AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.
2. Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

ROCK SUBSTANCE STRENGTH TERMS

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

Notes on Rock Substance Strength:

1. In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
2. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
3. The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index $I_{s(50)}$. The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

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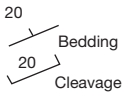
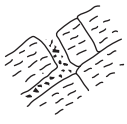
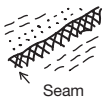
Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.			 (Note 2)
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			 (Note 2)
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

DEFECT SHAPE TERMS	
Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS	
Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS	
Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

BLOCK SHAPE TERMS	
Blocky	Approximately equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greate than cross section

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

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Engineering Log - Borehole

Borehole ID.	**BH1**
sheet:	1 of 2
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**22 Feb 2018**
principal:	
date completed:	**22 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,756.31; N: 6,299,817.01 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
PT			E	2				**FILL: Gravelly SAND**: fine to medium grained, pale brown, with fine sub-angular gravels, trace of low plasticity clay.	D			**FILL** PID: 2.5ppm
			SPT 5, /50mm N*=R	1	1.0			**FILL: CLAY**: medium to high plasticity, dark grey-black, trace of organics.	M			
							SC	**CLAYEY SAND**: fine grained, dark brown mottled dark grey, with low to medium plasticity clay, trace of fine gravel.		L		**ALLUVIUM**
			SPT 2, 4, 6 N*=10	0	2.0		CL	**Sandy CLAY**: medium to high plasticity, dark brown mottled dark grey, with fine grained sand, trace of fine gravel.		St		**RESIDUAL SOIL** PID: 3.4ppm
AD/T		22/02/18	SPT 4, 5, 5 N*=10	-1	3.0							
			SPT 2, 4, 8 N*=12	-2	4.0		CH	**CLAY**: medium to high plasticity, pale grey, trace of fine grained sand, trace of fine to medium sub-rounded gravel.				
					5.0				W			
			SPT 6, 13, 16 N*=29	-3			CL	5.2 m: harder ground conditions, red shade of soil appearing **Sandy CLAY**: medium to high plasticity, pale grey mottled orange, red, with very fine grained sand.		VSt		
				-4	6.0			6.5 m: harder ground conditions encountered		H		
			SPT 6, 19, 30 N*=49	-5	7.0		CL	**Sandy CLAY**: medium plasticity, pale grey, spotted red, with fine grained sand, trace of extremely weathered rock.				

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**BH1**
sheet:	2 of 2
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**22 Feb 2018**
principal:	
date completed:	**22 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,756.31; N: 6,299,817.01 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: 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			SPT 20, 30/50mm N*=R	-6			CL	**Sandy CLAY**: medium plasticity, pale grey, spotted red, with fine grained sand, trace of extremely weathered rock. *(continued)*	W	H		**RESIDUAL SOIL**
				-7	9.0			Borehole BH1 terminated at 8.70 m				
				-8	10.0							
				-9	11.0							
				-10	12.0							
				-11	13.0							
				-12	14.0							
				-13	15.0							

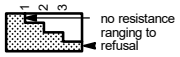
CDF_0_9_07_LIBRARY.GLB rev:AU Log COF BOREHOLE: NON CORED 754-SYDGE214942.GPJ <<DrawingFile>> 16/08/2019 09:25

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

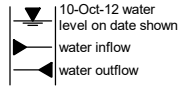
* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**BH2**
sheet:	1 of 2
project no.	**SYDGE214942**
client:	***SH Gosford Residential Pty Ltd***
date started:	***22 Feb 2018***
principal:	
date completed:	***23 Feb 2018***
project:	***Geotechnical and Environmental Assessment***
logged by:	***LP***
location:	***32 Mann Street, Gosford, NSW***
checked by:	***AM***

position: E: 345,719.85; N: 6,299,809.19 (MGA94) | surface elevation: 2.70 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT			E					**FILL: Gravelly SAND**: fine to medium grained, dark brown-black, with fine to medium angular gravel, trace of low to medium plasticity clay.	M			**FILL** PID: 3.7ppm
			E									PID: 3.8ppm
			E	2				**FILL: SAND**: fine to medium grained, brown-dark brown, trace of silt and fine gravel.	M			
			SPT 3, 1, 1 N*=2		1.0		SC	**CLAYEY SAND**: fine grained, grey, medium plasticity clay, organic odour, trace of organics and root fibres.	M - W	VL		**ALLUVIUM** PID: 4.9ppm
			E	1	2.0		CH	**Silty CLAY**: medium to high plasticity, pale grey-dark grey, trace of root fibres and fine white gravel.	M	St		
			SPT 3, 5, 4 N*=9	0								
			E		3.0							
			SPT 2, 4, 7 N*=11	-1	4.0		CH	**Silty CLAY**: medium to high plasticity, grey mottled orange-red, trace of fine grained sand, root fibres and fine pale gravel.				
				-2	5.0		CL	**Sandy CLAY**: medium to high plasticity, pale grey, white sotted orange, with fine grained sand, trace of root fibres and silt.				**RESIDUAL SOIL**
			SPT 2, 4, 7 N*=11	-3	6.0							
				-4								
			SPT 18, 21, 30 N*=51	-5	7.0		SC	**SAND**: fine grained, pale grey, streaked red, medium plasticity clay.		H		

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**BH2**
sheet:	2 of 2
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**22 Feb 2018**
principal:	
date completed:	**23 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,719.85; N: 6,299,809.19 (MGA94) | surface elevation: 2.70 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT			SPT 20, 30 N*=R	-6	9.0		CL	**Sandy CLAY**: medium to high plasticity, orange-brown mottled red, pale grey, fine to medium grained sand.	M	H		**RESIDUAL SOIL**
				-7	10.0		CH	**CLAY**: high plasticity, pale grey, spotted brown, trace of fine to coarse gravel.				
				-8				10.5 to 11.2 m: very soft spot encountered		F - St		
				-9	11.0		SC	**CLAYEY SAND**: fine to coarse grained, pale brown-orange mottled pale grey, with medium plasticity clay.		H		
					12.0			11.9 m: hard material encountered				
				-10			CL	**Silty CLAY**: medium to high plasticity, pale grey mottled pale brown, with silt, trace of fine sub-rounded grey gravel, medium strength.		St - VSt		
					13.0		SC	**CLAYEY SAND**: fine to medium grained, pale grey, with medium plasticity clay, trace of sandstone.		H		
				-11			SC	13.05 to 13.4 m: soft material **SAND**: fine to coarse grained, pale brown-orange, trace of sandstone.				
				-12	14.0							
					15.0			Borehole BH2 terminated at 15.06 m				
				-13								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**BH3**
sheet:	1 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**23 Feb 2018**
principal:	
date completed:	**23 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,755.46; N: 6,299,767.29 (MGA94) | surface elevation: 4.00 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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
PT				4			ML	**TOPSOIL: Silty CLAY**: low to medium plasticity, brown, pale brown, trace of organics and root fibres.	D - M			**TOPSOIL**
			E					0.8 m: grading to brown-dark brown				
			SPT 4, 5, 7 N*=12	3	1.0		SC	**CLAYEY SAND**: fine to medium grained, dark brown, trace of fine grained sand.		MD		**ALLUVIUM**
			E	2	2.0		CH	**CLAY**: medium to high plasticity, dark brown mottled red-dark grey.	M	St		**RESIDUAL SOIL**
			SPT 4, 6, 7 N*=13									
			E				CL	**Sandy CLAY**: medium to high plasticity, dark brown, grading to brown, pale brown, fine to medium grained sand, trace of silt.				
			E				CH	**CLAY**: medium to high plasticity, pale grey, white, trace of sllt, sand and root fibres.				
		Not Encountered	SPT 3, 5, 6 N*=11	1	3.0		CH	**CLAY**: medium to high plasticity, pale grey, white, trace of tree root fibres. 3.2 m: colour changes to pale grey spotted red				
			SPT 2, 4, 6 N*=10	0	4.0			4.1 m: colour changes to pale, more tree root fibres present				
				-1	5.0					VSt		
AD/T			SPT 5, 8, 13 N*=21	-2	6.0			5.9 m: grading red-orange		H		
				-3	7.0			Borehole BH3 continued as cored hole				

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
PT push tube

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
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

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Engineering Log - Cored Borehole

		Borehole ID.	**BH3**
		sheet:	2 of 3
		project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**	date started:	**23 Feb 2018**
principal:		date completed:	**23 Feb 2018**
project:	**Geotechnical and Environmental Assessment**	logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**	checked by:	**AM**

position: E: 345,755.46; N: 6,299,767.29 (MGA94) | surface elevation: 4.00 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

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
		4									
		3	1.0								
		2	2.0								
		1	3.0								
		0	4.0								
		-1	5.0								
		-2	6.0								
					started coring at 6.70m						
W	Not Encountered	-3	7.0		**SANDSTONE**: fine grained, orange-red stained brown-grey, laminated, iron staining present.	XW		a=0.47 d=0.05	13%		JT, 45°, PL, RO, CO SM, PL, SO, CO, 30 mm
					7.00 m: colour changes to pale grey-white, with iron stains	XW					
					SANDSTONE: fine grained, pale grey-grey, bedded, trace of iron stains.	DW		a=1.62 d=1.56	84%		JT, 85°, IR, RO, CO - Fe

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
RR rock roller
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
PT push tube

support
C casing M mud N none

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
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
SS shear surface
SZ shear zone
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stained
VN veneer
CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH3**
sheet:	3 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**23 Feb 2018**
principal:	
date completed:	**23 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,755.46; N: 6,299,767.29 (MGA94) | surface elevation: 4.00 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

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
W	Not Encountered	-5	9.0		**SANDSTONE**: fine grained, pale grey-grey, bedded, trace of iron stains. *(continued)*	SW		a=2.22 d=1.86	84%		PT, UN, RO, CN SM, PL, SO, CO SM, PL, SO, CO PT, UN, SO, CN PT, UN, SO, CN
		-6	10.0		**CLAYSTONE**: grey, laminated, with interbeds of sandstone. **SANDSTONE**: fine grained, pale grey, interlaminated with grey siltstone. **SANDSTONE**: fine grained, grey, bedded.			a=1.73 d=2.05 a=2.10 d=1.50			
		-7	11.0		10.44 to 10.49 m: claystone, dark grey laminated **CLAYSTONE**: dark grey, interlaminated with siltstone. **SILTSTONE**: grey, interlaminated with claystone.	SW - DW SW		a=1.24 d=0.77			
		-8	12.0		**SANDSTONE**: fine grained, pale grey-grey, bedded. **SILTSTONE**: grey-dark grey, interlaminated with claystone.			a=1.71 d=1.40 a=0.45 d=0.06	80%		PT, UN, SO, CN
		-9	13.0								PT, IR, SO, CN PT, UN, SO, CN PT, UN, SO, CO SM, SO, CO PT, UN, RO, CO PT, CU, SO, CN
		-10	14.0		**SANDSTONE**: fine to medium grained, grey stained red-orange, bedded, trace of gravel.	DW - XW		a=0.84 d=0.50	52%		PT, 0°, UN, SO - RO, CN PT, CU, SO - RO, CN PT, UN, SO - RO, CN
		-11	15.0		**SILTSTONE**: grey, thinly bedded.	SW		a=1.37 d=0.94			
					Borehole BH3 terminated at 15.10 m						

Defects are: PT, 0 - 5°, PL, RO - SO, CN - CO, unless otherwise described

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
RR rock roller
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
PT push tube

support
C casing M mud N none

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
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

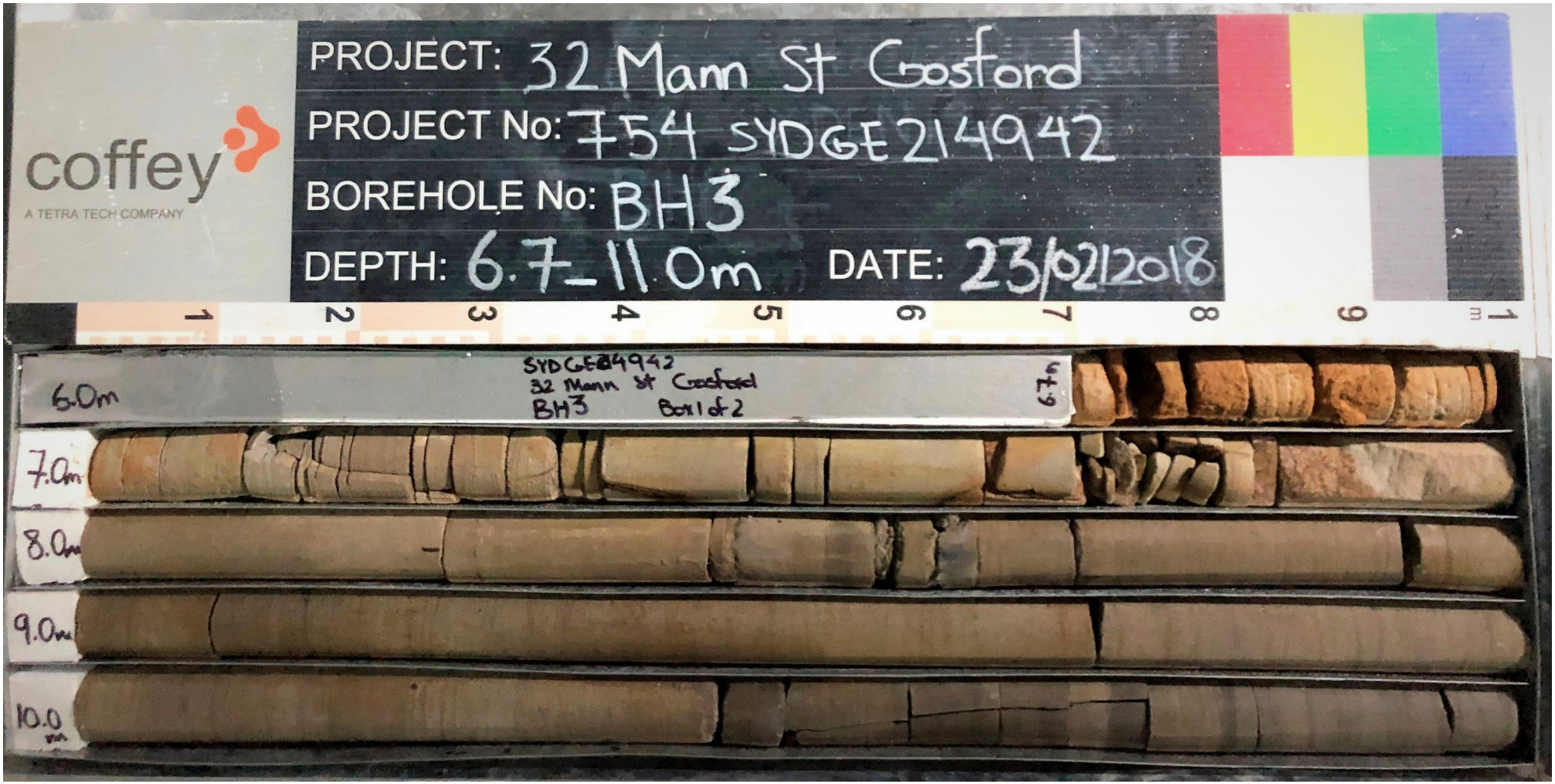
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

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

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stained
VN veneer
CO coating



BH3 6.70 - 11.00 m

drawn	LP
approved	AM
date	22/03/2018
scale	N.T.S.
original size	A4

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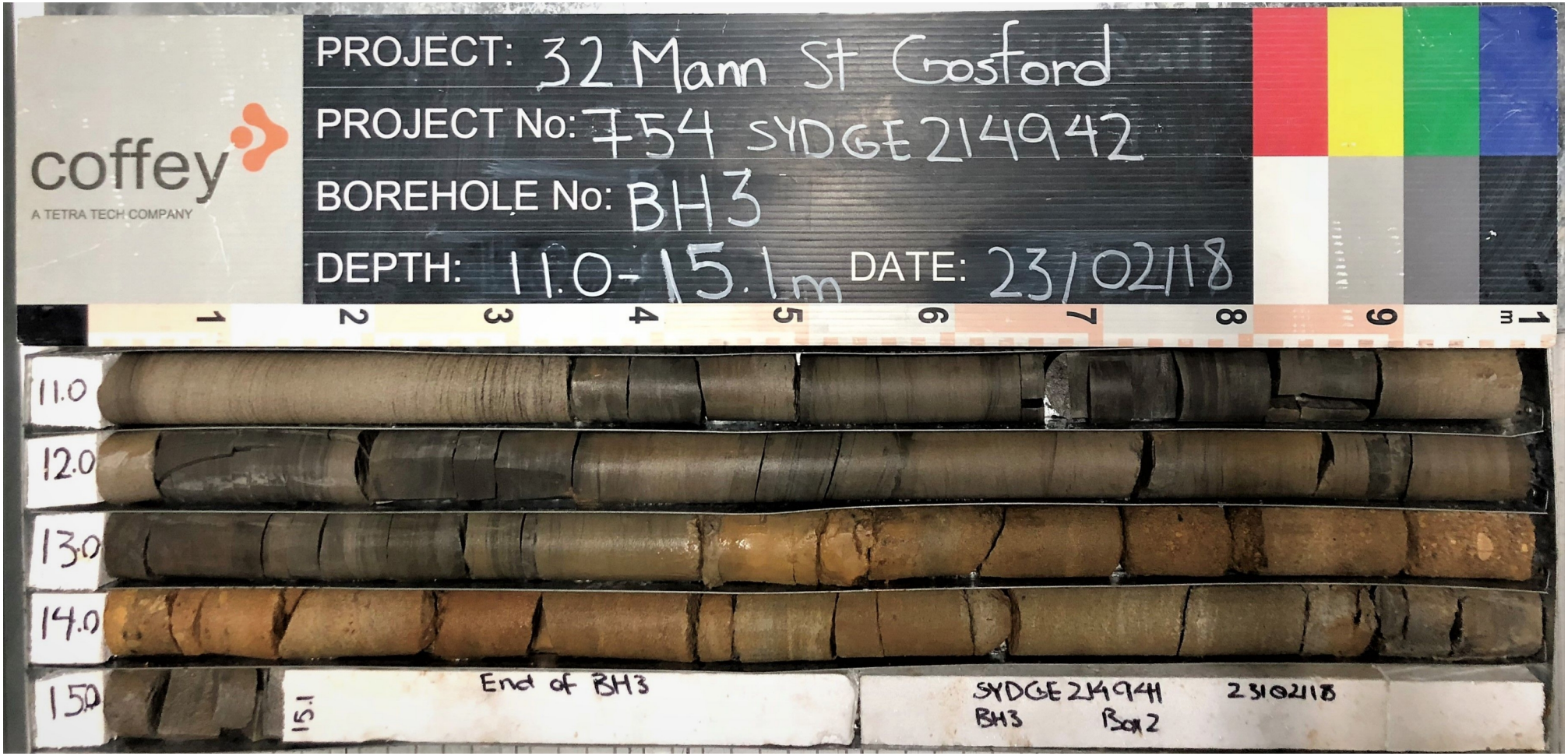
client: St Hilliers

project: Geotechnical and Environmental Assessment
32 Mann Street, Gosford, nsw

title: **CORE PHOTOGRAPH**
BH3

project no: SYDGE214942 | fig no: **FIGURE 1** | rev:



BH3 11.00 - 15.10 m

drawn	LP
approved	AM
date	22/03/2018
scale	N.T.S.
original size	A4

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client:	St Hilliers
project:	Geotechnical and Environmental Assessment 32 Mann Street, Gosford, nsw
title:	**CORE PHOTOGRAPH** **BH3**
project no: SYDGE214942	fig no: **FIGURE 2** rev:

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Engineering Log - Borehole

Borehole ID.	**BH4**
sheet:	1 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**27 Feb 2018**
principal:	
date completed:	**27 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,707.00; N: 6,299,886.00 (MGA94) | surface elevation: 2.80 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT			E					**FILL: Gravelly CLAYEY SAND**: fine to coarse grained, dark brown, with fine to medium angular gravel and low plasticity clay.	M			**FILL**
							SC	0.2 m: colour changes to brown-pale brown				**ALLUVIUM**
				2				**CLAYEY SAND**: fine to coarse grained, brown and red-orange, with medium plasticity clay.		VL		0.3-0.6m - ASS
			SPT 1, 1, 1 N*=2		1.0							
				1			CH	**Silty CLAY**: medium to high plasticity, dark brown, with fine to medium grained sand, root fibres (organics).		F		1.6-1.8m - ASS
			E				SP	**SAND**: fine to medium grained, pale grey.	W	VL		
			SPT 1, 1, 2 N*=3		2.0							
				0								2.5-2.7m - ASS
AD/T			SPT 1, 2, 5 N*=7		3.0		SC	**CLAYEY SAND**: fine to medium grained, grey, (organic odour).	M	L		
				-1								
		▶	SPT 1, 2, 4 N*=6		4.0		CH	**CLAY**: high plasticity, dark grey, trace of root fibres (organic odour).		F		
				-2				4.8 m: grading to sand with clay				
					5.0		CL	**Sandy CLAY**: medium to high plasticity, grey mottled dark red-orange, iron stained, with fine to medium grained sand, trace of silt.		F - St		**RESIDUAL SOIL**
			SPT 5, 6, 7 N*=13	-3								
W					6.0							
				-4				6.7 m: harder ground conditions				
					7.0							
			SPT 2, 3, 5 N*=8	-5				7.2 m: colour changes to pale grey spotted pale red (iron stained)				

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**BH4**
sheet:	2 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**27 Feb 2018**
principal:	
date completed:	**27 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,707.00; N: 6,299,886.00 (MGA94) | surface elevation: 2.80 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: 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
W			SPT 3, 3, 6 N*=9	-6	9.0		CL	**Sandy CLAY**: medium to high plasticity, grey mottled dark red-orange, iron stained, with fine to medium grained sand, trace of silt. *(continued)*	M	F - St		**RESIDUAL SOIL**
				-7				8.7 m: colour changes to pale grey mottled red-orange				
			SPT 5, 7, 11 N*=18		10.0					VSt - H		
				-8	11.0			11.2 m: ground gets harder				
			SPT 11, 14, 20 N*=34	-9	12.0							
				-10	13.0							
				-11	14.0			Borehole BH4 continued as cored hole				
				-12	15.0							
				-13								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Cored Borehole

Borehole ID.	**BH4**
sheet:	3 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**27 Feb 2018**
principal:	
date completed:	**27 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,707.00; N: 6,299,886.00 (MGA94) surface elevation: 2.80 m (AHD) angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted drilling fluid: Water hole diameter : 100 mm

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
		-6	9.0								
		-7	10.0								
		-8	11.0								
		-9	12.0								
		-10	13.0		started coring at 13.20m						
NMLC		-11	14.0		**SANDSTONE**: fine grained, pale grey, iron stained, interbedded with extremely weathered sandstone.	DW XW DW XW					JT, 85°, PL, CN
					NO CORE: 0.15 m				21%		
		-12	15.0		**SANDSTONE**: fine grained, pale grey, iron stained, interbedded with extremely weathered sandstone.						PT, 0°, PL, SO - RO, CN PT, 0°, PL, SO - RO, CN PT, 0°, PL, SO - RO, CN
					NO CORE: 0.21 m						
					SANDSTONE: fine grained, pale grey, iron stained, orange, bedded.			a=1.57 d=0.81			PT, 0 - 5°, PL, SO - RO, CN - SN
		-13			Borehole BH4 terminated at 15.00 m						Defects are: PT, 0 - 5°, PL, SO, CN unless otherwise described

method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
RR rock roller
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
PT push tube

support
C casing M mud N none

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
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
SS shear surface
SZ shear zone
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stained
VN veneer
CO coating

BH4 13.20 - 15.00 m

drawn	**LP**
approved	**AM**
date	**22/03/2018**
scale	**N.T.S.**
original size	**A4**

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client:	St Hilliers
project:	Geotechnical and Environmental Assessment 32 Mann Street, Gosford, nsw
title:	**CORE PHOTOGRAPH** **BH4**
project no: SYDGE214942	fig no: **FIGURE 1** rev:

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Engineering Log - Borehole

Borehole ID.	**BH5**
sheet:	1 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**28 Feb 2018**
principal:	
date completed:	**28 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,711.00; N: 6,299,825.00 (MGA94) | surface elevation: 2.70 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT				2				**FILL: Gravelly SILTY SAND**: fine to coarse grained, brown-red, trace ceramics fragments.	M			**FILL** PID: 0.6ppm
			SPT 3, 2, 1 N*=3	1	1.0		CL	**Sandy CLAY**: medium to high plasticity, grey-brown, trace of organics with fine to coarse grained sand.		S		**ALLUVIUM** PID: 2.0ppm
				0	2.0		CH	**Silty CLAY**: medium to high plasticity, dark brown-black, trace of root fibres.				PID: 0.8ppm
CASING		▶	SPT 1, 2, 3 N*=5	-1	3.0		SC	**CLAYEY SAND**: fine to coarse grained, pale grey, medium to high plasticity clay.	W	L		PID: 1.3ppm
AD/T			SPT 2, 5, 6 N*=11	-2	4.0		CL	**Sandy CLAY**: medium to high plasticity, grey mottled orange.		St		**RESIDUAL SOIL**
W			SPT 3, 3, 7 N*=10	-3	5.0		CH	5.4 m: colour change to red mottled orange-grey **CLAY**: medium to high plasticity, grey-pale grey, spotted orange, trace of silt and fine grained sand.				
				-4	6.0					VSt		
			SPT 6, 8, 10 N*=18	-5	7.0					VSt		

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

* 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

soil group symbol & soil description based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**BH5**
sheet:	2 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**28 Feb 2018**
principal:	
date completed:	**28 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,711.00; N: 6,299,825.00 (MGA94) | surface elevation: 2.70 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
W			SPT 6, 7, 13 N*=20	-6	9.0		CH	**CLAY**: medium to high plasticity, grey-pale grey, spotted orange, trace of silt and fine grained sand. *(continued)*	W	VSt - H		**RESIDUAL SOIL**
								9.3 m: started getting really hard Borehole BH5 continued as cored hole				
				-7	10.0							
				-8	11.0							
				-9	12.0							
				-10	13.0							
				-11	14.0							
				-12	15.0							
				-13								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Cored Borehole

Borehole ID.	**BH5**
sheet:	3 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**28 Feb 2018**
principal:	
date completed:	**28 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,711.00; N: 6,299,825.00 (MGA94) surface elevation: 2.70 m (AHD) angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted drilling fluid: Water hole diameter : 100 mm

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
		-6	9.0		started coring at 9.40m						
NMLC		-7	10.0		**SANDSTONE**: fine to coarse grained, red, iron stained, bedded, trace of fine gravel (quartz).	XW		a=0.61 d=0.61	84%		PT, 0°, PL, RO, CN JT, 20°, UN, RO, CN SM, 0°, PL, SO, CO, 100 mm SM, 0°, PL, SO, CO, 30 mm PT, 0°, UN, RO, CN CS, 0°, PL, RO, CO PT, 5°, UN, RO, CN PT, 0°, CU, SO, CN PT, 0°, CU, SO, CN
		-8	11.0		**SANDSTONE**: fine to medium grained, pale grey, laminated orange-red.	DW		a=0.65 d=0.95 a=0.35 d=0.07			
		-9	12.0		**SANDSTONE**: fine to medium grained, grey, bedded.	SW			51%		PT, 0°, UN, SO, CN SM, 0°, PL, SO, CO, 20 mm SM, 5°, PL, SO, CO, 30 mm PT, 2°, IR, SO, CN JT, 70°, IR, RO, CN, 100 mm SM, 5°, PL, SO, CO, 30 mm SZ, IR, CN, 70 mm
		-10	13.0		**NO CORE:** 0.35 m						
		-11	14.0		**SANDSTONE**: fine to medium grained, red-orange.	XW		a=0.49 d=0.38			PT, 3°, UN, SO, SN JT, 60°, PL, RO, CN, 130 mm JT, 75°, UN, RO, CN, 120 mm Fractured zone JT, 75°, PL, SO, SN, 130 mm SM, 0°, PL, SO, CO, 60 mm
		-12	15.0		**SANDSTONE**: fine grained, grey, bedded. **SANDSTONE**: dark grey, interbedded sandstone.	SW		a=0.58 d=0.10 a=0.52 d=0.43	12%		PT, 0 - 5°, UN - IR, RO, CN SM, 0°, PL, SO, CO, 20 mm SM, 0°, PL, SO, CO, 30 mm
		-13			Borehole BH5 terminated at 15.00 m						

Defects are: PT, 0 - 5°, PL, SO, CN, unless otherwise described

Defects are: PT, 0 - 5°, PL - IR, SO, RO, CN, unless otherwise described

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
RR rock roller
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
PT push tube

support
C casing M mud N none

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
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

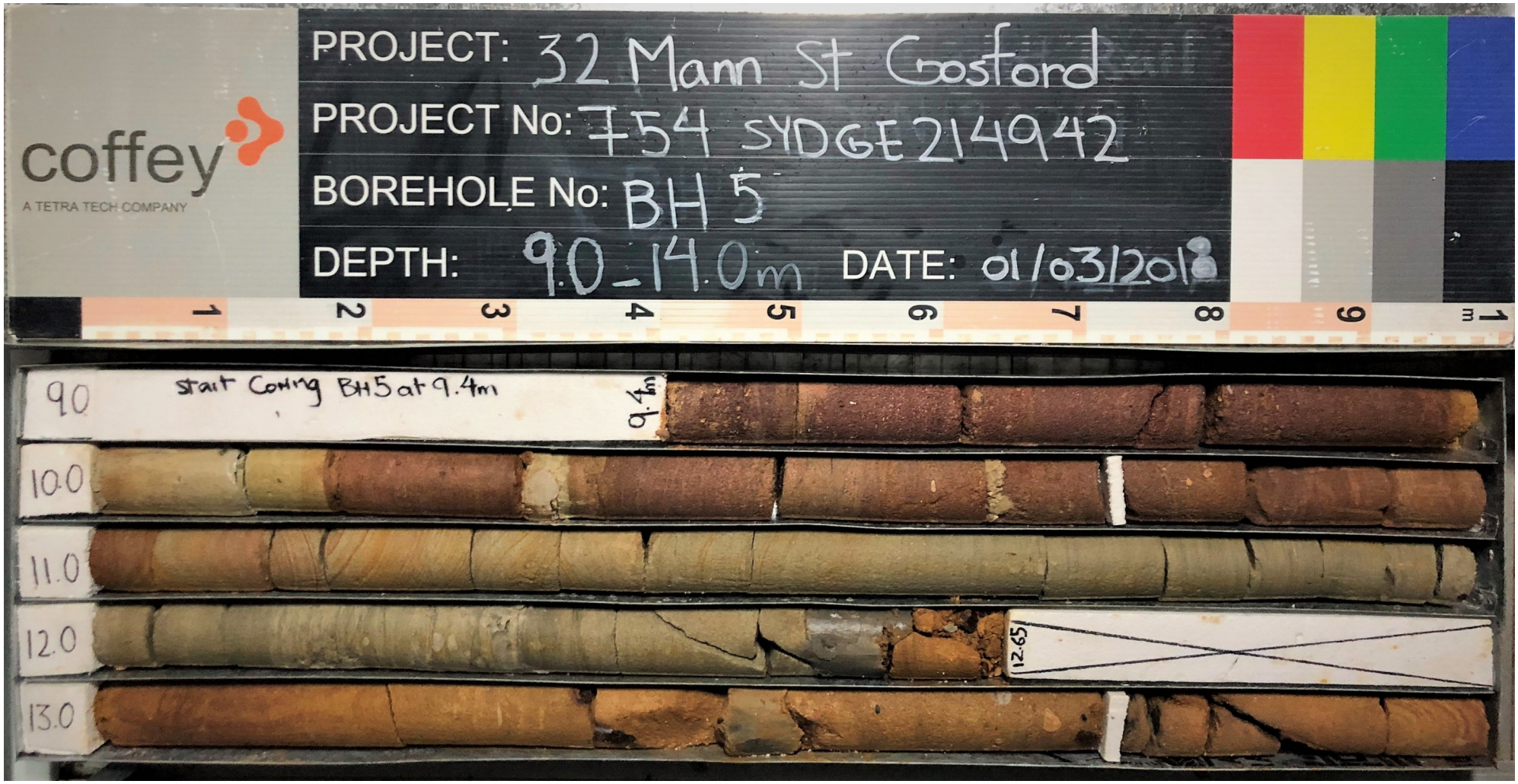
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

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

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stained
VN veneer
CO coating



BH5 9.00 - 14.00 m

drawn	LP
approved	AM
date	22/03/2018
scale	N.T.S.
original size	A4

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client: St Hilliers

project: Geotechnical and Environmental Assessment
32 Mann Street, Gosford, nsw

title: **CORE PHOTOGRAPH**
BH5

project no: SYDGE214942 | fig no: **FIGURE 1** | rev:

BH5 14.00 - 15.00 m

drawn	**LP**
approved	**AM**
date	**22/03/2018**
scale	**N.T.S.**
original size	**A4**

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client:	St Hilliers
project:	Geotechnical and Environmental Assessment 32 Mann Street, Gosford, nsw
title:	**CORE PHOTOGRAPH** **BH5**
project no: SYDGE214942	fig no: **FIGURE 2** rev:

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Engineering Log - Borehole

Borehole ID.	**BH6**
sheet:	1 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**01 Mar 2018**
principal:	
date completed:	**01 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,761.69; N: 6,299,796.39 (MGA94) | surface elevation: 4.00 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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
PT			E	4				**TOPSOIL: SILTY SAND**: fine to medium grained, brown-pale brown, trace of organics (root fibres).	M	L		**TOPSOIL** PID: 0.0ppm
							SP	**SILTY SAND**: fine to medium grained, dark brown-black, trace of low plasticity clay and root fibres.				**ALLUVIUM**
			E									PID: 1.3ppm
			SPT 3, 3, 3 N*=6	3	1.0							
			E							VS		
							CL	**Sandy CLAY**: medium to high plasticity, grey-brown, with fine grained sand, trace of silt.				PID: 1.0ppm
				2	2.0				W			
			E									PID: 2.2ppm
							CH	2.6 m: clay to sand ratio increases		VSt		**RESIDUAL SOIL**
CASING			SPT 5, 8, 10 N*=18	1	3.0			**CLAY**: high plasticity, grey, with fine grained sand, trace of tree root fibres.	M			
AD/T			SPT 5, 7, 9 N*=16	0	4.0							
				-1	5.0		CH	**Silty CLAY**: medium plasticity, pale grey-white mottled red-orange, trace of sand (iron stained).		H		
W			SPT 5, 10, 15 N*=25	-2	6.0							
				-3	7.0			Borehole BH6 continued as cored hole				

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Cored Borehole

Borehole ID.	**BH6**
sheet:	2 of 4
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**01 Mar 2018**
principal:	
date completed:	**01 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,761.69; N: 6,299,796.39 (MGA94) | surface elevation: 4.00 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

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
		4									
		3	1.0								
		2	2.0								
		1	3.0								
		0	4.0								
		-1	5.0								
		-2	6.0								
					started coring at 6.90m						
NMLC		-3	7.0		**Silty CLAY**: medium to high plasticity, pale grey-white, with orange-red banding (XW sandstone/siltstone). 7.00 to 7.10 m: ironstone, fine to medium grained sand, red-dark red-black	XW			6%		

method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
RR rock roller
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
PT push tube

support
C casing M mud N none

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
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
SS shear surface
SZ shear zone
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stained
VN veneer
CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH6**
sheet:	3 of 4
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**01 Mar 2018**
principal:	
date completed:	**01 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,761.69; N: 6,299,796.39 (MGA94) | surface elevation: 4.00 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

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

method & support	water	RL (m)	depth (m)	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				**SILTSTONE**: dark grey, thinly bedded.	SW - FR		a=0.90 d=0.48	6%		JT, 80°, IR, RO, CN, 90 mm PT, 0°, PL, SO, CO - Clay, 5 mm JT, UN, SO, CN, 100 mm JT, IR, RO, CN, 100 mm JT, IR, RO, CN, 70 mm PT, 0°, PL, SL, CN
		-5	9.0	**SANDSTONE**: fine to medium grained, grey, bedded.	SW		a=1.69 d=1.47			PT, 0°, PL, SL, CN JT, 75°, IR, SO, CN, 50 mm PT, 0°, PL, SL, CN
		-6	10.0					83%		
				SANDSTONE: grey-dark grey, interlamination of fine grained, grey sandstone, with interbedded siltstone?.	SW - FR		a=1.33 d=0.13			PT, 0 - 3°, PL - IR, RO, CN SM, 0°, PL, SO, CO - Clay, 5 mm
		-7	11.0				a=2.07 d=2.25			PT, 0°, PL, SO - SL, CN
		-8	12.0				a=1.39 d=0.92			JT, 85°, PL, SO - SL, CN
							a=3.62 d=0.85			PT, 0 - 2°, PL, SO - SL, CN
		-9	13.0					41%		
				NO CORE: 0.09 m						
				SANDSTONE: fine to coarse grained, grey, stained orange.	SW - FR		a=1.73 d=1.29			PT, 0°, CU, SO, CN
				NO CORE: 0.09 m	SW - FR					PT, 0 - 2°, PL, RO, CN JT, 90°, UN, RO, CN
				SANDSTONE: fine to coarse grained, grey, stained orange.	DW					PT, 0°, PL, RO, CO SM, 0°, PL, CO
		-10	14.0	**NO CORE:** 0.09 m	DW					SM, 0°, PL, CO
				SANDSTONE: fine to medium grained, grey.			a=1.75 d=1.16			
				NO CORE: 0.04 m						
				SANDSTONE: fine to medium grained, grey.						
		-11	15.0	14.95 to 15.01 m: laminated siltstone/sandstone 15.10 to 15.25 m: laminated siltstone/sandstone 15.25 to 16.00 m: fine to coarse grained, grey				92%		PT, 0 - 7°, PL - UN, SO - RO, CN
				Borehole BH6 terminated at 16.00 m			a=1.00			

Defects are: PT, 0 - 5°, PL, SO, CN - CO, unless otherwise described

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
RR rock roller
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
PT push tube

support
C casing M mud N none

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
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
SS shear surface
SZ shear zone
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stained
VN veneer
CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH6**
sheet:	4 of 4
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**01 Mar 2018**
principal:	
date completed:	**01 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,761.69; N: 6,299,796.39 (MGA94) | surface elevation: 4.00 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

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
		-12						d=0.28			SM, 7°, UN, SO, CO, 3 mm SM, 5°, UN, SO, CO, 1 mm
		-13	17.0								
		-14	18.0								
		-15	19.0								
		-16	20.0								
		-17	21.0								
		-18	22.0								
		-19	23.0								

method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
RR rock roller
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
PT push tube

support
C casing M mud N none

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
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
SS shear surface
SZ shear zone
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stained
VN veneer
CO coating

BH6 6.90 - 11.00 m

drawn	**LP**
approved	**AM**
date	**22/03/2018**
scale	**N.T.S.**
original size	**A4**

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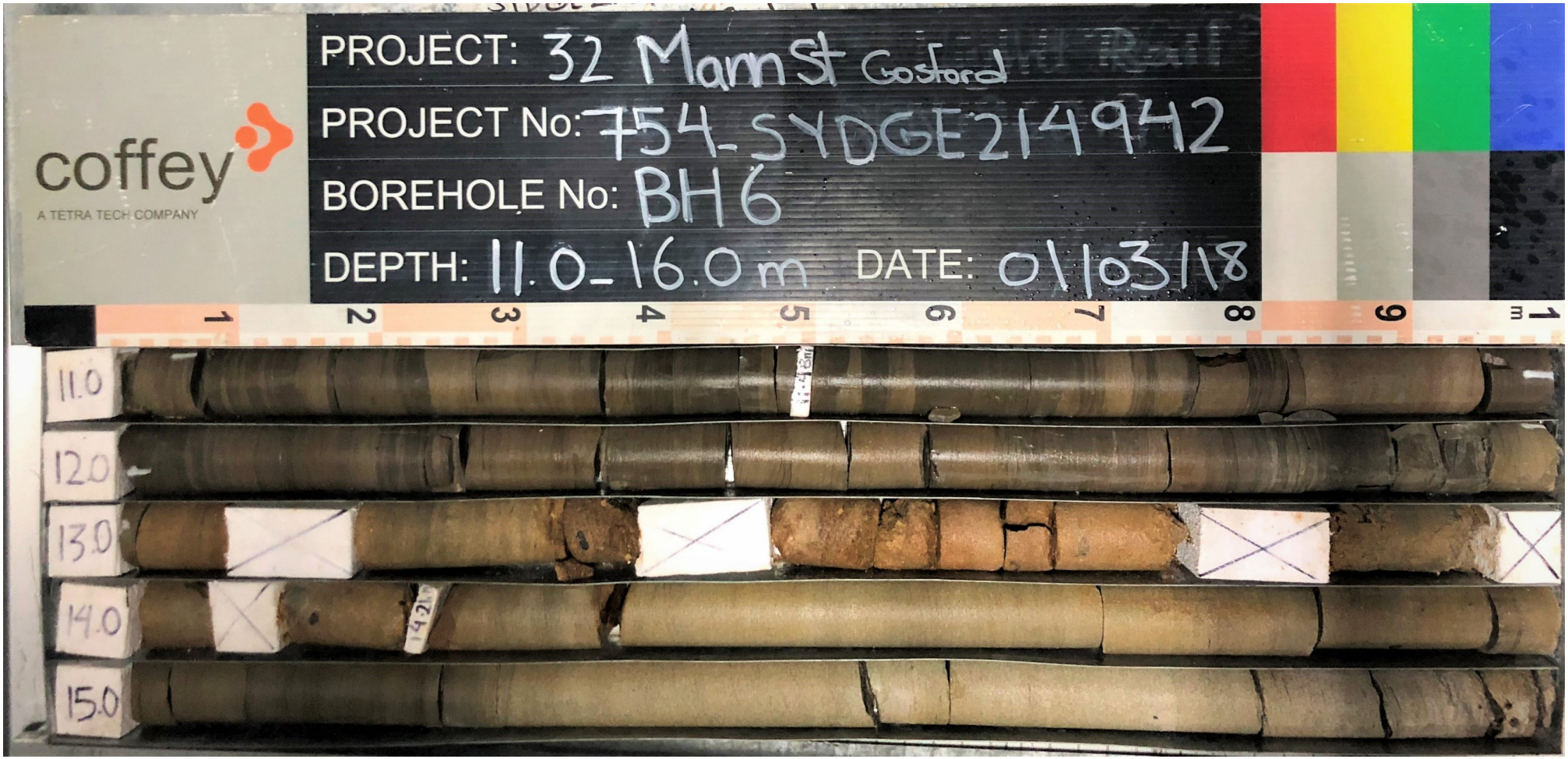
client:	St Hilliers		
project:	Geotechnical and Environmental Assessment 32 Mann Street, Gosford, nsw		
title:	**CORE PHOTOGRAPH** **BH6**		
project no: SYDGE214942		fig no: **FIGURE 1**	rev:



BH6 11.00 - 16.00 m

drawn	**LP**
approved	**AM**
date	**22/03/2018**
scale	**N.T.S.**
original size	**A4**

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client: St Hilliers

project: Geotechnical and Environmental Assessment
32 Mann Street, Gosford, nsw

title: **CORE PHOTOGRAPH**
BH6

project no: SYDGE214942 | fig no: **FIGURE 2** | rev:

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Engineering Log - Borehole

Borehole ID.	**BH7**
sheet:	1 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**02 Mar 2018**
principal:	
date completed:	**02 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,710.50; N: 6,299,759.90 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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
PT			E	2				**FILL: Gravelly SAND**: fine to coarse grained, dark brown, fine to medium angular gravel, trace of clay and ceramics.	M			**FILL** PID: 2.5ppm
								FILL: Gravelly SAND: fine to coarse grained, pale brown-orange, medium to coarse angular gravel.				
			SPT 2, 1, 1 N*=2	1	1.0		CL	**Sandy CLAY**: medium to high plasticity, dark brown, with fine grained sand, trace of silt.		VS		**ALLUVIUM**
			E									PID: 1.6ppm
							SC	**SAND**: fine to medium grained, grey, trace of low to medium plasticity clay.		VL		
			SPT 1, 1, 4 N*=5	0	2.0		CL	**Sandy CLAY**: medium to high plasticity, grey, with fine to medium grained sand, trace of silt, root fibres and organics. 2.5 m: colour change to grey mottled red-orange	W	F		**RESIDUAL SOIL** PID: 2.2ppm
			E									PID: 1.5ppm
			E									
AD/T			SPT 2, 3, 3 N*=6	-1	3.0		CH	**CLAY**: medium to high plasticity, grey, mottled orange, red.	M			
			SPT 3, 3, 4 N*=7	-2	4.0							
			SPT 9, 10, 16, N*=26	-3	5.0		CL	**Sandy CLAY**: low plasticity, pale grey-white mottled red-orange, fine to coarse grained sand, trace of extremely weathered ironstone gravel.		St - VSt		
				-4	6.0					H		
				-5	7.0							

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
PT push tube

* 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/remoulded (kPa)
R refusal
HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
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

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Engineering Log - Borehole

Borehole ID.	**BH7**
sheet:	2 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**02 Mar 2018**
principal:	
date completed:	**02 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,710.50; N: 6,299,759.90 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: 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				-6			CL	**Sandy CLAY**: low plasticity, pale grey-white mottled red-orange, fine to coarse grained sand, trace of extremely weathered ironstone gravel. *(continued)*	M	H		**RESIDUAL SOIL**
					9.0			Borehole BH7 continued as cored hole				
				-7								
					10.0							
				-8								
					11.0							
				-9								
					12.0							
				-10								
					13.0							
				-11								
					14.0							
				-12								
					15.0							
				-13								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Cored Borehole

Borehole ID.	**BH7**
sheet:	3 of 3
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**02 Mar 2018**
principal:	
date completed:	**02 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,710.50; N: 6,299,759.90 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

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
		-6			started coring at 8.60m						
NMLC			9.0		**SANDSTONE**: fine grained, pale grey, iron stained, interbedded with dark grey siltstone.	SW		a=0.63 d=0.61			PT, 0°, IR, RO, CN, 10 mm PT, 0°, PL, RO, CN PT, 0°, PL, SL, CN
		-7			**SILTSTONE**: dark grey, iron stained, interbedded with dark grey sandstone.			a=2.32 d=1.66			PT, 0°, IR, RO, CO - Clay PT, 0°, PL, SL, CN
			10.0		**SANDSTONE**: fine grained, pale grey, iron stained, bedded.				69%		JT, 87 - 90°, PL, SO, CN PT, 0 - 5°, PL - UN, SO - RO, CN CS, 0°, PL, SO, 20 mm
		-8									PT, 0 - 5°, PL - UN, SO - SL, CN
			11.0					a=0.56 d=0.59			
		-9			**SANDSTONE**: fine to coarse grained, pale grey, iron stained, massive, trace of gravel.						PT, 0 - 5°, PL - UN, SO, CN PT, 0 - 5°, PL - UN, SO, CN
			12.0					a=1.18 d=1.58			SM, 0°, PL, SO, CO
		-10						a=1.49 d=1.53			
			13.0		**SILTSTONE**: dark grey, interlaminated with fine grained sandstone.	FR		a=1.91 d=1.32	83%		JT, 75°, IR, SO - RO, CN
		-11			**SANDSTONE**: fine to coarse grained, pale grey, highly iron stained bedded.						
			14.0					a=1.20 d=1.84			
		-12				HW					PT, 0 - 7°, IR, SO - RO, CN
			15.0					a=0.97 d=0.99 a=1.19 d=1.56	100%		
		-13			Borehole BH7 terminated at 15.20 m						

Defects are: PT, 0 - 5°, PL, SO, CN, unless otherwise described

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
RR rock roller
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
PT push tube

support
C casing M mud N none

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
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
SS shear surface
SZ shear zone
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stained
VN veneer
CO coating

BH7 8.60 - 13.00 m

drawn	**LP**
approved	**AM**
date	**22/03/2018**
scale	**N.T.S.**
original size	**A4**

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client:	St Hilliers		
project:	Geotechnical and Environmental Assessment 32 Mann Street, Gosford, nsw		
title:	**CORE PHOTOGRAPH** **BH7**		
project no:	SYDGE214942	fig no: **FIGURE 1**	rev:

BH7 13.00 - 15.20 m

drawn	LP
approved	AM
date	22/03/2018
scale	N.T.S.
original size	A4

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client:	St Hilliers
project:	Geotechnical and Environmental Assessment 32 Mann Street, Gosford, nsw
title:	**CORE PHOTOGRAPH** **BH7**
project no: SYDGE214942	fig no: **FIGURE 2** rev:

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Engineering Log - Borehole

Borehole ID.	**BH8**
sheet:	1 of 2
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**06 Mar 2018**
principal:	
date completed:	**06 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,745.57; N: 6,299,797.53 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT				2				**ASPHALT**.	M	L - MD		**FILL** PID: 1.5ppm
							CH	**FILL: Gravelly SAND**: fine to coarse grained, dark brown, with fine to medium gravel, trace of ceramics.		F		**ALLUVIUM**
				1	1.0			**Silty CLAY**: medium to high plasticity, dark brown, trace of sand and organics (root fibres).				PID: 0.3ppm
							SP	**SILTY SAND**: fine to coarse grained, grey, low to medium plasticity clay, trace of organics (root fibres).		L		PID: 0.6ppm
				0	2.0							
			SPT 2, 2, 7 N*=9				CL	**Sandy CLAY**: medium to high plasticity, grey mottled dark red-orange, with fine to coarse grained sand, trace ironstone.	W	St		**RESIDUAL SOIL** PID: 1.3ppm
				-1	3.0				M			
			SPT 4, 7, 9 N*=16		4.0		CL	**Silty CLAY**: medium plasticity, pale grey-white, trace of fine sun-rounded gravel.		VSt		
				-2	5.0							
AD/T			SPT 10, 16, 15 N*=31	-3			CL	**Silty CLAY**: medium to high plasticity, brown-orange, with fine sand.		H		
				-4	6.0			6.4 to 6.5 m: ground gets soft				
			SPT 30, 30, N*=R		7.0		SC	**CLAYEY SAND**: fine to medium grained, brown-orange, with low to medium plasticity clay, trace of weathered sandstone.				
				-5								

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
PT push tube

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
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

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Engineering Log - Borehole

Borehole ID.	**BH8**
sheet:	2 of 2
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**06 Mar 2018**
principal:	
date completed:	**06 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,745.57; N: 6,299,797.53 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: 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				-6			CL	**Sandy CLAY**: medium to high plasticity, grey.	M	H		**RESIDUAL SOIL**
					9.0			Borehole BH8 terminated at 8.57 m Refusal				
				-7								
					10.0							
				-8								
					11.0							
				-9								
					12.0							
				-10								
					13.0							
				-11								
					14.0							
				-12								
					15.0							
				-13								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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.	**BH9**
sheet:	1 of 2
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**06 Mar 2018**
principal:	
date completed:	**06 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,723.00; N: 6,299,841.00 (MGA94) | surface elevation: 2.60 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT				2				**FILL: Gravelly SAND**: fine to coarse grained, dark grey-brown, with fine angular gravel, trace of ceramics and concrete.	M			**FILL** PID: 2.0ppm
							SC	**CLAYEY SAND**: fine to coarse grained, pale brown-orange, with low to medium plasticity clay, trace of root fibres.		L - MD		**ALLUVIUM**
				1	1.0		CL	**Silty CLAY**: medium plasticity, dark brown-black, high organic content (root fibres).		St		PID: 0.7ppm
		▶		0	2.0							PID: 0.7ppm
							SC	**CLAYEY SAND**: fine to coarse grained, grey, pale grey, with medium to high plasticity clay.	W	L - MD		PID: 0.1ppm
AD/T				-1	3.0		CL	**Sandy CLAY**: medium to high plasticity, grey mottled red-orange, with fine to coarse grained sand.		St - VSt		**RESIDUAL SOIL**
				-2	4.0		CL	**Silty CLAY**: medium to high plasticity, pale grey-white, trace of fine grained gravel.	M	VSt - H		
				-3	5.0							
				-4	6.0							
				-5	7.0							

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

* 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

soil group symbol & soil description based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**BH9**
sheet:	2 of 2
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**06 Mar 2018**
principal:	
date completed:	**06 Mar 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,723.00; N: 6,299,841.00 (MGA94) | surface elevation: 2.60 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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				-6			CL	**Silty CLAY**: medium to high plasticity, pale grey-white, trace of fine grained gravel. *(continued)*	M	VSt - H		**RESIDUAL SOIL**
					9.0		SC	**CLAYEY SAND**: fine to coarse grained, brown-orange, with low to medium plasticity clay, trace weathered sandstone.	W	D		
				-7								
					10.0							
				-8				10.5 m: ground gets hard				
					11.0							
				-9								
					12.0							
				-10								
					13.0							
				-11								
					14.0							
				-12				Borehole BH9 terminated at 14.5 m Refusal				
					15.0							
				-13								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	***P1***
sheet:	1 of 1
project no.	***SYDGE214942***
client:	***SH Gosford Residential Pty Ltd***
date started:	***28 Feb 2018***
principal:	
date completed:	***28 Feb 2018***
project:	***Geotechnical and Environmental Assessment***
logged by:	***LP***
location:	***32 Mann Street, Gosford, NSW***
checked by:	***AM***

position: E: 345,720.57; N: 6,299,886.73 (MGA94) | surface elevation: 2.90 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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
PT			E	2				**FILL: Gravelly CLAYEY SAND**: fine to coarse grained, grey to dark grey, with low plasticity clay, and fine to medium angular gravel.	M			**FILL** 0.1-0.3m - ASS PID: 3.4ppm
								FILL: CLAYEY SAND: fine to coarse grained, red-orange, with medium plasticity clay, trace of fine angular gravel.				
			E	1	1.0		CH CL	**CLAY**: medium to high plasticity, dark brown-grey, spotted red.	W			**ALLUVIUM** PID: 3.4ppm 0.9-1.1m - ASS High organic content, smell of organics
								Silty CLAY: medium to high plasticity, dark brown-black, high organic content.				
			E	0	2.0		CL	**Sandy CLAY**: medium to high plasticity, pale grey-grey, with fine grained sand.	M			PID: 2.2ppm 1.7-2.0m - ASS
				-1	3.0			Borehole P1 terminated at 3.0 m				
				-2	4.0							
				-3	5.0							
				-4	6.0							
				-5	7.0							

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	***P2***
sheet:	1 of 1
project no.	***SYDGE214942***
client:	***SH Gosford Residential Pty Ltd***
date started:	***27 Feb 2018***
principal:	
date completed:	***27 Feb 2018***
project:	***Geotechnical and Environmental Assessment***
logged by:	***LP***
location:	***32 Mann Street, Gosford, NSW***
checked by:	***AM***

position: E: 345,726.57; N: 6,299,834.92 (MGA94) | surface elevation: 2.60 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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
PT			E	2				**FILL: SAND**: fine to coarse grained, dark grey-black, with fine to medium angular gravel.	M			**FILL** 0.1-0.3m - ASS PID: 2.6ppm
					1.0		SC	**CLAYEY SAND**: fine to coarse grained, dark grey-brown, with medium to high plasticity clay.	W			**ALLUVIUM**
			E	1			CH	**Silty CLAY**: medium to high plasticity, dark brown-black.				PID: 2.8ppm 1.1-1.2m - ASS
					2.0		SC	**CLAYEY SAND**: fine to coarse grained, medium to high plasticity, pale grey-grey, trace of fine gravel.				**RESIDUAL SOIL** PID: 2.8ppm 2.0-2.2m - ASS
			E	0			CL	**Sandy CLAY**: medium to high plasticity, grey, with fine grained sand.				
					3.0		CH	**CLAY**: medium to high plasticity, grey mottled brown-pale brown.	M			
				-1				Borehole P2 terminated at 3.0 m				
					4.0							
				-2								
					5.0							
				-3								
					6.0							
				-4								
					7.0							
				-5								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**P3**
sheet:	1 of 1
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**27 Feb 2018**
principal:	
date completed:	**27 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,725.84; N: 6,299,792.39 (MGA94) | surface elevation: 2.70 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT			E	2			SP	**FILL: Gravelly CLAY**: low to medium plasticity, grey, with fine to medium angular gravel.	M			**FILL** 0.1-0.2m - ASS
							SP	**SAND**: fine to coarse grained, grey, spotted red, with angular fine grained.				**ALLUVIUM** PID: 2.9ppm
					1.0		SP	**SILTY SAND**: fine to coarse grained, dark brown, highly organic.				
			E	1			CL	**Sandy CLAY**: medium to high plasticity, grey, brown, with fine grained sand.				**RESIDUAL SOIL** PID: 2.9ppm 1.1-1.3m - ASS
							CH	**Silty CLAY**: medium to high plasticity, dark brown-grey.				
					2.0		CH	**CLAY**: medium to high plasticity, grey, trace sand.				PID: 2.4ppm 2.4-2.6m - ASS
			E	0								
					3.0			Borehole P3 terminated at 3.0 m				
				-1	4.0							
				-2	5.0							
				-3	6.0							
				-4	7.0							
				-5								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**P4**
sheet:	1 of 1
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**27 Feb 2018**
principal:	
date completed:	**27 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,720.53; N: 6,299,761.38 (MGA94) | surface elevation: 2.70 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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
PT			E					**FILL: Gravelly CLAYEY SAND**: fine to coarse grained, brown mottled orange-red, low plasticity clay, with fine angular gravel.	M			**FILL** PID: 2.0ppm 0.2-0.5m - ASS
			E	2			CH	**Silty CLAY**: medium to high plasticity, dark brown-black, with fine grained sand.				**ALLUVIUM** PID: 3.0ppm 0.8-1.8m - ASS
					1.0							
			E	1			SP	**SAND**: fine to medium grained, pale brown-grey, trace of silt.				PID: 2.4ppm 1.8-2.0m - ASS
			E		2.0		CH	**CLAY**: medium to high plasticity, brown, pale orange, with fine to medium sand.				**RESIDUAL SOIL** 2.0-3.0m - ASS PID: 2.6ppm
				0								
					3.0			Borehole P4 terminated at 3.0 m				
				-1	4.0							
				-2	5.0							
				-3	6.0							
				-4	7.0							
				-5								

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

* 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

soil group symbol & soil description based on AS 1726:2017

moisture condition
- 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
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Engineering Log - Borehole

Borehole ID.	**P5**
sheet:	1 of 1
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**28 Feb 2018**
principal:	
date completed:	**28 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,701.52; N: 6,299,802.02 (MGA94) | surface elevation: 2.70 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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
PT			E	2				**FILL: Gravelly CLAYEY SAND**: dark grey, fine to coarse grained sand, low to medium plasticity clay, fine to coarse gravel.	M			**FILL** 0.2-0.3m - ASS PID: 2.2ppm
			E		1.0		SP	**SAND**: fine to coarse grained, pale grey.				**ALLUVIUM**
			E	1			CL	**Sandy CLAY**: medium to high plasticity, dark brown, with fine to medium plasticity sand.				PID: 1.5ppm 1.6-1.8m - ASS
					2.0		SC	**CLAYEY SAND**: fine to medium grained, dark brown, with medium to high plasticity clay.				PID: 4.0ppm 2.0-2.2m - ASS
				0			CH	**CLAY**: medium to high plasticity, grey mottled orange, trace of fine grained sand and silt.				**RESIDUAL SOIL**
					3.0			Borehole P5 terminated at 3.0 m				
				-1	4.0							
				-2	5.0							
				-3	6.0							
				-4	7.0							
				-5								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Engineering Log - Borehole

Borehole ID.	**P6**
sheet:	1 of 1
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**28 Feb 2018**
principal:	
date completed:	**28 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,696.69; N: 6,299,824.94 (MGA94) | surface elevation: 2.75 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT			E	2			SP	**FILL: Gravelly SAND**: fine to coarse grained, red-brown, with fine angular gravel, trace ceramics, concrete, low to medium plasticity clay.	M			**FILL** 0.1-0.2m - ASS
			E				SC	**SILTY SAND**: fine to coarse grained, red, dark red, with silt and fine gravel.				**ALLUVIUM** PID: 2.2ppm
			E				CH	**CLAYEY SAND**: fine to medium grained, grey, with medium plasticity clay.				PID: 2.6ppm 0.6-0.9m - ASS
				1	1.0			**Sandy Silty CLAY**: medium to high plasticity, pale brown-orange-grey, with fine to coarse grained sand, trace of root fibres and organics.				PID: 2.3ppm 1.0-1.3m - ASS
				0	2.0							
				-1	3.0			Borehole P6 terminated at 3.0 m				
				-2	4.0							
				-3	5.0							
				-4	6.0							
				-5	7.0							

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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.	**P7**
sheet:	1 of 1
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**28 Feb 2018**
principal:	
date completed:	**28 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,700.01; N: 6,299,783.58 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: 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
PT			E	2	0.0			**FILL: Gravelly Sandy CLAY**: low to medium plasticity, pale brown-brown, with fine to coarse grained sand, fine angular gravel.	M			**FILL** 0.1-0.3m - ASS PID: 3.2ppm
					0.5		SC	**CLAYEY SAND**: fine to coarse grained, brown-dark brown, with medium plasticty clay.				**ALLUVIUM**
			E	1	1.0		CH	**Silty CLAY**: medium to high plasticity, grey-dark grey-brown-black, highly organic with organics.				PID: 2.0ppm 1.3-1.5m - ASS
			E		1.8		SP	**SILTY SAND**: fine to coarse grained, grey, with medium to high plasticity clay.				**RESIDUAL SOIL**
			E	0	2.0		CH	**CLAY**: medium to high plasticity, grey mottled dark grey, with fine to coarse grained sand.				PID: 1.9ppm 2.1-2.3m - ASS
					3.0			Borehole P7 terminated at 3.0 m				
				-1	4.0							
				-2	5.0							
				-3	6.0							
				-4	7.0							
				-5								

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

* 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

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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.	**P8**
sheet:	1 of 1
project no.	**SYDGE214942**
client:	**SH Gosford Residential Pty Ltd**
date started:	**28 Feb 2018**
principal:	
date completed:	**28 Feb 2018**
project:	**Geotechnical and Environmental Assessment**
logged by:	**LP**
location:	**32 Mann Street, Gosford, NSW**
checked by:	**AM**

position: E: 345,712.24; N: 6,299,840.53 (MGA94) | surface elevation: 2.60 m (AHD) | angle from horizontal: 90°

drill model: Geoprobe 7822DT, Track mounted | drilling fluid: Water | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: 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
PT			E	2				**FILL: Gravelly SAND**: fine to coarse grained, brown, with fine angular gravel, and low to medium plasticity clay.	M			**FILL**
							CH	**Silty CLAY**: medium to high plasticity, dark brown-black, high organic matter, trace of brown sand.				PID: 2.0ppm 0.5-0.6m - ASS
					1.0							**ALLUVIUM**
							SC	**CLAYEY SAND**: fine to coarse grained, pale grey-grey, with medium to high plasticity sand.				PID: 2.5ppm 1.2-1.5m - ASS
			E	1			SC	**SAND**: fine to coarse grained, pale grey-grey mottled brown, with medium to high plasticity clay.				
					2.0			2.0 m: colour changes to grey mottled red				PID: 2.0ppm 2.0-2.3m - ASS
			E				CL	**Sandy CLAY**: medium to high plasticity, grey mottled red-orange, with fine grained sand.				
				0	3.0			Borehole P8 terminated at 3.0 m				
				-1	4.0							
				-2	5.0							
				-3	6.0							
				-4	7.0							
				-5								

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

* 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/remoulded (kPa)
- R refusal
- HB hammer bouncing

soil group symbol & soil description
based on AS 1726:2017

moisture condition
- 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

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Appendix C - Laboratory Report Sheets

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-02100-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00181AA
Project Name:	754-SYDGE214942 - 754-32 MANN ST GOSFORD
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: 26/03/2018

Sample Details

Sample ID:	SYDN18S-02100
Client Sample:	-
Date Sampled:	12/02/2018
Source:	Ex. Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	32 Mann St Gosford
Sample Location:	BH1 2.00 - 2.45

Other Test Results

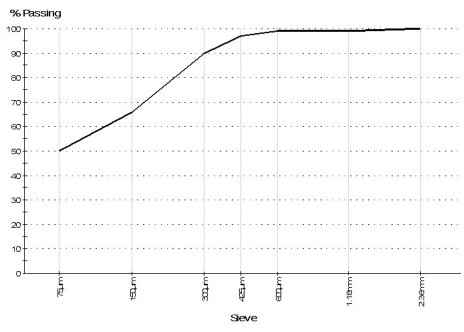
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.5	
Mould Length (mm)		127	
Liquid Limit (%)	AS 1289.3.1.1	24	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	11	
Plasticity Index (%)	AS 1289.3.3.1	13	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	19/03/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	99	
425µm	97	
300µm	90	
150µm	66	
75µm	50	

Chart



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-02101-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00181AA
Project Name:	754-SYDGE214942 - 754-32 MANN ST GOSFORD
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: 26/03/2018

Sample Details

Sample ID:	SYDN18S-02101
Client Sample:	-
Date Sampled:	12/02/2018
Source:	Ex. Site
Material:	Clayey Sand
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	32 Mann St Gosford
Sample Location:	BH3 1.00 - 1.45

Other Test Results

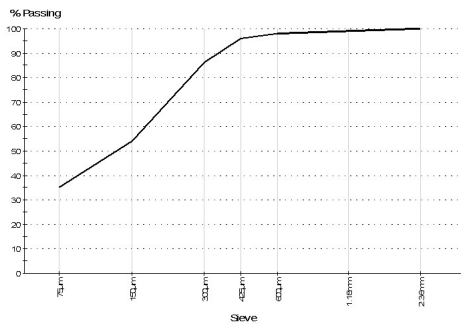
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.0	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	22	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	16	
Plasticity Index (%)	AS 1289.3.3.1	6	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	19/03/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	98	
425µm	96	
300µm	86	
150µm	54	
75µm	35	

Chart



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

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Material Test Report

Report No: SYDN18S-02102-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00181AA
Project Name:	754-SYDGE214942 - 754-32 MANN ST GOSFORD
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: 26/03/2018

Sample Details

Sample ID:	SYDN18S-02102
Client Sample:	-
Date Sampled:	12/02/2018
Source:	Ex. Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	32 Mann St Gosford
Sample Location:	BH4 3.00 - 3.45

Other Test Results

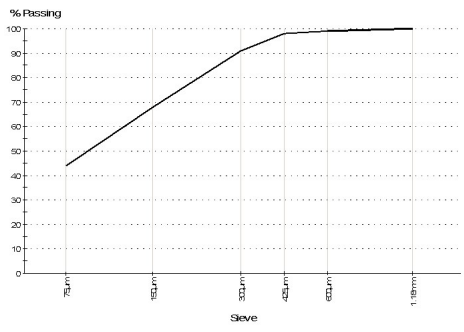
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.5	
Mould Length (mm)		127	
Liquid Limit (%)	AS 1289.3.1.1	27	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	13	
Plasticity Index (%)	AS 1289.3.3.1	14	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	19/03/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
1.18mm	100	
600µm	99	
425µm	98	
300µm	91	
150µm	68	
75µm	44	

Chart



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-02103-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00181AA
Project Name:	754-SYDGE214942 - 754-32 MANN ST GOSFORD
Lot No.:	- **TRN:** -

NATA WORLD RECOGNISED ACCREDITATION

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: 26/03/2018

Sample Details

Sample ID:	SYDN18S-02103
Client Sample:	-
Date Sampled:	12/02/2018
Source:	Ex. Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	32 Mann St Gosford
Sample Location:	BH6 5.50 - 5.95

Other Test Results

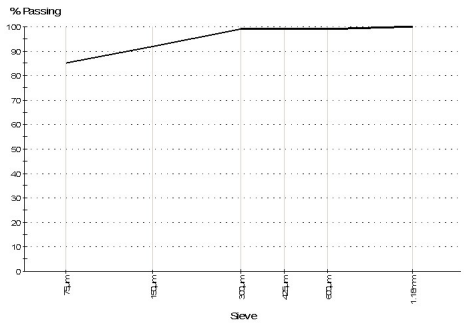
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	9.0	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	37	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	18	
Plasticity Index (%)	AS 1289.3.3.1	19	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	19/03/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
1.18mm	100	
600µm	99	
425µm	99	
300µm	99	
150µm	92	
75µm	85	

Chart



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-02104-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00181AA
Project Name:	754-SYDGE214942 - 754-32 MANN ST GOSFORD
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: 26/03/2018

Sample Details

Sample ID:	SYDN18S-02104
Client Sample:	-
Date Sampled:	12/02/2018
Source:	Ex. Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	32 Mann St Gosford
Sample Location:	BH7 5.50 - 5.95

Other Test Results

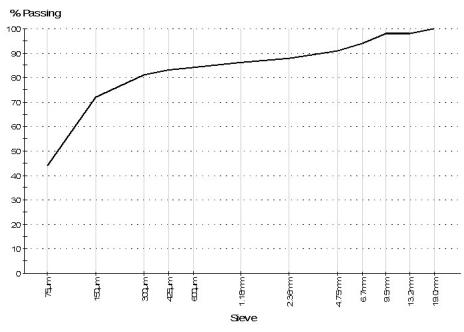
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	6.5	
Mould Length (mm)		127	
Liquid Limit (%)	AS 1289.3.1.1	29	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	12	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	19/03/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	98	
9.5mm	98	
6.7mm	94	
4.75mm	91	
2.36mm	88	
1.18mm	86	
600µm	84	
425µm	83	
300µm	81	
150µm	72	
75µm	44	

Chart



Comments

N/A

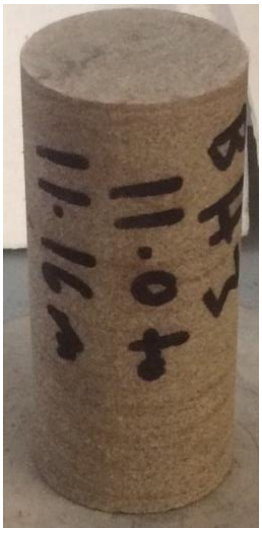
Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street, Melrose Park NSW 2114 Australia
ph: +61 4 8876 0500

Test report - uniaxial compressive strength

client:	*COFFEY SERVICES AUSTRALIA PTY LTD*	job no:	***754-SYDS00113AA***
Principal:	*ST HILL*	laboratory:	*Sydney*
project:	*32 MANN STREET, GOSFORD NSW*	report date:	*29 March 2018*
location:	*32 MANN ST GOSFORD*	borehole:	***BH3***
	test procedure: *AS 4133.1.1.1 and 4133.4.2.1*	date received:	
	test apparatus: *Avery with 200 kN CAS load cell 4222*		*page 1 of 1*

The sample was cut short to remove existing damaged sections

QESTLAB work order ID	date tested	height	uniaxial compressive strength	wet density	sample description	comments
depth		average diameter		moisture content	bedding/foliation	
QESTLab sample ID	test duration	height/dia ratio	**MPa**			failure mechanism
SYDS18W00047		*119 mm*		***2.4 t/m³***	*Sandstone*	*Tested in 'as received" moisture condition*
BH3 11.00 to 11.16 m	*23 Mar 18*	*51.9 mm*	***28.2***	***4.9 %***	*Bedding planes are at an angle of 80° to the axis of loading*	
SYDS18S-00232	*7.53 min*	*2.29:1*				*Shear*



BH3
11.00 to 11.16 m
before testing

BH3
11.00 to 11.16 m
after testing

ABTM---UCS---RPT---001---2013

NATA ACCREDITED FOR TECHNICAL COMPETENCE

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.

NATA Accredited Laboratory No. 431

Date: *29 Mar 2018*

Authorised Signature:

Alan Cocks

Technology Manager

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street, Melrose Park NSW 2114 Australia
ph: +61 4 8876 0500

Test report - uniaxial compressive strength

client:	*COFFEY SERVICES AUSTRALIA PTY LTD*	job no:	***754-SYDS00113AA***
Principal:	*ST HILL*	laboratory:	*Sydney*
project:	*32 MANN STREET, GOSFORD NSW*	report date:	*22 March 2018*
location:	*32 MANN STREET, GOSFORD NSW*	borehole:	***BH5***
	test procedure: *AS 4133.1.1.1 and 4133.4.2.1*	date received:	
	test apparatus: *Avery with 200 kN CAS load cell 4222*		*page 1 of 1*

QESTLAB work order ID	date tested	height	uniaxial compressive strength	wet density	sample description	comments
depth		average diameter		moisture content	bedding/foliation	
QESTLab sample ID	test duration	height/dia ratio	**MPa**			failure mechanism
SYDS18W00047		*136 mm*		***2.3 t/m³***	*Sandstone*	*Tested in 'as received" moisture condition*
BH5 10.49 to 10.64 m	*22 Mar 18*	*51.8 mm*	***19.1***		*Bedding planes are at an angle of 80° to the axis of loading*	
SYDS18S00233	*8.72 min*	*2.62:1*				*Shear*

BH 5
10.49 to 10.64 m
before testing

BH 5
10.49 to 10.64 m
after testing

ABTM---UCS---RPT---001---2013

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.

NATA Accredited Laboratory No. 431

Date: *22 Mar 2018*

Authorised Signature:
Alan Cocks
Technology Manager

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street, Melrose Park NSW 2114 Australia
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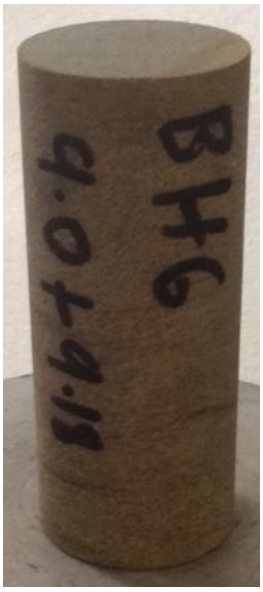
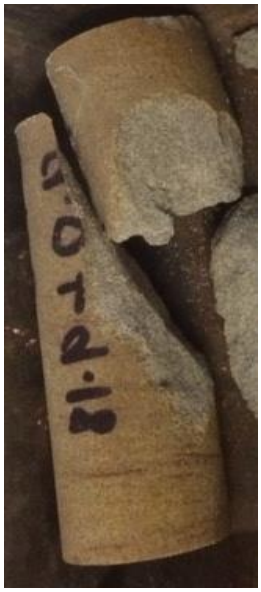
Test report - uniaxial compressive strength

client:	*COFFEY SERVICES AUSTRALIA PTY LTD*	job no:	***754-SYDS00113AA***
Principal:	*ST HILL*	laboratory:	*Sydney*
project:	*32 MANN STREET, GOSFORD NSW*	report date:	*22 March 2018*
location:	*32 MANN STREET, GOSFORD NSW*	borehole:	***BH6***
	test procedure: *AS 4133.1.1.1 and 4133.4.2.1*	date received:	
	test apparatus: *Avery with 200 kN CAS load cell 4222*		*page 1 of 1*

QESTLAB work order ID		height	uniaxial compressive strength	wet density	sample description	comments
depth	date tested	average diameter	**MPa**	moisture content	bedding/foliation	
QESTLab sample ID	test duration	height/dia ratio				failure mechanism
SYDS18W00047		*145 mm*		***2.4 t/m³***	*Sandstone*	*Tested in 'as received" moisture condition*
BH6 9.00 to 9.18 m	*22 Mar 18*	*51.9 mm*	***25.9***		*Bedding planes are at an angle of 80° to the axis of loading*	
SYDS18S00234	*9.08 min*	*2.80:1*				*Shear*



BH 6
9.00 to 9.18 m
before testing



BH 6
9.00 to 9.18 m
after testing

NATA Accredited Laboratory No. 431

Date: *22 Mar 2018*

Authorised Signature:

Alan Cocks

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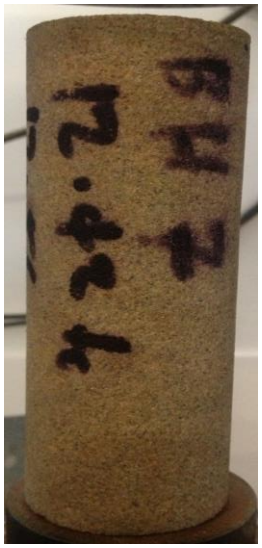
client:	*COFFEY SERVICES AUSTRALIA PTY LTD*	job no:	***754-SYDS00113AA***
Principal:	*ST HILL*	laboratory:	*Sydney*
project:	*32 MANN STREET, GOSFORD NSW*	report date:	*22 March 2018*
location:	*32 MANN STREET, GOSFORD NSW*	borehole:	***BH7***
	test procedure: *AS 4133.1.1.1 and 4133.4.2.1*	date received:	
	test apparatus: *Avery with 200 kN CAS load cell 4222*		*page 1 of 1*

QESTLAB work order ID		height	uniaxial compressive strength	wet density	sample description	comments
depth	date tested	average diameter		moisture content	bedding/foliation	
QESTLab sample ID	test duration	height/dia ratio	**MPa**			failure mechanism
SYDS18W00047		*148 mm*		***2.3 t/m³***	*Sandstone*	*Tested in 'as received" moisture condition*
BH7 12.42 to 12.55 m	*22 Mar 18*	*51.8 mm*	***34.1***		*Bedding planes are at an angle of 85° to the axis of loading*	
SYDS18S00235	*4.65 min*	*2.86:1*				*Shear*



BH 7
12.42 to 12.55 m
before testing

BH 7
12.42 to 12.55 m
after testing

ABTM---UCS---RPT---001---2013

NATA ACCREDITED FOR TECHNICAL COMPETENCE

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.

NATA Accredited Laboratory No. 431

Date: *22 Mar 2018*

Authorised Signature:
Alan Cocks
Technology Manager

eurofins | mgt

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

Certificate of Analysis

Coffey Environments Pty Ltd NSW
Level 20, 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 **590507-S**
Project name 32 MANN ST GOSFORD
Project ID 214942
Received Date Mar 22, 2018

Client Sample ID			**BH1 (3-3.45M)**	**BH1 (5.5-5.95M)**	**BH1 (7-7.34M)**	**BH2 (8.5-8.61M)**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-Ma25413**	**S18-Ma25414**	**S18-Ma25415**	**S18-Ma25416**
Date Sampled			**Not Provided**	**Not Provided**	**Not Provided**	**Not Provided**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	16	24	26	19
Conductivity (1:5 aqueous extract at 25°C as rec.)	5	uS/cm	52	42	35	39
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	7.8	7.3	7.2	7.2
Resistivity*	0.5	ohm.m	960	1200	1400	1300
Sulphate (as SO4)	10	mg/kg	43	29	20	< 10
% Moisture	1	%	11	15	14	12

Client Sample ID			**BH4 (5.5-5.95M)**
Sample Matrix			**Soil**
Eurofins | mgt Sample No.			**S18-Ma25417**
Date Sampled			**Not Provided**
Test/Reference	LOR	Unit	
Chloride	10	mg/kg	22
Conductivity (1:5 aqueous extract at 25°C as rec.)	5	uS/cm	82
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	6.4
Resistivity*	0.5	ohm.m	610
Sulphate (as SO4)	10	mg/kg	120
% Moisture	1	%	15

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	Mar 22, 2018	28 Day
- Method: E045 /E047 Chloride			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	Mar 22, 2018	7 Day
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	Mar 22, 2018	7 Day
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Sydney	Mar 22, 2018	28 Day
- Method: E045 Anions by Ion Chromatography			
% Moisture	Sydney	Mar 22, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

eurofins | mgt

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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name: Coffey Environments Pty Ltd NSW
Address: Level 20, Tower B, Citadel Tower 799 Pacific Highway
Chatswood
NSW 2067

Project Name: 32 MANN ST GOSFORD
Project ID: 214942

Order No.:
Report #: 590507
Phone: +61 2 9406 1000
Fax: +61 2 9406 1004

Received: Mar 22, 2018 10:33 AM
Due: Mar 23, 2018
Priority: 1 Day
Contact Name: Renni Cetinich

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217						X	X
Brisbane Laboratory - NATA Site # 20794							
Perth Laboratory - NATA Site # 23736							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH1 (3-3.45M)	Not Provided		Soil	S18-Ma25413	X	X
2	BH1 (5.5-5.95M)	Not Provided		Soil	S18-Ma25414	X	X
3	BH1 (7-7.34M)	Not Provided		Soil	S18-Ma25415	X	X
4	BH2 (8.5-8.61M)	Not Provided		Soil	S18-Ma25416	X	X
5	BH4 (5.5-5.95M)	Not Provided		Soil	S18-Ma25417	X	X
Test Counts						5	5

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

ug/L: micrograms per litre

ppb: Parts per billion

org/100mL: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/L: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Conductivity (1:5 aqueous extract at 25°C as rec.)	uS/cm	< 5			5	Pass	
LCS - % Recovery							
Chloride	%	104			70-130	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	%	96			70-130	Pass	
Resistivity*	%	96			70-130	Pass	
Sulphate (as SO4)	%	120			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25°C as rec.)	S18-Ma25413	CP	uS/cm	52	53	2.0	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	S18-Ma25413	CP	pH Units	7.8	7.7	pass	30%	Pass	
Resistivity*	S18-Ma25413	CP	ohm.m	960	940	2.0	30%	Pass	
% Moisture	S18-Ma25413	CP	%	11	11	1.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S18-Ma25415	CP	mg/kg	26	25	1.0	30%	Pass	
Sulphate (as SO4)	S18-Ma25415	CP	mg/kg	20	20	3.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	No
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Nibha Vaidya Analytical Services Manager

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Appendix D - Point Load Test Results

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Project No **754-SYDGE214941**

Point Load Strength Index Test Results

Sheet **1** of **2**

Client	***St Hilliers***	Office	***Chatswood***
Principal		Date	***8-3-2018***
Project	***32 Mann St Gosford***	By	***LP***
Location	***32 Mann St Gosford***	Checked	

Test Method	*AS 4133.4.1 - 2007 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique	*NMLC core*	Sampling Da	*8-3-2018*
Test Machine	*GSA (bench-mounted)*	Storage History	*Coffey Chatswood*	Testing Date	*#REF!*
Calibration Date	*21-11-2011*	Moisture Condition	*Natural*	Tested By	*LP*
		Loading Rate			

Rock Type	Location	Depth (m)	Diametral Tests					Axial, Block, and Irregular Lump Tests							Strength Classification
			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	
Claystone	***BH3***	***6.87 - 6.99***	*50*	*60*	*0.12*	***0.05***		*50*	*30*	*-*	*0.96*	*0.5*	***0.47***		***VL / M***
Sandstone	***BH3***	***7.53 - 7.62***	*50*	*45*	*3.91*	***1.56***		*50*	*46*	*-*	*4.59*	*1.57*	***1.62***		***H***
Sandstone	***BH3***	***8.93 - 9.0***	*50*	*35*	*4.65*	***1.86***		*50*	*31*	*-*	*4.62*	*2.34*	***2.22***		***H***
Sandstone	***BH3***	***9.6 -9.71***	*50*	*55*	*5.12*	***2.05***		*50*	*32*	*-*	*3.69*	*1.81*	***1.73***		***H***
Sandstone	***BH3***	***10.3 -10.37***	*50*	*35*	*3.76*	***1.5***		*50*	*34*	*-*	*4.69*	*2.16*	***2.1***		***H***
Siltstone	***BH3***	***10.75 - 10.82***	*50*	*35*	*1.92*	***0.77***		*50*	*26*	*-*	*2.26*	*1.37*	***1.25***		***M / H***
Sandstone	***BH3***	***11.27 - 11.34***	*50*	*35*	*3.5*	***1.4***		*50*	*30*	*-*	*3.47*	*1.82*	***1.71***		***H***
Siltstone	***BH3***	***11.76 - 11.83***	*50*	*35*	*0.15*	***0.06***		*50*	*30*	*-*	*0.92*	*0.48*	***0.45***		***VL / M***
Sandstone	***BH3***	***13.71 -13.79***	*50*	*40*	*1.26*	***0.5***		*50*	*40*	*-*	*2.12*	*0.83*	***0.84***		***M***
Sandstone	***BH3***	***14.45 - 14.51***	*50*	*30*	*2.35*	***0.94***		*50*	*29*	*-*	*2.7*	*1.46*	***1.37***		***M / H***
Ironstone	***BH4***	***14.78 - 14.86***	*50*	*40*	*2.03*	***0.81***		*50*	*25*	*-*	*2.76*	*1.74*	***1.57***		***M / H***
Ironstone	***BH5***	***9.5 - 9.63***	*50*	*65*	*1.53*	***0.61***		*50*	*35*	*-*	*1.39*	*0.62*	***0.61***		***M***
Ironstone	***BH5***	***10.64 - 10.73***	*50*	*45*	*2.37*	***0.95***		*50*	*33*	*-*	*1.42*	*0.67*	***0.65***		***M***
Sandstone	***BH5***	***11.16 - 11.26***	*50*	*50*	*0.17*	***0.07***		*50*	*47*	*-*	*1.01*	*0.34*	***0.35***		***VL / M***
Ironstone	***BH5***	***13.28 - 13.35***	*50*	*35*	*0.94*	***0.37***		*50*	*36*	*-*	*1.15*	*0.5*	***0.49***		***M***
Sandstone	***BH5***	***14.45 - 14.56***	*50*	*55*	*0.26*	***0.1***		*50*	*38*	*-*	*1.42*	*0.59*	***0.58***		***L / M***
Siltstone	***BH5***	***14.82 - 14.90***	*50*	*40*	*1.08*	***0.43***		*50*	*34*	*-*	*1.17*	*0.54*	***0.52***		***M***

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SPECIALISTS MANAGING THE EARTH

Project No **754-SYDGE214941**

Sheet **2** of **2**

Point Load Strength Index Test Results

Client	***St Hilliers***	Office	***Chatswood***
Principal		Date	***8-3-2018***
Project	***32 Mann St Gosford***	By	***LP***
Location	***32 Mann St Gosford***	Checked	

Test Method	*AS 4133.4.1 - 2007 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique	*NMLC core*	Sampling Dat	*8-3-2018*
		Storage History	*Coffey Chatswood*	Testing Date	*#REF!*
Test Machine	*GSA (bench-mounted)*	Moisture Condition	*Natural*	Tested By	*LP*
Calibration Date	*21-11-2011*	Loading Rate			

Rock Type	Location	Depth	Diametral Tests					Axial, Block, and Irregular Lump Tests							Strength Classification
			D	L	P	$I_{s(50)}$	Failure Mode	W	D	L	P	I_s	$I_{s(50)}$	Failure Mode	
		(m)	(mm)	(mm)	(kN)	(MPa)		(mm)	(mm)	(mm)	(kN)	(MPa)	(MPa)		
Mudstone	***BH6***	***8.7 - 8.84***	*50*	*70*	*1.2*	***0.48***		*50*	*37*	*-*	*2.15*	*0.91*	***0.9***		***M***
Sandstone	***BH6***	***9.18 - 9.35***	*50*	*85*	*3.67*	***1.47***		*50*	*30*	*-*	*3.43*	*1.8*	***1.69***		***H***
Siltstone	***BH6***	***10.41 - 10.50***	*50*	*45*	*0.33*	***0.13***		*50*	*39*	*-*	*3.3*	*1.33*	***1.33***		***L / H***
Siltstone	***BH6***	***10.80 - 10.92***	*50*	*60*	*5.62*	***2.25***		*50*	*30*	*-*	*4.21*	*2.2*	***2.07***		***H***
Siltstone	***BH6***	***11.64 - 11.75***	*50*	*55*	*2.29*	***0.92***		*50*	*37*	*-*	*3.31*	*1.41*	***1.39***		***M / H***
Siltstone	***BH6***	***12.44 - 12.51***	*50*	*35*	*2.12*	***0.85***		*50*	*40*	*-*	*9.17*	*3.6*	***3.62***		***M / VH***
Sandstone	***BH6***	***13.17 - 13.32***	*50*	*75*	*3.23*	***1.29***		*50*	*46*	*-*	*4.89*	*1.67*	***1.73***		***H***
Sandstone	***BH6***	***14.22 - 14.35***	*50*	*65*	*2.91*	***1.16***		*50*	*35*	*-*	*4*	*1.79*	***1.75***		***H***
Sandstone	***BH6***	***15.81 - 15.89***	*50*	*40*	*0.69*	***0.28***		*50*	*39*	*-*	*2.49*	*1*	***1***		***L / H***
Sandstone	***BH7***	***8.91 - 9.0***	*50*	*45*	*1.52*	***0.61***		*50*	*35*	*-*	*1.43*	*0.64*	***0.62***		***M***
Siltstone	***BH7***	***9.25 - 9.34***	*50*	*45*	*4.15*	***1.66***		*50*	*33*	*-*	*5.07*	*2.42*	***2.32***		***H***
Siltstone	***BH7***	***10.92 - 11.0***	*50*	*40*	*1.48*	***0.59***		*50*	*33*	*-*	*1.22*	*0.58*	***0.56***		***M***
Sandstone	***BH7***	***11.55 - 11.70***	*50*	*75*	*3.95*	***1.58***		*50*	*40*	*-*	*2.98*	*1.17*	***1.18***		***H***
Sandstone	***BH7***	***12.0 - 12.08***	*50*	*40*	*3.83*	***1.53***		*50*	*40*	*-*	*3.78*	*1.48*	***1.49***		***H***
Siltstone	***BH7***	***12.77 - 12.88***	*50*	*55*	*3.31*	***1.32***		*50*	*39*	*-*	*4.76*	*1.92*	***1.91***		***H***
Sandstone	***BH7***	***13.9 - 14.0***	*50*	*50*	*4.6*	***1.84***		*50*	*27*	*-*	*2.24*	*1.31*	***1.2***		***H***
Sandstone	***BH7***	***14.77 - 14.90***	*50*	*65*	*2.47*	***0.99***		*50*	*23*	*-*	*1.61*	*1.1*	***0.97***		***M***
Sandstone	***BH7***	***15.0 - 15.09***	*50*	*45*	*3.89*	***1.56***		*50*	*25*	*-*	*2.09*	*1.32*	***1.19***		***H***

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