Proposed Mixed-Use Tower Development - 711 Hunter Street, Newcastle West

Preliminary Geotechnical Report

Hunter Street JV Co Pty Ltd

Reference: 754-NTLGE293239-AC.Rev1

26 October 2022

PROPOSED MIXED-USE TOWER DEVELOPMENT - 711 HUNTER STREET, NEWCASTLE WEST

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26 October 2022

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QUALITY INFORMATION

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
BGL	Below Ground Level
CBR	California Bearing Ratio
CN	City of Newcastle
CPTu	Cone Penetration Test with pore pressure
DA	Development Application
Tetra Tech	Tetra Tech Coffey Pty Ltd
UCS	Unconfined Compressive Strength

1. INTRODUCTION

1.1 OVERVIEW

Hunter Street JV Co Pty Ltd commissioned Tetra Tech Coffey Pty Ltd (Tetra Tech) to carry out geotechnical investigations for the proposed mixed-use tower development at 711 Hunter Street, Newcastle West.

The works were undertaken in general accordance with our proposal 754-NTLGE293239-AB. Rev1, dated 19th May 2022. This report is only related to the objectives and scope of works outlined in section 2.2 and 3.4 of our proposal. Factual information about the mine subsidence information and assessment is included in our previous report 754-NTLGE293239-AE.Rev1 dated 26 October 2022. The area beneath the site and surrounding area is known to be undermined by the Australian Agricultural Company combined D, Pit, No 2 Pit and Hamilton Pit at a depth of 67m.

The development has undergone an Architectural Design Competition where three competitors put forward their designs in accordance with the brief. The Plus Architecture scheme was recommended by the Jury as the winning scheme in the competitive design process.

The overall outcome of the proposal aims to develop a mixed-use precinct with high quality tower forms providing a positive relationship to the immediate surrounds and acknowledging the surrounding heritage context. The proposal intends to act as a landmark for Newcastle West with a curated mix of eclectic and creative retail, F&B and commercial opportunities activating the ground levels.

The key features are summarised below:

- Demolition of the existing commercial premises and ancillary structures on site
- Construction of a mixed-use precinct forming active ground and podium levels reaching 5 storeys of retail and commercial tenancies, with two tower forms for residential apartments reaching 26 storeys comprising 258 apartments
- Podium level car park for 300 cars incorporated within the podium levels
- Communal open space for residents located on level 5 and 17
- Vehicle access to the site via Little King Street
- Associated landscaping with the public domain improvements
- An urban plaza fronting National Park Street providing opportunities for activation and public art
- Construction of ancillary infrastructure and utilities as required

It is noted the overall development will form two separate DAs. Stage 1 will form the northern tower and podium elements and Stage 2 will form the southern tower and podium elements. These separate DA components are explored further below.

1.1.1 Stage 1

The northern tower will include commercial and retail tenancies at ground level which will be accessible via National Park Street, Little King Street and Hunter Street. The podium levels will be situated above ground and contain car parking for both visitors and residents, accessed via Little King Street. Level 5 to Level 25 will contain a mixture of residential apartments ranging from 1 bedroom to 3 bedrooms.

A numerical breakdown of Stage 1 is shown below:

- 136 apartments including 35 one bedroom, 74 two bedroom, 26 three bedroom and 1 four bedroom
- Total gross floor area (GFA) 13,581m^2

- Floor space ratio: 5.41:1
- Total car parking spaces 165 spaces over four podium levels

1.1.2 Stage 2

The southern tower will include commercial and retail tenancies at ground level which will be accessible via National Park Street, Little King Street and Hunter Street. The podium levels will be situated above ground and contain car parking for both visitors and residents, accessed via Little King Street. Level 5 to Level 25 will contain a mixture of residential apartments ranging from 1 bedroom to 3 bedrooms.

A numerical breakdown of Stage 1 is shown below:

- 122 apartments including 35 one bedroom, 72 two bedroom and 15 three bedroom
- Total gross floor area (GFA) 12,027m^2
- Floor space ratio: 5.43:1
- Total car parking spaces 135 spaces over four podium levels

Both stages will include surrounding landscaping, public domain works and green spaces, The strata and stratum approach are detailed further in the SEE.

1.2 SITE DETAILS

Site Address: 711 Hunter Street, Newcastle West

Lot and DP: Lot 1 DP 867617

Site Area: 4,724m^2

Boundaries: The site has frontages of 48m to Hunter Street to the north, 113m to National Park Street to the east and 43m to King Street to the south

Further information on the site can be seen on the attached drawings.

1.3 OBJECTIVES

The objective of this report is to provide results of our geotechnical investigations for the 27-storey tower and to provide information on the following:

- The general geology of the area
- The interpreted subsurface soil profiles based on the investigation conducted.
- Inferred soil and rock conditions to expected foundation level
- Review of the details and descriptions of the existing strata including laboratory test results for various soil characteristics at various depths
- Foundation options and design parameters
- Recommended further investigation where applicable
- Soil aggressivity to buried steel and concrete
- Groundwater and how it may affect the development during construction and in the long term
- Earthquake design factor
- General guidelines on earthworks and fill placement

1.4 SCOPE OF WORKS

- Review of previous projects in the area including:
  - Proposed Mixed Use Development - 1 National Park Street - Geotechnical Investigation (Tetra Tech Coffey Pty Ltd, 2022)
  - Proposed Development - 498-500 King Street, Newcastle West - Geotechnical Assessment (Regional Geotechnical Solutions, 2016)
- Prior to attending site, Tetra Tech prepared a site-specific health and safety plan including SWMS.
- The borehole location was surveyed prior to setup targeting a bord based on mine plans.
- Due to a substation nearby, non-destructive drilling was conducted. Non-Destructive drilling was conducted to 2m BGL using a vacuum truck to locate the underground services within the investigation location.
- During the fieldwork, one deep borehole was drilled using auger drilling and wash bore techniques to top of rock (39.5m BGL) with SPT testing at regular intervals and then the borehole was continued using HQ sized coring to 3m below the Borehole Seam (77.60m BGL).
- Soil and rock samples were collected during the fieldwork for the laboratory analysis.
- After the completion of the borehole, downhole geophysics were completed to obtain the following
  - Density of the rock to assist in verifying zones of rubble, unmined and voids.
  - Acoustic scan to observe any open defects within the borehole
- After encountering the void and borehole completion, sonar scan and camera inspection were conducted to inspect the height of bord.
- A cone penetration test with pore pressure (CPTu) was completed to a depth of 17.14m with two dissipation tests.

The location of the borehole is shown on Drawings in Appendix B. Fieldwork was undertaken under fulltime presence of a Tetra Tech Geotechnical Engineer who produced field logs and collected soil and rock samples.

2. SITE INFORMATION

2.1 SITE GEOLOGY

Based on the 1:100,000 scale Newcastle Coalfield Geology map sheet 9231, the site is covered by Quaternary aged estuarine deposits. The 1:250,000 scale Newcastle Geology map shows to site to be underlain by Permian age Newcastle Coal Measures comprising conglomerate, sandstone, tuff, shale and coal. It also indicates the presence of Permian age Tomago Coal Measures comprising shale, mudstone, sandstone, tuff and coal to the north of the site.

The site is over a former low-lying area associated with Cottage Creek, Throsby Creek and Hunter River estuary.

2.2 SITE DESCRIPTION

The site at 711 Hunter Street is bounded by Hunter Street to the north and National Park Street to the east and developments on the southern and western sides. Drawing 1 shows the locality of the site.

The investigation area was generally flat with 130mm thick (approx.) concrete surface and an upward sloped driveway leading from the western side of the investigation area (southern portion of site) to an existing multi-

level carpark and a building on the southern end of site. The site also has an existing building in the front portion. Photos 1 and 2 below show the investigation location and surroundings.

Photo 1: Facing North-West: Showing southern wall of front building and driveway leading towards building on south

Photo 2: Facing East: Showing Borehole location, Northern wall of rear building and National Park Street

2.3 SUBSURFACE CONDITIONS

Summary descriptions of the materials encountered are provided below in Table 1 and a summary of the depth to the base of the assessed units is provided in Table 2.

Further details are provided in the engineering logs in Appendix C and D.

Table 1: Geological Units

Geotechnical Unit	Inferred Origin	Material Description
Unit 1a	Pavement	Concrete Asphalt Fill: Silty Sandy Gravel: medium to coarse, rounded, fine to medium sand, grey to brown
Unit 1b	Fill	Fill: Sand to Silty Sand: fine to medium grained, grey to brown
Unit 2a	Estuarine Soil Clay	Clay: medium plasticity, soft to firm. Not observed but known to be present in area.
Unit 2b	Estuarine Soil Sand	Sand: fine to medium grained with a trace of coarse black sand, loose to medium dense
Unit 2c	Estuarine Soil Sand	Sand to Silty Sand: fine to medium grained with a trace of coarse black sand, loose to medium dense
Unit 3a	Alluvial Soil Clay	Silty Clay: medium to/and high plasticity, firm to stiff, grey
Unit 3b	Alluvial/ Estuarine Soil Sands	Clayey sand: fine to medium, trace of sea shells, dark grey
Unit 3c	Alluvial/ Estuarine Soil Clay	Clay: high plasticity, very soft to stiff, dark grey to black. Some sand lenses less than 0.5m thick. Possibly layered alluvial and estuarine soil. Layer of sea shells at 19.3m
Unit 4a	Residual Soil	Sandy Clay: medium to high plasticity, stiff to very stiff, fine to medium grained sand, pale brown mottled orange. Some oxides causing colour changes
Unit 4b	Extremely Weathered of the Tighes Hill Formation	Clayey Gravel, fine to medium sized subangular gravel, mixed orange, red, grey, white and black Clayey Sand, medium to coarse grained, pale brown to grey Silty/ Sandy Clay, high plastic, very stiff to hard, pale grey to pale blue /pale brown to grey and red and dark grey, fine to coarse sand
Unit 5a	Highly to slightly weathered of the Tighes Hill Formation	Sandstone: interbedded find and fine to coarse grained, low to high strength, trace carbonaceous laminations, some core loss
Unit 5b	Fresh Rock of the Tighes Hill Formation	Sandstone: interbedded fine and fine to coarse grained, high to very high strength, trace carbonaceous laminations Interbedded siltstone and sandstone, dark grey siltstone grey sandstone Interlaminated siltstone and sandstone, dark grey siltstone grey sandstone, carbonaceous laminations
Unit 6	Borehole Seam	Mine Void Rubble from roof fall and mine waste Coal: black shiny cleated, some dully silty bands Siltstone: grey to black split in seam
Unit 7	Waratah Sandstone	Sandstone: fine to coarse grained, very high strength

Table 2: Distribution of Geological Units (711 Hunter Street and data from surrounding site)

Geotechnical Unit	Inferred Origin	Depth to Base of Unit (m)				
		BH22-03	**CPT22-01A**	CPT01	CPT04	CPT05
Site Location		**711 Hunter Street**	**711 Hunter Street**	1 National Park Street	723 Hunter Street	
Unit 1a	Concrete /Pavement	0.4	0.13	0.5	0.05	0.05
Unit 1b	Fill	1.0	1.4	1.5	1.0	0.5
Unit 2a	Estuarine Soil Clay	NE	NE	NE	NE	NE
Unit 2b	Estuarine Soil Sand	5.5	6.5	7.4	6.0	4.0 & 12.0
Unit 2c	Estuarine Soil Sand	12.5	12.5	12.9	12.0	4.0 - 7.5
Unit 3a	Alluvial Soil Clay	13.5	13.5	13.5	12.5	13.0
Unit 3b	Alluvial/ Estuarine Soil Sands	NE	NE	NE	NE	NE
Unit 3c	Alluvial/ Estuarine Soil Clay	23.5	>17.14	26.4	>18.0	>20.0
Unit 4a	Residual Soil	36.5	-	>30.72	-	-
Unit 4b	Extremely Weathered of the Tighes Hill Formation	36.9	-	-	-	-
Unit 5a	Highly to slightly weathered of the Tighes Hill Formation	39.75	-	-	-	-
Unit 5b	Fresh Rock of the Tighes Hill Formation	67.2	-	-	-	-
Unit 6	Borehole Seam	75.3	-	-	-	-

Although Units 2a and Unit 3b were not encountered at the site, nearby around the site they have been found to exist. The Unit 2a is less likely to exist as the site is moving further away from the historical swamp associated with Cottage Creek.

2.4 GROUNDWATER

The groundwater level was difficult to verify during drilling due to using a vacuum truck. From the CPT, the water level appears to be 1.8m.

The monitoring well MW01 had a water level of 1.95m on the 28 September 2022.

2.5 LABORATORY TESTING

2.5.1 Mechanical Testing

Selected samples collected during borehole drilling were tested to verify conditions at Coffey Testing Newcastle laboratory. Testing at the Coffey Testing Laboratory comprised

- One Atterberg limits test
- One Particle distribution test
- Two Unconfined Compressive Strength tests (UCS)

Test reports are provided in Appendix E and summarised below in Tables 3 and 4.

Table 3: Summary of Atterberg Limits testing

Test Location	Depth (m)	Unit	Material	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
BH22-03	13.5	2c	Silty clay	68	25	43	15.5

Table 4: Summary of particle size distribution testing

Test Location	Depth (m)	Unit	Material	Percent passing 2.36mm (%)	Percent passing 0.6mm (%)	Percent passing 0.075mm (%)
BH22-03	8.5	2c	Silty sand	100	98	10

Two additional samples were tested at University of Newcastle specialist geotechnical laboratory (Australian Research Council Centre of Excellence CGSE) for Unconfined Compressive Strength tests (UCS) as reporting in Table 5.

Table 5: Summary of unconfined compressive strength testing

Test Location	Depth (m)	Unit	Material	Unconfined Compressive Strength (MPa)	Tangent Modulus (MPa)
BH22-03	39.7	5a	Sandstone	24.3	1300
BH22-03	40.5-41	5b	Sandstone	39.9	4054

Due to the composition of the fill causing refusal of hand equipment and cables prevent the use of powered equipment the upper fill was advanced by vacuum truck. This meant a large bulk CBR sample was not collected.

2.5.2 Chemical Testing

Four samples were collected for aggressivity testing, with results compared against the exposure classification in accordance with AS2159-2009 – Piling Design and Installation (Standards Australia, 2009). Results are provided in Table 6.

Table 6: Summary of aggressivity testing

Location	Depth and Unit (m)	Soil Condition	Chlorides Cl (ppm)	Sulfate (SO_4) (ppm)	pH	Resistivity (ohm.cm)	Pile Type	Exposure Classification (1)
BH22-03	7.0 (Unit 2c)	Soil Condition A	30	650	5.4	3250	Concrete piles	Moderate
							Steel piles	Mild
BH22-03	10.5 (Unit 2c)	Soil Condition A	50	290	6.9	5680	Concrete piles	Mild
							Steel piles	Non-Aggressive
BH22-03	14.5 (Unit 3a)	Soil Condition B	360	220	7.9	2190	Concrete piles	Non-Aggressive
							Steel piles	Non-Aggressive
BH22-03	26.5 (Unit 4a)	Soil Condition B	680	80	8.1	1830	Concrete piles	Non-Aggressive
							Steel piles	Mild
Notes:	(1): Exposure classification in accordance with AS2159-2009 – Piling Design and Installation (Standards Australia, 2009)							

3. RECOMMENDATIONS

3.1 GENERAL

The position of the site within an Estuarine floodplain means the subsurface conditions are highly variable. Nearby at 1 National Park Street, entire units pinched out between borehole / CPT locations. The upper sand layer was observed to be medium dense to dense only on the surrounding sites.

Although within the borehole, the sands had SPT values generally less than 5, using the CPTu the sands were observed to be medium dense to 6.5m.

Due to the compressibility of the Unit 2c, which will be time dependent, loading above this unit is not recommended for the following reason:

- The units are highly variable and will cause differential settlements

- The settlement is likely to be in excess of 200mm for the proposed heights of 27 storeys
- Piles should be founded on similar levels to prevent differential movements
- The upper sands are only medium dense
- Where piles are founded both above and below the compressible units, the upper units will be subject to negative skin friction.
- Although the compression of the sands would mostly during construction, the consolidation of clays may occur after construction.

Tetra Tech can assess the actual settlement and provide the primary piling design to consider the interaction of soil/piling interaction with the potential consolidation settlement and the induced down-drag force. This analysis should be under different proposal.

3.2 PRELIMINARY GEOTECHNICAL PARAMETERS

The geotechnical design parameters for the soil and rock units are provided in Table 7.

Table 7: Geotechnical Parameters

Geotechnical Unit	Inferred Origin	Density (kN/m^3)	Shear Strength (kPa)	Effective Shear Strength (kPa)	Friction Angle (°)	K_0	K_a	K_p
Unit 1a	Concrete Pavement	25	NA	NA	NA			
Unit 1b	Fill	18	NA	0	30	0.50	0.33	3.00
Unit 2a	Estuarine Soil Clay (Not encountered)	15	15	1	24	0.59	0.42	2.37
Unit 2b	Estuarine Soil Sand	18	NA	0	30	0.50	0.38	3.00
Unit 2c	Estuarine Soil Sand	18	NA	0	29	0.52	0.35	2.88
Unit 3a	Alluvial Soil Clay	17	40	5	27	0.55	0.38	2.66
Unit 3b	Alluvial/ Estuarine Soil Sands (Not Encountered)	17	NA	0	30	0.50	0.33	3.00
Unit 3c	Alluvial Soil Clay	19	75	7	27	0.55	0.38	2.66
Unit 4a	Residual Soil	20	100	10	28	0.53	0.36	2.77
Unit 4b	Extremely Weathered		150	15	28	0.53	0.36	2.77

3.3 PRELIMINARY PILE DESIGN PARAMETERS

Due to the depth of very low SPT values and the potential settlement from the alluvial clay unit, it is recommended piles be founded within residual soil or better (Unit 4a or better).

The preliminary pile design parameters are provided in Table 8. These pile parameters have been developed with reference to “Classification of sandstone and shales in the Sydney region: a forty-year review” (Pells, Mostyn, Bertuzzi, & Wong, 2019)

Table 8: Pile design parameters

Geotechnical Unit	Inferred Origin	Ultimate Shaft Adhesion (kN/m^2)	Ultimate End Bearing (MPa)[1]	Serviceability End Bearing (MPa)[2]	Ultimate Lateral Pressures (kPa)	Vertical Modulus (MPa)
Unit 2a	Estuarine Soil Clay	0	NA	NA	10	2
Unit 2b	Estuarine Soil Sand	Minimum of (4 x Depth or 25) [5]	NA	NA	70 x Depth	12
Unit 2c	Estuarine Soil Sand	16[5]	NA	NA	60 x Depth	8
Unit 3a	Alluvial Soil Clay	40	NA	NA	360	12
Unit 3b	Alluvial/ Estuarine Soil Sands	25[5]	NA	NA	70 x Depth	15
Unit 3c	Alluvial Soil Clay	45	NA	NA	675	15
Unit 4a	Residual Soil	50	900	400	900	20
Unit 4b	Extremely Weathered Material	60	1300	500	1350	30
Unit 5a	Highly to slightly weathered Rock	200	10000	3000	2000	200
Unit 5b	Fresh Rock	2000	50000	10000	25000	1500

Notes:

(1): Ultimate end bearing occurs at large displacements in the order of 5% of pile diameter

(2): Serviceability end bearing occurs at small displacements in the order of 1% of pile diameter

(3): Shaft adhesion and ultimate lateral pressures for sands are a function of overburden pressures which have been simplified to ratio of depth

(4): Values assume downward loading. For uplift use a reduction factor of 0.6

(5): For sands the adhesion assumes non-displacement piles. For displacement piles within sand units the adhesion may be doubled.

Due to the presence of mine workings as encountered in the Mine Subsidence Investigation Report (754-NTLGE293239-AE.Rev1 dated 26 October 2022 piles, additional consideration is required should piles extend to depths greater than 37m within the areas nominated on Drawing 3.

A series of grout locations and cover verification locations are shown on Drawing 3. For more information on the proposed grouting strategy, please refer to Mine Subsidence Numerical Modelling Assessment 754-NTLGE293239-AF.Rev1 dated 26 October 2022.

Based on the ground investigation and current observations in accordance with Australian Standard AS2159-2009 – Piling Design and Installation (Standards Australia, 2009), the average risk rating (ARR) is estimated to be 3.69 which is moderate to high. For low redundancy settings the ϕ_g should be 0.45. This value may be improved with the use of site-specific pile test data.

3.4 GROUND ANCHOR PARAMETERS

For estimating purposes, it is suggested that an allowable bond stress (adopted a factor of safety of 2 for estimation) of 200kPa be adopted in low to medium strength rock (Unit 4a) and 1500kPa in high strength rock (Unit 4b).

In relation to rock anchors the following is noted:

- It is the contractor's responsibility to ensure that the correct design values (specific to the anchor system and method of installation) are used and that the anchor holes are carefully cleaned out prior to grouting.
- It is recommended that anchors be tested to comply with the requirements by AS4678.
- Checks are recommended to ensure that anchor load is maintained throughout the construction period and is not lost due to creep effects or to other causes.

3.5 EARTHQUAKE FACTOR

In accordance with AS1170.4 2007, the site is classified as Class De due to the deep soils.

The site was assessed for its liquefaction potential when subject to earthquake effects. The data from CPT22-01A CPT test onsite as well as CPT01 from 1 National Park Street (Tetra Tech Coffey Pty Ltd, 2022) was modelled through CPT liquefaction software (CLiq). The ground was modelled on the following assumptions:

- 6.0 Magnitude earthquake.
- Hazard Design Factor (Z) of 0.11 for the Newcastle region (AS 1170-2007).
- Groundwater assumed to be at the same level at the time of investigation.
- Analysed for the top 20m of depth, as 20m below ground has no liquefication potential .

The outcome of the assessment has indicated there is a ‘low risk’ potential for liquefaction except for depths between 7.3 and 9.5 for CPT22-01A and 7.5m and 10.5m for CPT01 where FOS against liquefaction is less than 1. It is suggested that for the seismic design of the pile group and ground settlement analysis, the liquefied residual shear strength ϕ_{red}’ of 5^o should be adopted along this depth. The nearby results for 723 Hunter Street (Regional Geotechnical Solutions, 2016) could not be assessed as Tetra Tech does not have access to the raw data file.

For the detailed geotechnical investigation as a minimum an additional four CPTu tests should be completed to confirm the depth of liquefaction potential for the site.

3.6 PRELIMINARY PAVEMENT ASSESSMENT

Although at the deep borehole location BH22-03 coal reject fill was observed, from the environmental boreholes and surrounding sites this was not representative of the general fill used in the area. Based on experience CBR value of 10% can be adopted for the estuarine sand (Unit 2a) and generally sand fill with gravels.

Where excavation for pavements expose coal reject or cobbles during construction the material should be replaced with a suitable granular material. The replaced material should be as mentioned in section 3.7 below and in accordance with AS3798-2007.

3.7 GENERAL EARTHWORKS

All earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007 'Guidelines for Earthworks for Commercial and Residential Developments' and City of Newcastle Council Guidelines where applicable.

Based on the laboratory testing and previous experience, a CBR of 10% is applicable to the upper sand fill. As it is proposed the main building will be founded on piles, re-compaction of the whole thickness of sand fill will not be necessary. However, for pavement support within driveways and similar, it is recommended as a minimum:

- The subgrade for pavement areas should be proof rolled to observe soft areas
- Any areas of non-granular material should be over excavated and replaced with sand/ gravel
- The upper 300mm below pavements be recompacted to minimum 75% or greater density index.
- Any new fill should be of a granular nature (i.e. sand or gravel) with all new fill to be placed in layers no greater than 300mm loose and compacted to
    - 75% density index for clean sands
    - 98% standard MDD for all other granular materials compacted at 60-90% optimum moisture content

3.8 GROUND IMPROVEMENT

Although ground improvement is feasible for the area, as the compressible firm clays at a depth of 12m to 26m and the loose to very loose sands from 6.5m to 12.5m would be challenging to remediate, ground improvements are currently not recommended for the site.

3.9 TEMPORARY EXCAVATIONS

Excavations into the fill is likely achievable with standard construction equipment. Due to the predominately granular nature of the fill, the batter slopes should be limited to 1V:2H for excavations up to 1.2m depth. Excavations greater than 1.2m will likely require dewatering of the excavation footprint area and shoring to prevent water inflow and dewatering of the area.

3.10 ADDITIONAL CONSIDERATIONS

The proposed development will require the grouting of mine workings beneath the site as well as the surrounding area. Details of the mine grouting is provided in Mine Subsidence Numerical Modelling Assessment 754-NTLGE293239-AF.Rev1 dated 26 October 2022. The proposed grouting strategy involves building on the grouting completed for the two adjoining properties, 500 King Street, Newcastle West (Ditton Geotechnical Services Pty Ltd, 2021) and 1 National Park Street (Coffey Services Australia Pty Ltd, 2019) which is currently in progress. The additional grouting works includes the drilling of three grout locations and filling bords to support two pillars, one on the southern side of the site the other the eastern side. As well as the minimum grouting workings for subsidence prevention, an additional three locations are proposed to verify the depth to workings and allow partially filling to ensure thickness of overburden between base of piles and workings is greater than 10 times the remnant void height.

4. CLOSING REMARKS

The site at 711 Hunter Street comprises deep alluvial and estuarine soils to depths greater than 25m followed by residual soils to extremely weathered material to depths up to 40m. The alluvial and estuarine soils are considered to be highly compressible requiring deep foundations.

Due to mine workings beneath the site, mine grouting as recommended in the Mine Subsidence Numerical Modelling Report 754-NTLGE293239-AF.Rev1 dated 26 October 2022 will be required to:

- Ensure subsidence parameters applicable to the development will be within the designable range for the proposed structures
- Ensure the cover between base of piles and the mine workings is greater than 10 x the remnant void height after grouting.

Further advice on the uses and limitations of this report is presented in the attached document, Important Information about your Tetra Tech Coffey Report which forms and integral part of this report

Signature:	
Full name:	Simon Baker
Title:	Senior Geotechnical Engineer
Date:	26 October 2022

5. BIBLIOGRAPHY

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APPENDIX A: LIMITATIONS

IMPORTANT INFORMATION ABOUT YOUR TETRA TECH COFFEY REPORT

As a client of Tetra Tech Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Tetra Tech 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 Tetra Tech 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 Tetra Tech Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Tetra Tech 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 Tetra Tech 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 Tetra Tech 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 Tetra Tech 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 Tetra Tech 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 Tetra Tech 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 Tetra Tech Coffey to work with other project design professionals who are affected by the report. Have Tetra Tech 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 Tetra Tech Coffey for information relating to geoenvironmental issues.

Rely on Tetra Tech Coffey for additional assistance

Tetra Tech 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 Tetra Tech 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 Tetra Tech Coffey to other parties but are included to identify where Tetra Tech Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Tetra Tech Coffey closely and do not hesitate to ask any questions you may have.

APPENDIX B: DRAWINGS

SITE BOUNDARY

THROSBY BASIN

LEGEND

SITE BOUNDARY

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

MAP PROJECTION: GDA2020 MGA ZONE 56

100 0 100 300 500

Scale (metres) 1:10000

drawn	SJB
approved	CD
date	25-10-2022
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

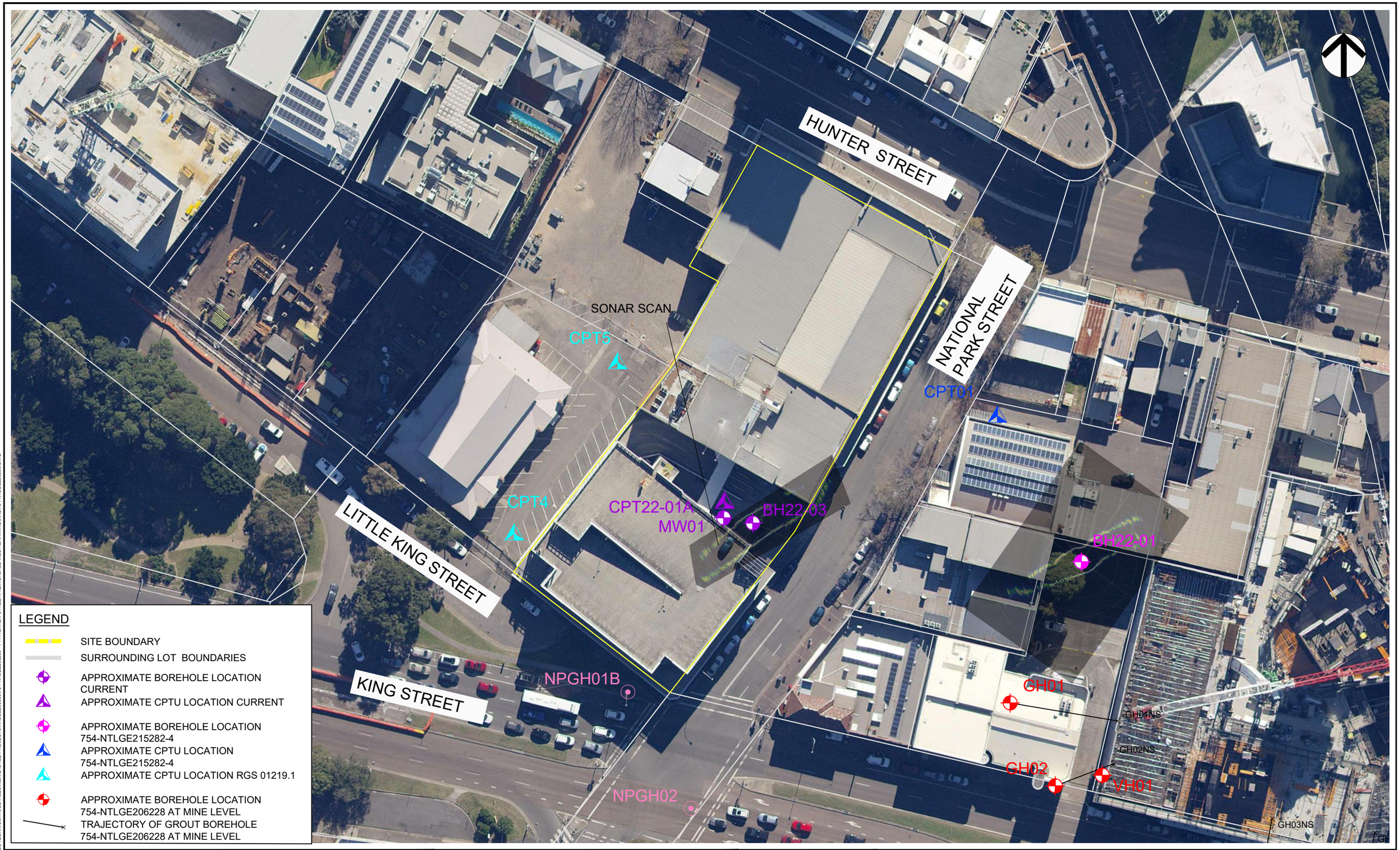
client: HUNTER STREET JV CO PTY LTD

project: PROPOSED MIXED USE DEVELOPMENT
711 HUNTER STREET NEWCASTLE WEST
GEOTECHNICAL INVESTIGATION

title: SITE LOCATION PLAN

project no: 754-NTLGE293239 | drawing no: DRAWING 1 | rev: A

PLOT DATE: 25/10/2022 2:59:57 PM DWG FILE: F:\GEOTECH\NIC\S1_JOB FILES\NEWCASTLE PROJECTS\NTLGE290000\754-NTLGE293239 - 711 HUNTER STREET, NEWCASTLE WEST\DRAWINGS\ACI\754-NTLGE293239.DWG



LEGEND

- SITE BOUNDARY
- SURROUNDING LOT BOUNDARIES
- APPROXIMATE BOREHOLE LOCATION CURRENT
- APPROXIMATE CPTU LOCATION CURRENT
- APPROXIMATE BOREHOLE LOCATION 754-NTLGE215282-4
- APPROXIMATE CPTU LOCATION 754-NTLGE215282-4
- APPROXIMATE CPTU LOCATION RGS 01219.1
- APPROXIMATE BOREHOLE LOCATION 754-NTLGE206228 AT MINE LEVEL
- TRAJECTORY OF GROUT BOREHOLE 754-NTLGE206228 AT MINE LEVEL

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

MAP PROJECTION: GDA2020 MGA ZONE 56

10 0 10 20 30 40

Scale (metres) 1:750

drawn	SJB
approved	CD
date	25-10-2022
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

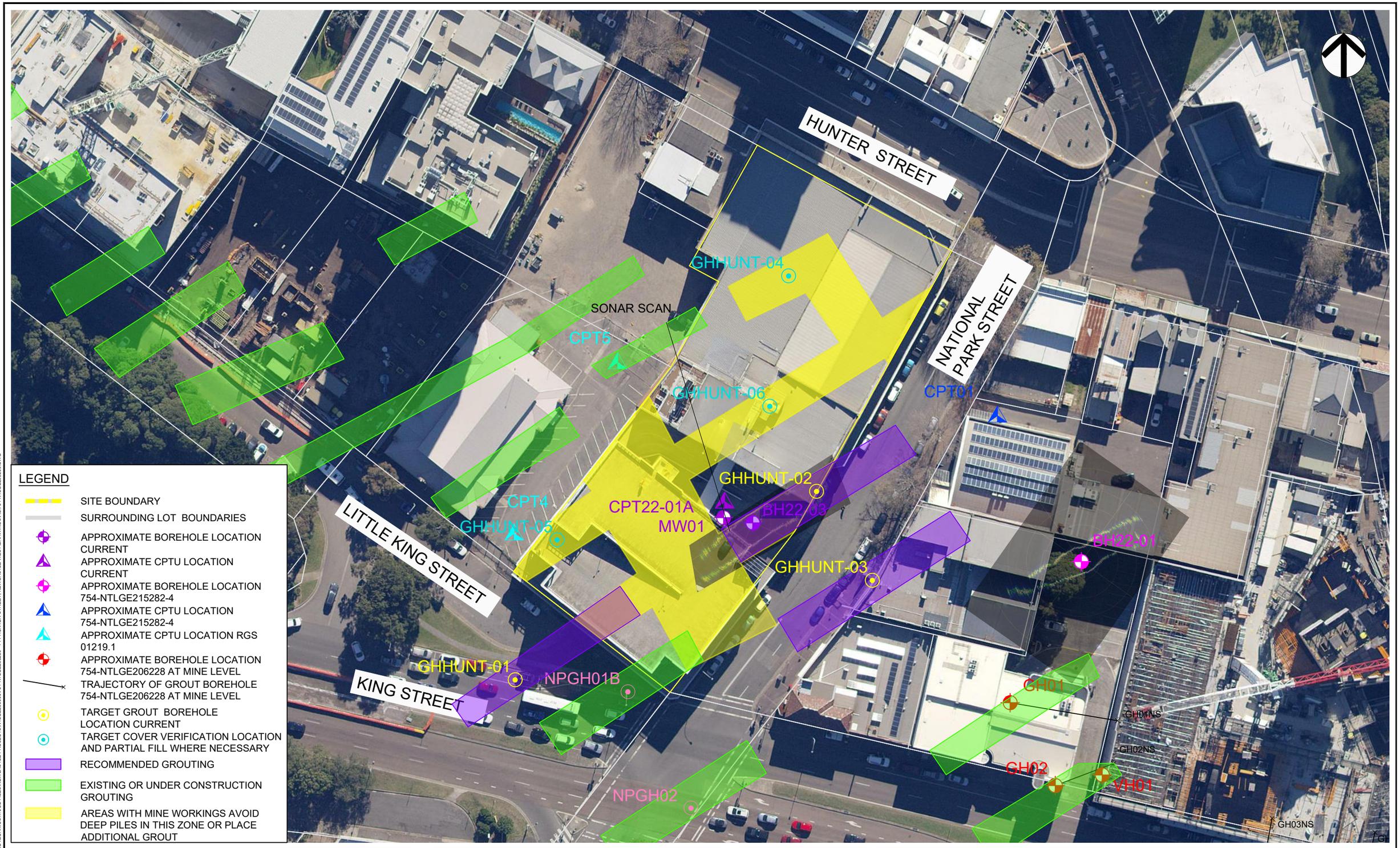
client: HUNTER STREET JV CO PTY LTD

project: PROPOSED MIXED USE DEVELOPMENT
711 HUNTER STREET NEWCASTLE WEST
GEOTECHNICAL INVESTIGATION

title: TEST LOCATION PLAN

project no: 754-NTLGE293239 | drawing no: DRAWING 2 | rev: A

PLOT DATE: 25/10/2022 3:00:12 PM DWG FILE: F:\GEOTECHNICS\1 - JOB FILES\NEWCASTLE PROJECTS\NTLGE290000\754-NTLGE293239 - 711 HUNTER STREET, NEWCASTLE WEST\DRAWINGS\AC\754-NTLGE293239.DWG



LEGEND

- SITE BOUNDARY
- SURROUNDING LOT BOUNDARIES
- APPROXIMATE BOREHOLE LOCATION CURRENT
- APPROXIMATE CPTU LOCATION CURRENT
- APPROXIMATE BOREHOLE LOCATION 754-NTLGE215282-4
- APPROXIMATE CPTU LOCATION 754-NTLGE215282-4
- APPROXIMATE CPTU LOCATION RGS 01219.1
- APPROXIMATE BOREHOLE LOCATION 754-NTLGE206228 AT MINE LEVEL
- TRAJECTORY OF GROUT BOREHOLE 754-NTLGE206228 AT MINE LEVEL
- TARGET GROUT BOREHOLE LOCATION CURRENT
- TARGET COVER VERIFICATION LOCATION AND PARTIAL FILL WHERE NECESSARY
- RECOMMENDED GROUTING
- EXISTING OR UNDER CONSTRUCTION GROUTING
- AREAS WITH MINE WORKINGS AVOID DEEP PILES IN THIS ZONE OR PLACE ADDITIONAL GROUT

PLOT DATE: 25/10/2022 3:00:29 PM DWG FILE: F:\GEOTECHNICS\1 JOB FILES\NEWCASTLE PROJECTS\NTLGE293000\754-NTLGE293239 - 711 HUNTER STREET, NEWCASTLE WEST\DRAWING\SVAC\754-NTLGE293239.DWG

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

MAP PROJECTION: GDA2020 MGA ZONE 56

10 0 10 20 30 40

Scale (metres) 1:750

drawn	SJB
approved	CD
date	25-10-2022
scale	AS SHOWN
original size	A3

TETRA TECH COFFEY

client: HUNTER STREET JV CO PTY LTD

project: PROPOSED MIXED USE DEVELOPMENT
711 HUNTER STREET NEWCASTLE WEST
GEOTECHNICAL INVESTIGATION

title: MINE WORKING AREAS

project no: 754-NTLGE293239 | drawing no: DRAWING 3 | rev: A

APPENDIX C: BOREHOLE LOG AND PHOTOS

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 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.

Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES USC (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	CL	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	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.		SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
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		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.	
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.		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.	
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.		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.	

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:
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. 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.

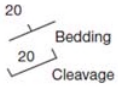
ROCK SUBSTANCE STRENGTH TERMS

Term	Abbre-viation	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:
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.
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.
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 Is(50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

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. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
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.			
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.			

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.

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
Veneer	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 greater than cross section

72710 / 07-06

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	**BH22-03**
sheet:	1 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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 characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
DT			E					**CONCRETE**: fine to coarse grained, rounded to angular, grey, cement matrix.	M			**CONCRETE**
			E	2				**FILL: Gravelly CLAYEY SAND**: fine to coarse grained, dark brown, medium to coarse grained subrounded to subangular gravel (coal reject), trace of cobbles.				**FILL**
NDD			E		1.0		SP	**SAND**: fine to medium grained, dark brown to grey.	W	L to VL		**ESTUARINE SOIL**
			E	1								
			SPT 8, 8, 9 N*=17		2.0			2.1 m: Remnant tree truck/ root				SPT value unreliable due to wood
AD				0	3.0							
				-1								
			SPT 0, 0, 0 N*=0		4.0			4.0 m: Chunks of wood within SPT sample partially decomposed				SPT sank under weight of hammer
				-2	5.0							
W			SPT 1, 1, 2 N*=3	-3				5.8 m: Chunks of wood within SPT sample partially decomposed				
				-4	6.0							
			SPT 1, 1, 5 N*=6		7.0							
				-5			SM	**SILTY SAND**: fine to medium grained, dark grey to brown, trace of organics wood / peat.				

PW casing

HW casing

CDF_0_10_00.3_LIBRARY.GLB rev:CDF_0_10_00.3 2020-08-25 Log COF BOREHOLE: NON CORED 754-NTLGE293239.GPJ <<DrawingFile>> 10/10/2022 15:09

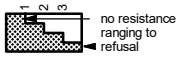
method

DT	diatube
AD	auger drilling*
AS	auger screwing*
HA	hand auger
W	washbore
RR	rock roller
*	bit shown by suffix
e.g.	AD/T
B	blank bit
T	TC bit
V	V bit

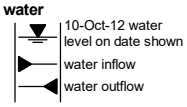
support

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 & material 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

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	**BH22-03**
sheet:	2 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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 characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
W HW casing			SPT 0, 0, 0 N*=0	-6	9.0		SM	**SILTY SAND**: fine to medium grained, dark grey to brown, trace of organics wood / peat. *(continued)*	W	L to VL		**ESTUARINE SOIL** SPT sank under weight of hammer
				-7								
					10.0							
				-8								
					11.0							
			SPT 1, 2, 3 N*=5	-9								
					12.0							
				-10			CH	**Silty CLAY**: high plasticity, dark grey, trace of decomposed wood.	>Wp	St		**ALLUVIAL SOIL**
			U75		13.0							
				-11								
			SPT 4, 5, 6 N*=11									
					14.0							
				-12						VS		
			SPT 0, 0, 0 N=0									
					15.0							
				-13								

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* 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 & material 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

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	**BH22-03**
sheet:	3 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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 characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
W HW casing			SPT 0, 0, 4 N*=4	-14	17.0		CH	**Silty CLAY**: high plasticity, dark grey, trace of decomposed wood. *(continued)* 16.0 m: Some possible cobbles of extremely weathered claystone dark grey , very low strength	>Wp	VS		**ESTUARINE SOIL**
			SPT 0, 0, 0 N*=0	-15	18.0							SPT sank under weight of hammer
			SPT 0, 0, 0 N*=0	-16 -17	19.0			19.3 m: Some white shells				SPT sank under weight of hammer
			SPT 0, 0, 0 N*=0	-18	20.0			20.5 m: Some hard black gravel sized decomposed wood				SPT sank under weight of hammer
				-19	21.0							
				-20	22.0							
			SPT 5, 6, 8 N*=14	-21	23.0		CL-CH	**Silty CLAY**: medium to high plasticity, pale brown, with some orange to red iron oxide. 23.5 m: Orange to red iron oxide as well as other oxides		St		**RESIDUAL SOIL**

method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* 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 & material 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

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	**BH22-03**
sheet:	4 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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 characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
W HW casing				-22	25.0		CL-CH	causing green zones **Silty CLAY**: medium to high plasticity, pale brown, with some orange to red iron oxide. *(continued)*	>Wp	St		**RESIDUAL SOIL**
				-23	26.0							
			SPT 5, 6, 8 N*=14	-24								
				-25	27.0							
				-26	28.0							
			SPT 7, 9, 11 N*=20	-27	29.0					VSt		
				-28	30.0							
				-29	31.0		CL-CH	**Sandy CLAY**: medium to high plasticity, blue-grey, some iron oxide staining.	=Wp	H		**EXTREMELY WEATHERED MATERIAL**

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method
DT diatube
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
RR rock roller

* 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 & material 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

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	**BH22-03**
sheet:	5 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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 characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
HW casing W				-30	33.0		CL-CH	**Sandy CLAY**: medium to high plasticity, blue-grey, some iron oxide staining. *(continued)*	=Wp	H		**EXTREMELY WEATHERED MATERIAL**
			SPT 10, 15, 19 N*=34	-31	34.0							
				-32	35.0							
			SPT 4, 5, 9 N*=14	-33	36.0			35.5 m: Becoming purple in colour, some angular to subangular gravels mixed origin (former conglomerate?)		St		
				-34	37.0					H		
			SPT 9, 24, 38 N*=62	-35	38.0			38.6 m: Becoming black to dark grey (former siltstone)				
				-36	39.0							
				-37				Borehole BH22-03 continued as cored hole				Hammer bouncing

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method
- DT diatube
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller

* 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 & material 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

TETRA TECH COFFEY

Engineering Log - Cored Borehole

Borehole ID.	**BH22-03**
sheet:	6 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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
		-30	33.0								
		-31	34.0								
		-32	35.0								
		-33	36.0								
		-34	37.0								
		-35	38.0								
		-36	39.0								
HQ		-37			started coring at 39.50m **CLAYSTONE**: orange to brown, returned as gravel.	HW MW SW		a=0.27 d=0.07	95%		PT, 3°, PL, SO, Clay VN, 5 mm

method
DT diatube
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
RR rock roller

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 sheared surface
SZ sheared 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

TETRA TECH COFFEY

Engineering Log - Cored Borehole

Borehole ID.	**BH22-03**
sheet:	7 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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
HQ		-38			39.89 m: Several coal laminations **SANDSTONE**: fine grained, grey, thinly bedded, with some carbonacous laminations parallel and cross bedded, some carbonaceous veins. *(continued)* 40.20 m: 200mm siltstone/ mudstone bed with carbonacous laminations at start	SW HW FR		a=1.88 d=1.25 a=1.71 d=1.33 a=1.12 d=1.63			PT, 2°, PL, SO, Clay VN, 3 mm CS, 2°, IR, VR, Clay, 50 mm	Defects are: PT, 1 - 5°, PL, RO, CN, <1 mm, unless otherwise described
			41.0		40.44 m: 100mm of fine to coarse sandstone			a=1.79 d=1.20	95%			
		-39			41.60 m: 100mm siltstone bed	MW FR		a=1.15 d=0.32 d=0.21			PT, 2°, ST, RO, CN, 2 mm Drilling Break Drilling Break	
			42.0		42.00 m: trace of carbonacous laminations			a=2.38 d=2.00 a=2.07 d=1.35 a=0.42 d=0.22				
		-40			42.55 m: 150mm of fine to coarse sandstone grey to dark grey						PT, 10°, PL, RO, CN, 3 mm PT, 10°, UN, RO, VN, 3 mm, White calcite? PT, 0°, CU, RO, CN, <1 mm Drilling Break	
			43.0					a=2.22 d=0.93	97%		PT, 3°, ST, RO, CN, <5 mm Drilling Break	
		-41						a=2.20 d=1.77 a=2.81 d=1.74			Drilling Break	
			44.0		44.16 m: 40mm of siltstone laminations			a=2.23 d=1.66 a=3.16 d=1.84				
		-42			44.39 m: 30mm of pebbly sandstone, mixed origin clasts			a=1.21 a=1.55 d=1.20			Drilling Break	
			45.0					a=2.16 d=2.47 a=2.59 d=2.21				
		-43										
			46.0		45.84 m: 200mm of fine to coarse sandstone with some coal veins 46.10 m: 200mm of laminations with 46.28 m: 30mm siltstone bed			a=2.74 d=0.95 a=2.00 d=2.07 a=2.00 d=2.13	91%		PT, 3°, UN, VR, CN, <1 mm	
		-44										
			47.0					d=1.94			PT, 3°, ST, VR, CN, <1 mm JT, 90°, PL, RO, VN, White? Drilling Break Drilling Break	
		-45							100%			

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method
DT diatube
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
RR rock roller

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 sheared surface
SZ sheared 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

TETRA TECH COFFEY

Engineering Log - Cored Borehole

Borehole ID.	**BH22-03**
sheet:	8 of 11
project no.	**754-NTLGE293239**
client:	***HUNTER STREET JV CO PTY LIMITED***
date started:	***24 Aug 2022***
principal:	
date completed:	***01 Sep 2022***
project:	***Proposed Mixed Use Development***
logged by:	***OB***
location:	***711 Hunter Street, Newcastle West***
checked by:	***SJB***

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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
HQ		-46	49.0		**SANDSTONE**: fine grained, grey, thinly bedded, with some carbonacous laminations parallel and cross bedded, some carbonaceous veins. *(continued)* 48.17 m: 130mm of increased carbonacous laminations 48.62 m: 50mm of siltstone laminations	FR		d=2.04 a=2.69 d=2.27 a=2.54 d=0.74 a=2.39 d=2.47 a=2.46 d=1.69 a=2.91 d=2.12 a=2.78 d=2.30 a=1.71 d=2.57 d=1.71 a=1.50 d=1.74 a=1.66 d=1.63	100%		PT, 2°, UN, RO, CN, 3 mm
		-47									
			50.0								
		-48			50.30 to 50.50 m: 200mm interlaminated siltstone and sandstone						
			51.0					a=3.33 d=3.17			
		-49									
			52.0		51.75 m: 30mm siltstone at 3°			a=2.38 d=2.04	100%		PT, 1°, CU, RO, CN, <1 mm
		-50									
			53.0		53.19 to 53.40 m: some thick carbonacous laminations						PT, 1 - 12°, CU, RO, CN, <1 mm
		-51						a=1.61 d=2.18			PT, 1°, ST, RO, Coal VN, 1 mm PT, 25°, ST, RO, Coal VN
			54.0					a=2.46 d=2.20			
		-52									
			55.0					a=1.83 d=2.71	100%		PT, 5°, ST, RO, CN, 5 mm
		-53									JT, 80°, PL, RO, VN, 2 mm, White?

Defects are: PT, 1 - 5°, PL, RO, CN, <1 mm, unless otherwise described

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method
DT diatube
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
RR rock roller

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 sheared surface
SZ sheared 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

TETRA TECH COFFEY

Engineering Log - Cored Borehole

Borehole ID.	**BH22-03**
sheet:	9 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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
HQ		-54			**SANDSTONE**: fine grained, grey, thinly bedded, with some carbonacous laminations parallel and cross bedded, some carbonaceous veins. *(continued)*	FR		a=2.33 d=2.89	100%		
			57.0					a=3.23 d=2.22			
		-55									
			58.0		**INTERLAMINATED SILTSTONE AND SANDSTONE**: dark grey and black, SANDSTONE fine grained, dark grey, SILTSTONE dark grey with carbonacous laminations.			a=1.69 d=0.84	100%		PT, 2°, ST, SO, SN, White?
		-56			57.80 m: Starts with a 300mm siltstone bed **SANDSTONE**: fine grained, grey, thinly bedded, with some carbonacous laminations parallel and cross bedded, some carbonaceous veins. 58.40 m: Becoming more sandstone with carbonacous laminations						
			59.0					a=2.97 d=2.08			
		-57			**INTERLAMINATED SILTSTONE AND SANDSTONE**: dark grey and black, SANDSTONE fine grained, dark grey, SILTSTONE dark grey with carbonacous laminations. 59.55 m: Increasing siltstone content						JT, 60°, PL, RO, CN
			60.0					a=2.39 d=0.89			
		-58			**SANDSTONE**: fine grained, grey, thinly bedded, with some carbonacous laminations parallel and cross bedded, some carbonaceous veins.						
			61.0					a=2.12 d=3.10	100%		
		-59			**INTERLAMINATED SILTSTONE AND SANDSTONE**: dark grey and black, SANDSTONE fine grained, dark grey, SILTSTONE dark grey with carbonacous laminations.						
			62.0					a=1.96 d=0.92			
		-60			**SANDSTONE**: fine grained, grey, thinly bedded, with some carbonacous laminations parallel and cross bedded, some carbonaceous veins.						Drilling Break
			63.0					a=2.24 d=0.22			
		-61							100%		

Defects are: PT, 1 - 5°, PL, RO, CN, <1 mm, unless otherwise described

CDF_0_10_00.3_LIBRARY.GLB rev:CDF_0_10_00.3 2020-08-25 Log COF BOREHOLE: CORED 754-NTLGE293239.GPJ <<DrawingFile>> 10/10/2022 16:04

method
DT diatube
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
RR rock roller

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 sheared surface
SZ sheared zone
CO contact
CS crushed seam
SM seam

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

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

coating
CN clean
SN stained
VN veneer
CO coating

TETRA TECH COFFEY

Engineering Log - Cored Borehole

Borehole ID.	**BH22-03**
sheet:	10 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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
HQ		-62	65.0		**INTERLAMINATED SILTSTONE AND SANDSTONE**: dark grey and black, SANDSTONE fine grained, dark grey, SILTSTONE dark grey with carbonacous laminations.	FR		a=2.01 d=0.90	100%		JT, 45°, PL, RO, CN, <2 mm
		-63						a=2.33 d=1.03			
			66.0					a=3.31 d=0.70			
		-64							71%		PT, 2°, PL, SO, CN, <1 mm
			67.0		**NO CORE:** 0.31 m Possibly interlaminated siltstone and sandstone.						
		-65			**INTERLAMINATED SILTSTONE AND SANDSTONE**: dark grey and black, SANDSTONE fine grained, dark grey, SILTSTONE dark grey with carbonacous laminations.	SW					
			68.0		**NO CORE:** 3.00 m Open void.				0%		
		-66									
			69.0								
		-67									
			70.0		**ROOF COLLAPSE**: Fragments comprise of SILTSTONE, grey to dark brown.						
		-68			**NO CORE:** 0.50 m Probable roof collapse.				0%		
			71.0		**ROOF COLLAPSE**: Fragments comprise of SILTSTONE, grey to dark brown.						
		-69			**NO CORE:** 0.80 m Probable roof collapse.				0%		

method
DT diatube
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
RR rock roller

support
C casing M mud N none

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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
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L low
M medium
H high
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defect type
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JT joint
SS sheared surface
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CO contact
CS crushed seam
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roughness
VR very rough
RO rough
SO smooth
POL polished
SL slickensided

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

coating
CN clean
SN stained
VN veneer
CO coating

TETRA TECH COFFEY

Engineering Log - Cored Borehole

Borehole ID.	**BH22-03**
sheet:	11 of 11
project no.	**754-NTLGE293239**
client:	**HUNTER STREET JV CO PTY LIMITED**
date started:	**24 Aug 2022**
principal:	
date completed:	**01 Sep 2022**
project:	**Proposed Mixed Use Development**
logged by:	**OB**
location:	**711 Hunter Street, Newcastle West**
checked by:	**SJB**

position: E: 384,156.7; N: 6,356,144.2 (MGA94) | surface elevation: 2.50 m (AHD) | angle from horizontal: 90°

drill model: Hanjin DB8 | drilling fluid: | casing diameter : HW/PW

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
HQ		-70	73.0		**ROOF COLLAPSE**: Fragments comprise of SILTSTONE, grey to dark brown. **NO CORE:** 0.58 m Probable roof collapse.				0%		
		-71	74.0		**ROOF COLLAPSE**: Fragments comprise of SILTSTONE, grey to dark brown. **FILL/ COAL WASTE**: Fragments comprise of coal, black dull and shiny, medium to coarse grained sized gravel. **NO CORE:** 1.30 m Probable coal waste.				0%		
		-72	75.0		**FILL/ COAL WASTE**: Fragments comprise of coal, black dull and shiny, medium to coarse grained sized gravel.				0%		
		-73	76.0		**INTERLAMINATED SILTSTONE, SANDSTONE AND COAL**: SANDSTONE fine grained, dark grey, SILTSTONE dark grey, COAL black and dull. **SANDSTONE**: fine to coarse grained, grey, some coal veins.	SW FR		a=1.29 d=0.05 a=1.97 d=2.78	100%		Many partings possibly drilling induced PT, 3°, PL, VR, CN, <3 mm PT, 15°, PL, VR, CN, <3 mm PT, 5°, PL, VR, CN, <3 mm PT, 10°, PL, VR, CN, <3 mm
		-74									
		-75	77.0					a=3.22 d=3.20			
		-76	78.0		Borehole BH22-03 terminated at 77.60 m						
		-77	79.0								

CDF_0_10_00.3_LIBRARY.GLB rev:CDF_0_10_00.3 2020-08-25 Log COF BOREHOLE: CORED 754-NTLGE293239.GPJ <<DrawingFile>> 10/10/2022 16:04

method
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NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
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RR rock roller

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 sheared surface
SZ sheared zone
CO contact
CS crushed seam
SM seam

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

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

coating
CN clean
SN stained
VN veneer
CO coating

SPT at 2.5m

SPT at 5.5m

drawn	**PK**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**SJB**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**10/10/2022**			
scale	**Not to scale**		title:	**SPT PHOTOS: BH22-03**
original size	**A4**		project no:	**754-NTLGE293239**

SPT at 7.0m

SPT at 8.5m

SPT at 10.0m

drawn	**PK**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**SJB**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**10/10/2022**			
scale	**Not to scale**		title:	**SPT PHOTOS: BH22-03**
original size	**A4**		project no:	**754-NTLGE293239**

SPT at 11.5m

SPT at 13.45m

SPT at 14.5m

drawn	**PK**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**SJB**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**10/10/2022**			
scale	**Not to scale**		title:	**SPT PHOTOS: BH22-03**
original size	**A4**		project no:	**754-NTLGE293239**

SPT at 16.0m

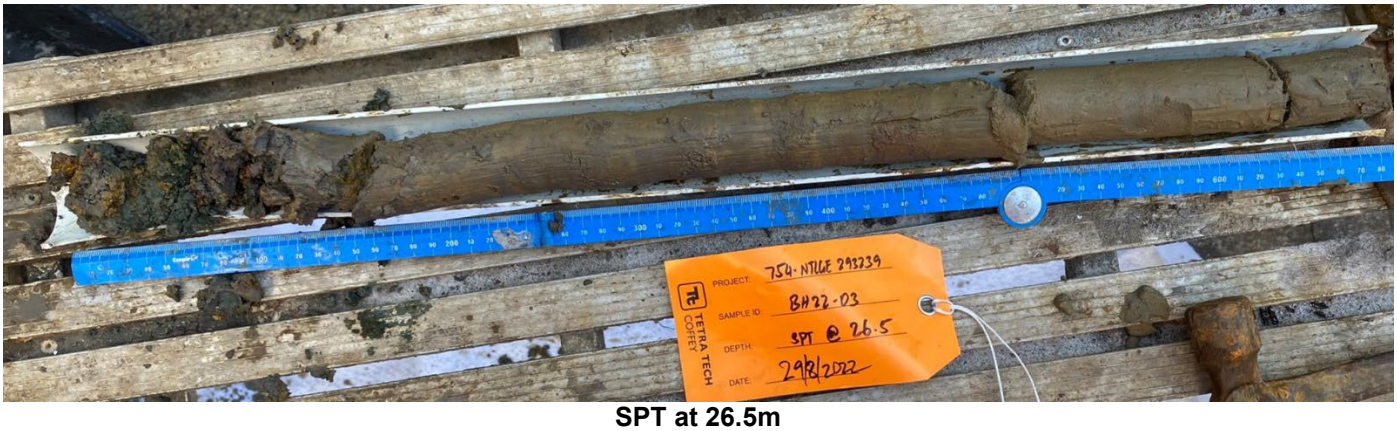
SPT at 17.5m

SPT at 19.0m

drawn	**PK**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**SJB**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**10/10/2022**			
scale	**Not to scale**		title:	**SPT PHOTOS: BH22-03**
original size	**A4**		project no:	**754-NTLGE293239**

SPT at 20.5m

SPT at 23.5m

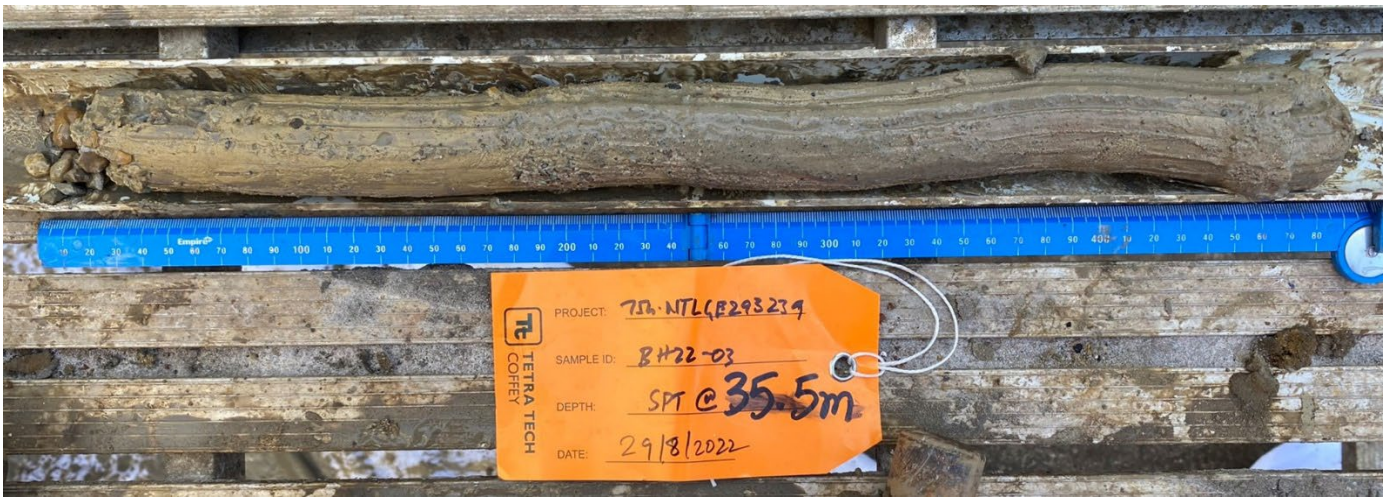


SPT at 26.5m

drawn	**PK**	TETRA TECH COFFEY	client: **HUNTER STREET JV CO PTY LIMITED**
approved	**SJB**		project: **PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**10/10/2022**		
scale	**Not to scale**		title: **SPT PHOTOS: BH22-03**
original size	**A4**		project no: **754-NTLGE293239**

SPT at 29.5m

SPT at 32.5m



SPT at 35.5m

drawn	**PK**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**SJB**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**10/10/2022**		title:	**SPT PHOTOS: BH22-03**
scale	**Not to scale**			
original size	**A4**		project no:	**754-NTLGE293239**

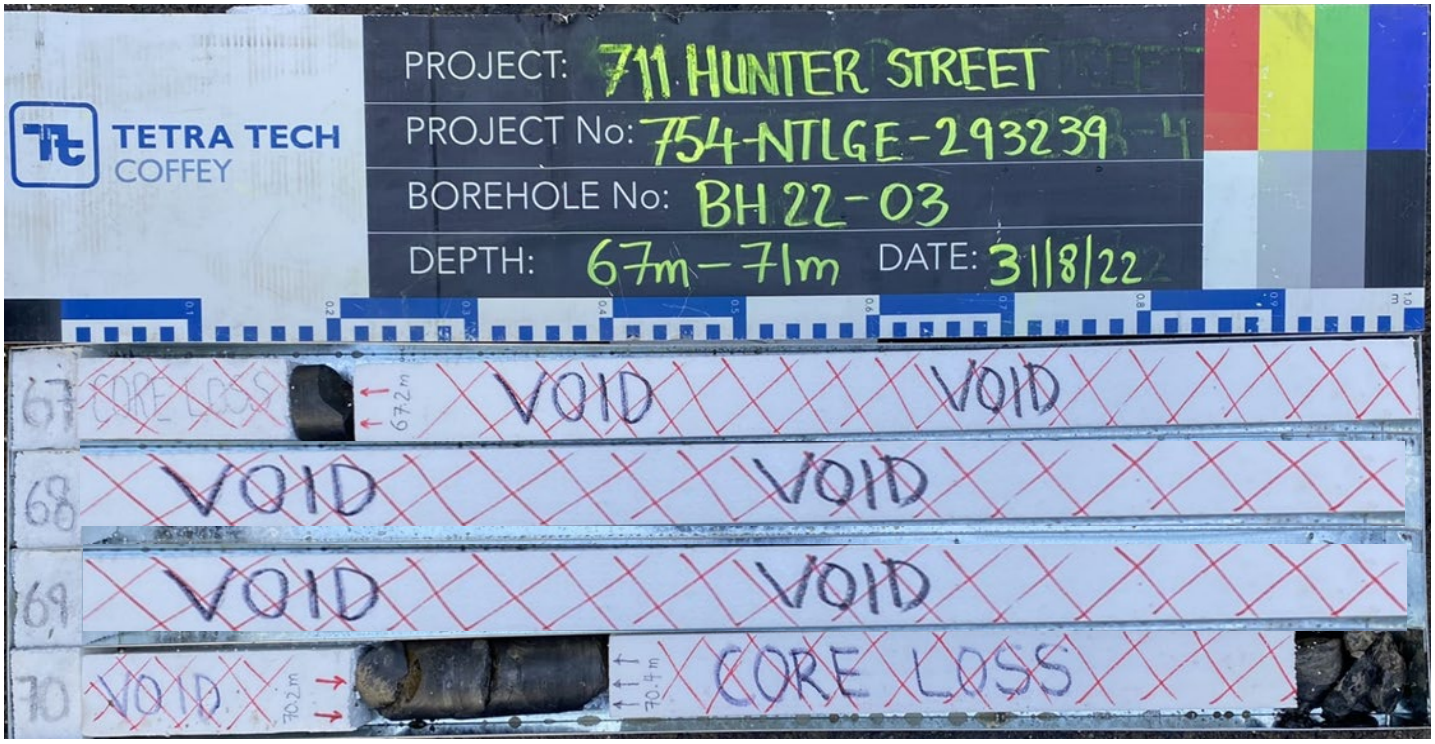
SPT at 38.5m

drawn	**PK**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**SJB**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**10/10/2022**			
scale	**Not to scale**		title:	**SPT PHOTOS: BH22-03**
original size	**A4**		project no:	**754-NTLGE293239**

drawn	**OB**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**PK**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**5/10/2022**			
scale	**Not to scale**		title:	**CORE BOX PHOTOS: BH22-03**
original size	**A4**		project no:	**754-NTLGE293239**

drawn	**OB**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**PK**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**5/10/2022**			
scale	**Not to scale**		title:	**CORE BOX PHOTOS: BH22-03**
original size	**A4**		project no:	**754-NTLGE293239**

drawn	**OB**	TETRA TECH COFFEY	client: **HUNTER STREET JV CO PTY LIMITED**
approved	**PK**		project: **PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**5/10/2022**		
scale	**Not to scale**		title: **CORE BOX PHOTOS: BH22-03**
original size	**A4**		project no: **754-NTLGE293239**



drawn	**OB**	TETRA TECH COFFEY	client: **HUNTER STREET JV CO PTY LIMITED**
approved	**PK**		project: **PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**5/10/2022**		
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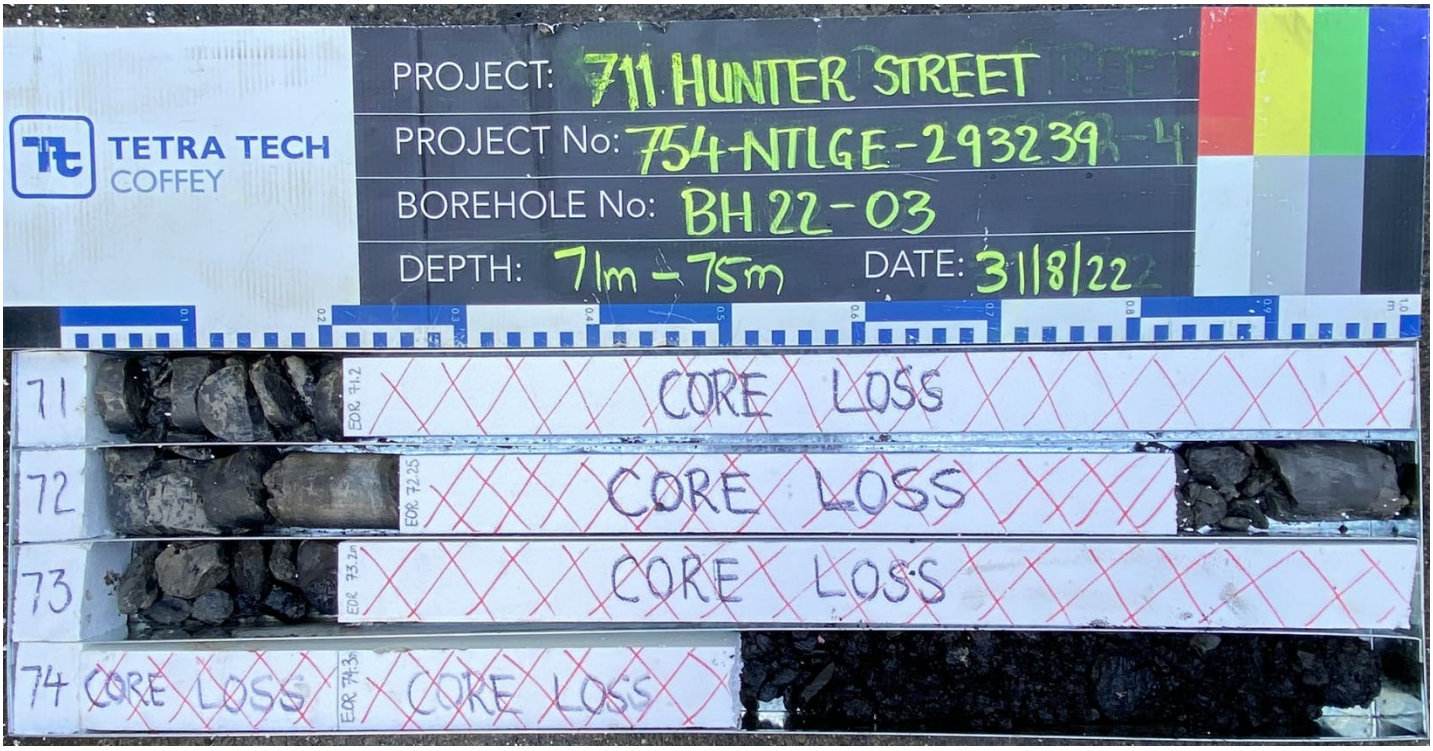
original size	**A4**		project no: **754-NTLGE293239**



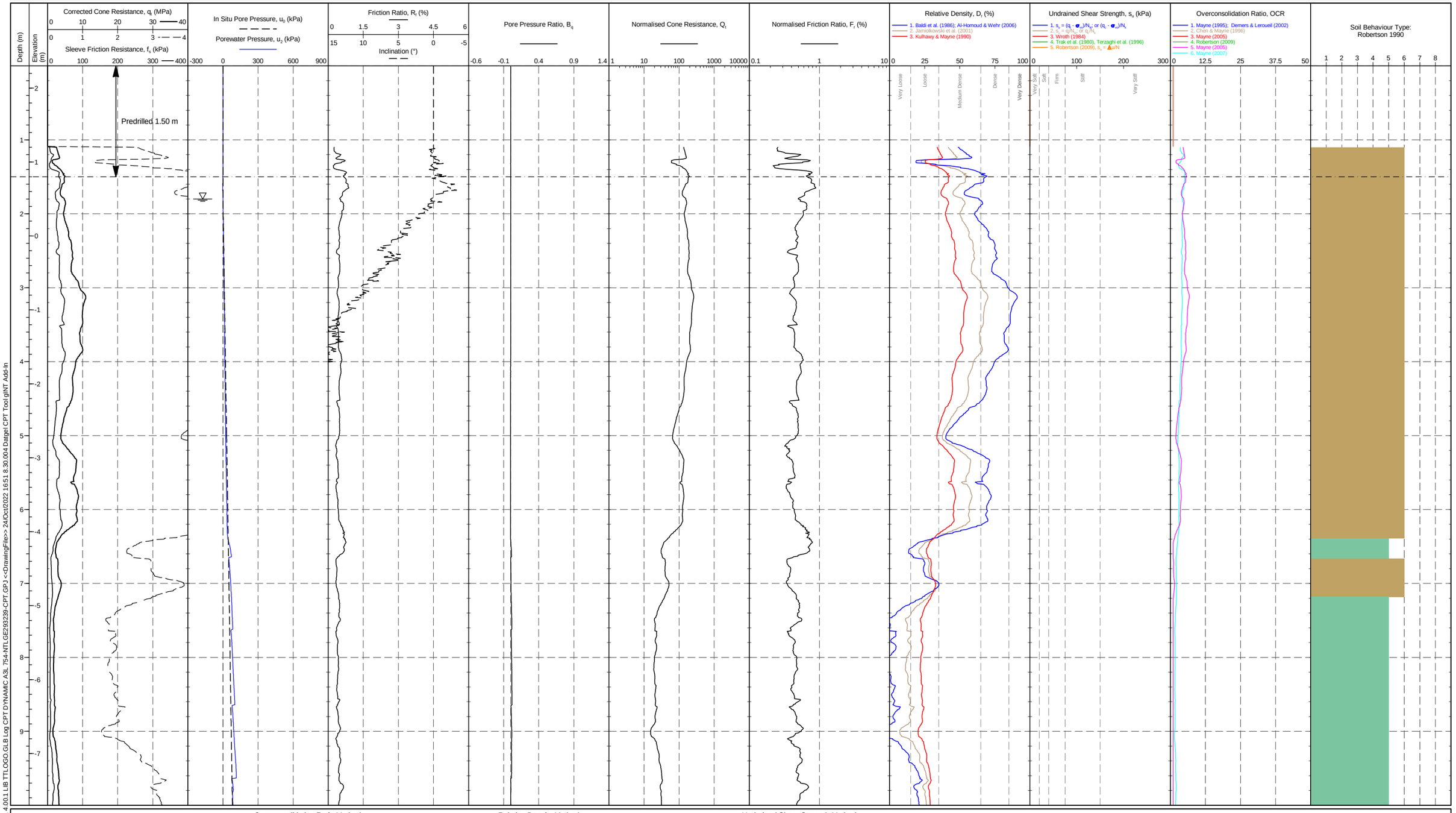
drawn	**OB**	TETRA TECH COFFEY	client:	**HUNTER STREET JV CO PTY LIMITED**
approved	**PK**		project:	**PROPOSED MIXED USED DEVELOPMENT – 711 HUNTER STREET, NEWCASTLE WEST**
date	**5/10/2022**			
scale	**Not to scale**		title:	**CORE BOX PHOTOS: BH22-03**
original size	**A4**		project no:	**754-NTLGE293239**

TETRA TECH COFFEY

CPT LOG

PointID **CPT22-01A**

CLIENT : HUNTER STREET JV CO PTY LTD ENGINEER : PROJECT : PROPOSED MIXED USE DEVELOPMENT LOCATION : 711 HUNTER STREET, NEWCASTLE WEST PROJECT No. : 754-NTLGE293239	AREA : EASTING : 384150.7 m NORTHING : 6356148.6 m COORD. SYS. : ELEVATION : 2.30 m	RIG : CONE TYPE : PC CONE ID : C10CFIIP.C19137 OPERATOR :	CHECKED BY : CHECKED DATE : APPROVED BY : APPROVED DATE :	REMARK	SHEET : 1 OF 2 STATUS : DATE : 14/10/2022



DATGEL CPT TOOL 4.00.1 LIB TTLOGO.GLB Log CPT DYNAMIC A3L 754-NTLGE293239-CPT.GPJ <<DrawingFile>> 24/Oct/2022 16:51 8.30.004 Datgel CPT Tool gINT Add-In

Overconsolidation Ratio Method:
1. Mayne (1995); Demers & Leroueil (2002)
2. Chen & Mayne (1996)
3. Mayne (2005)
4. Robertson (2009)
5. Mayne (2005)
6. Mayne (2007)

Relative Density Method:
1. Baldi et al. (1986); Al-Homoud & Wehr (2006)
2. Jamiolkowski et al. (2001)
3. Kulhawy & Mayne (1990)

Undrained Shear Strength Method:
1. $s_u = (q_t - \sigma_{vo})/N_{kt}$; or $(q_t - \sigma_{vo})/N_k$
2. $s_u = q_t/N_{kt}$; or q_t/N_k
3. Wroth (1984)
4. Trak et al. (1980), Terzaghi et al. (1996)
5. Robertson (2009), $s_u = \Delta u/N$

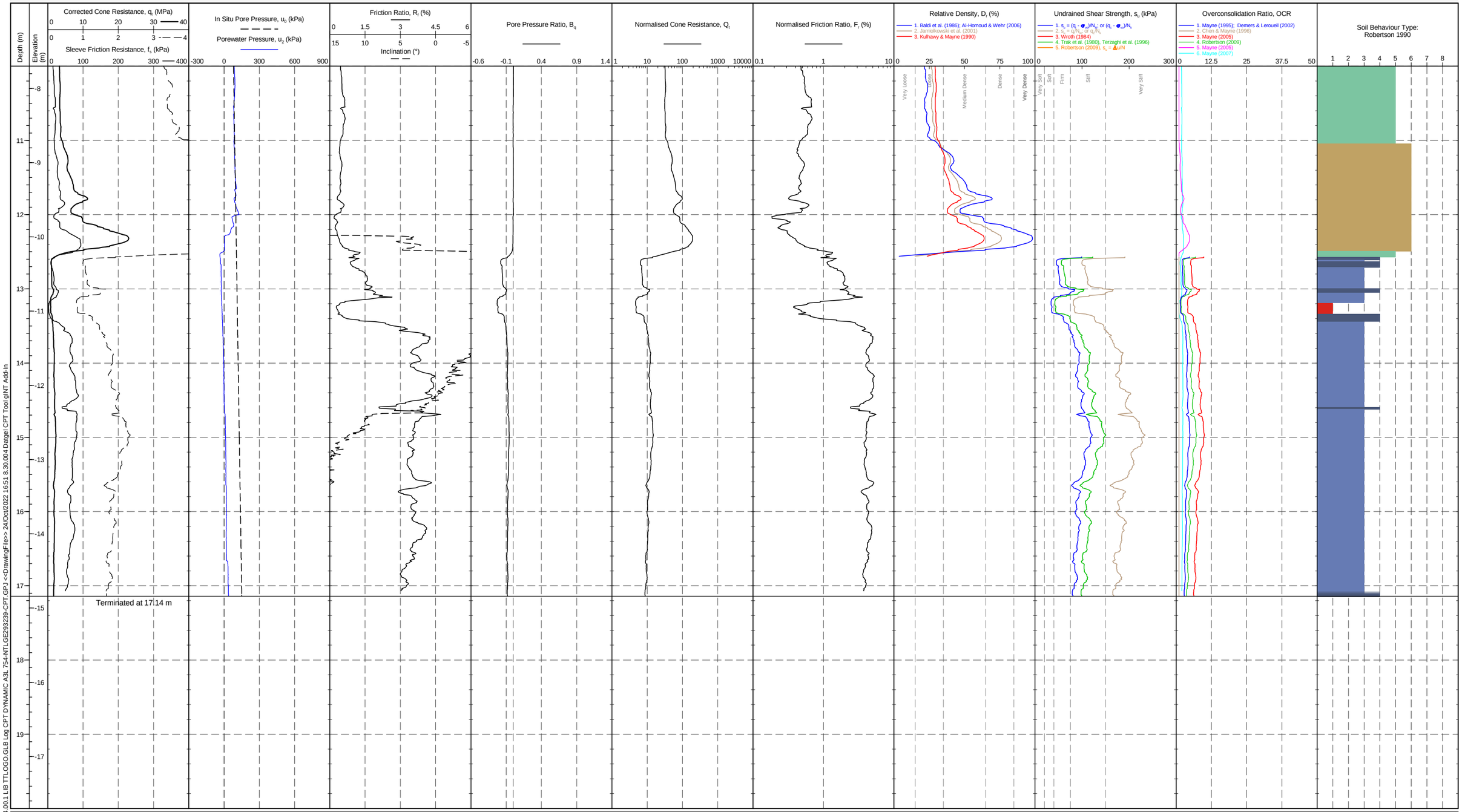
METHOD: Robertson 1990
- 1 - Sensitive, fine grained
- 2 - Organic soil - PEATS
- 3 - CLAYS - CLAY to silty CLAY
- 4 - SILT mixtures - clayey SILT to silty CLAY
- 5 - SAND mixtures - silty SAND to sandy SILT
- 6 - SANDS - clean SAND to silty SAND
- 7 - Gravelly SAND to SAND
- 8 - Very stiff SAND to clayey SAND
- 9 - Very stiff fine grained

TETRA TECH COFFEY

CPT LOG

PointID **CPT22-01A**

CLIENT : HUNTER STREET JV CO PTY LTD ENGINEER : PROJECT : PROPOSED MIXED USE DEVELOPMENT LOCATION : 711 HUNTER STREET, NEWCASTLE WEST PROJECT No. : 754-NTLGE293239	AREA : EASTING : 384150.7 m NORTHING : 6356148.6 m COORD. SYS. : ELEVATION : 2.30 m	RIG : CONE TYPE : PC CONE ID : C10CFIIP.C19137 OPERATOR :	CHECKED BY : CHECKED DATE : APPROVED BY : APPROVED DATE :	REMARK	SHEET : 2 OF 2 STATUS : DATE : 14/10/2022



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1. $s_u = (q_t - \sigma_{vo})/N_{kt}$; or $(q_t - \sigma_{vo})/N_k$
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- 5 - SAND mixtures - silty SAND to sandy SILT
- 6 - SANDS - clean SAND to silty SAND
- 7 - Gravelly SAND to SAND
- 8 - Very stiff SAND to clayey SAND
- 9 - Very stiff fine grained

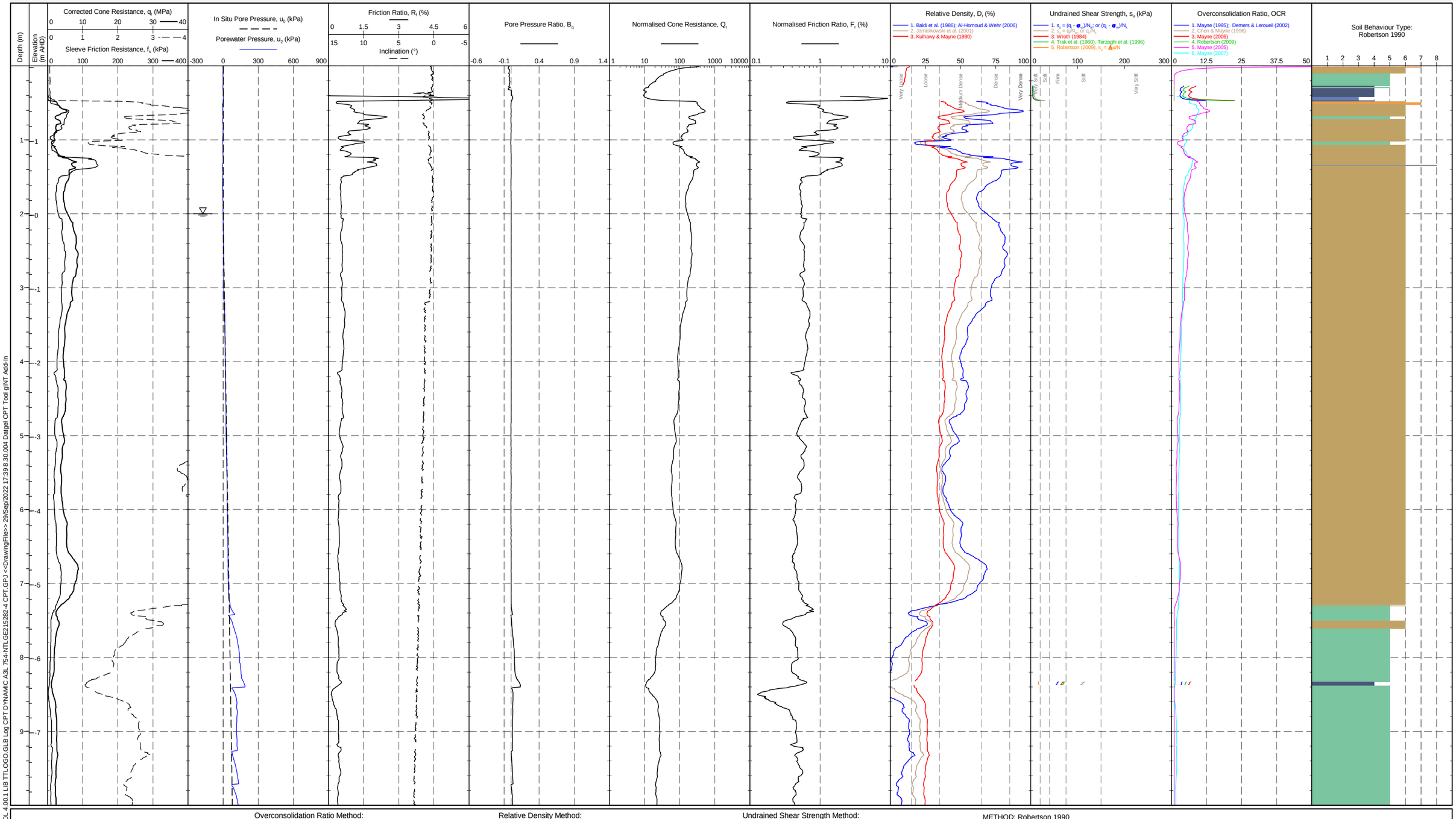
APPENDIX D: BOREHOLE LOG AND CPT RESULTS (DATA FROM SURROUNDING SITES)

TETRA TECH COFFEY

CPT LOG

PointID **CPT01**

CLIENT : GWH BUILD PTY LTD	AREA :	RIG : NewSyd Track	CHECKED BY : SJB	REMARK	SHEET : 1 OF 4
ENGINEER :	EASTING : 384209.2 m	CONE TYPE : PC	CHECKED DATE : 29/09/2022		STATUS :
PROJECT : PROPOSED ONE NATIONAL PARK STREET DEVELOPMENT	NORTHING : 6356167.0 m	CONE ID : C10CFIIP.C21089	APPROVED BY : SJB		DATE : 15/08/2022
LOCATION : 1 NATIONAL PARK STREET NEWCASTLE WEST	COORD. SYS. : MGA94 Zone 56	OPERATOR : BT	APPROVED DATE : 29/09/2022		
PROJECT No. : 754-NTLGE215282-4	ELEVATION : 2.02 m AHD				



Overconsolidation Ratio Method:
1. Mayne (1995); Demers & Leroueil (2002)
2. Chen & Mayne (1996)
3. Mayne (2005)
4. Robertson (2009)
5. Mayne (2005)
6. Mayne (2007)

Relative Density Method:
1. Baldi et al. (1986); Al-Homoud & Wehr (2006)
2. Jamiolkowski et al. (2001)
3. Kulhawy & Mayne (1990)

Undrained Shear Strength Method:
1. $s_u = (q_t - \sigma_{vo})/N_{kt}$; or $(q_t - \sigma_{vo})/N_k$
2. $s_u = q_t/N_{kt}$; or q_t/N_k
3. Wroth (1984)
4. Trak et al. (1980), Terzaghi et al. (1996)
5. Robertson (2009), $s_u = \Delta u/N$

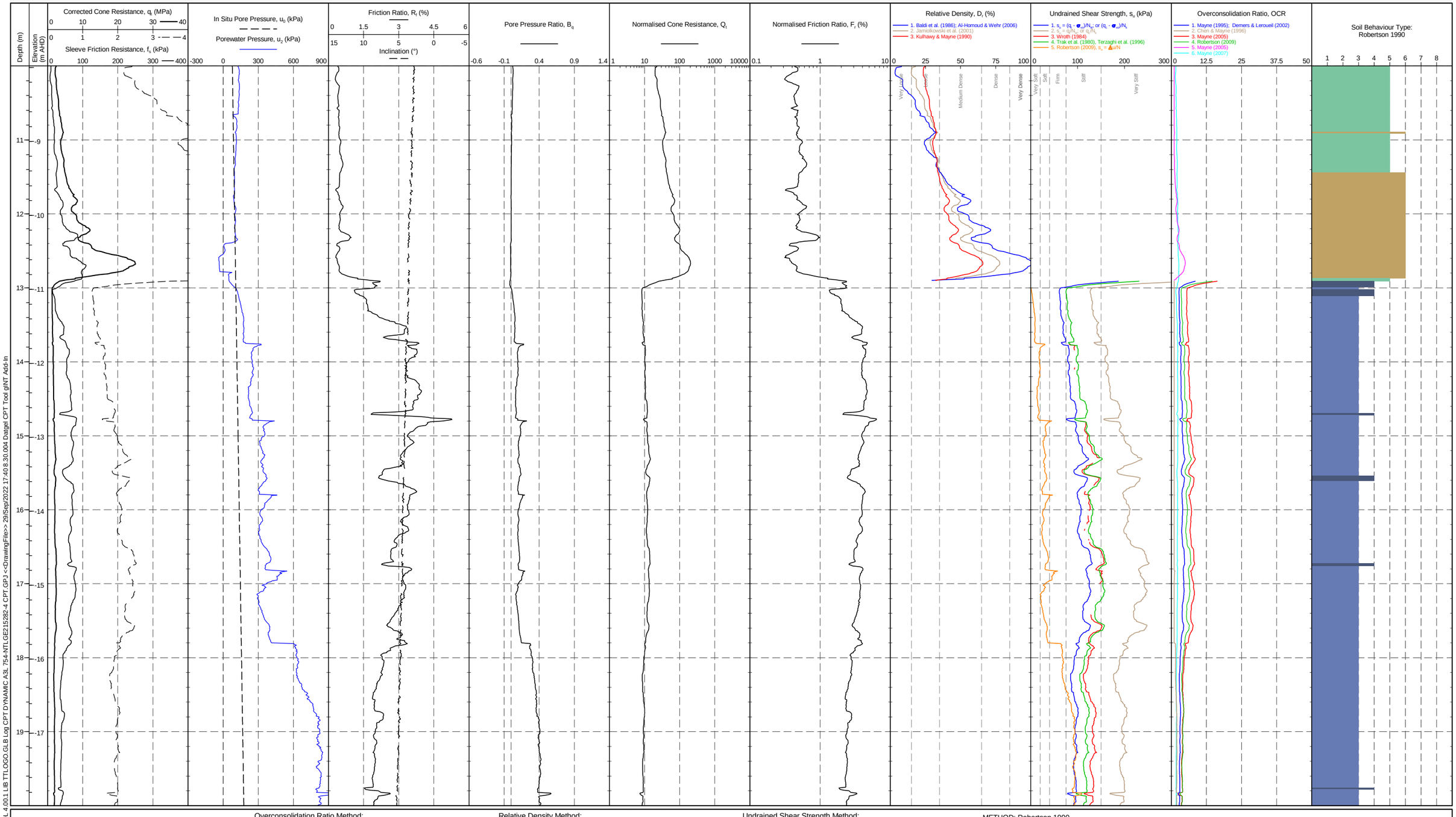
METHOD: Robertson 1990
1 - Sensitive, fine grained
2 - Organic soil - PEATS
3 - CLAYS - CLAY to silty CLAY
4 - SILT mixtures - clayey SILT to silty CLAY
5 - SAND mixtures - silty SAND to sandy SILT
6 - SANDS - clean SAND to silty SAND
7 - Gravelly SAND to SAND
8 - Very stiff SAND to clayey SAND
9 - Very stiff fine grained

TETRA TECH COFFEY

CPT LOG

PointID **CPT01**

CLIENT : GWH BUILD PTY LTD	AREA :	RIG : NewSyd Track	CHECKED BY : SJB	REMARK	SHEET : 2 OF 4
ENGINEER :	EASTING : 384209.2 m	CONE TYPE : PC	CHECKED DATE : 29/09/2022		STATUS :
PROJECT : PROPOSED ONE NATIONAL PARK STREET DEVELOPMENT	NORTHING : 6356167.0 m	CONE ID : C10CFIIP.C21089	APPROVED BY : SJB		DATE : 15/08/2022
LOCATION : 1 NATIONAL PARK STREET NEWCASTLE WEST	COORD. SYS. : MGA94 Zone 56	OPERATOR : BT	APPROVED DATE : 29/09/2022		
PROJECT No. : 754-NTLGE215282-4	ELEVATION : 2.02 m AHD				



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Overconsolidation Ratio Method:
1. Mayne (1995); Demers & Leroueil (2002)
2. Chen & Mayne (1996)
3. Mayne (2005)
4. Robertson (2009)
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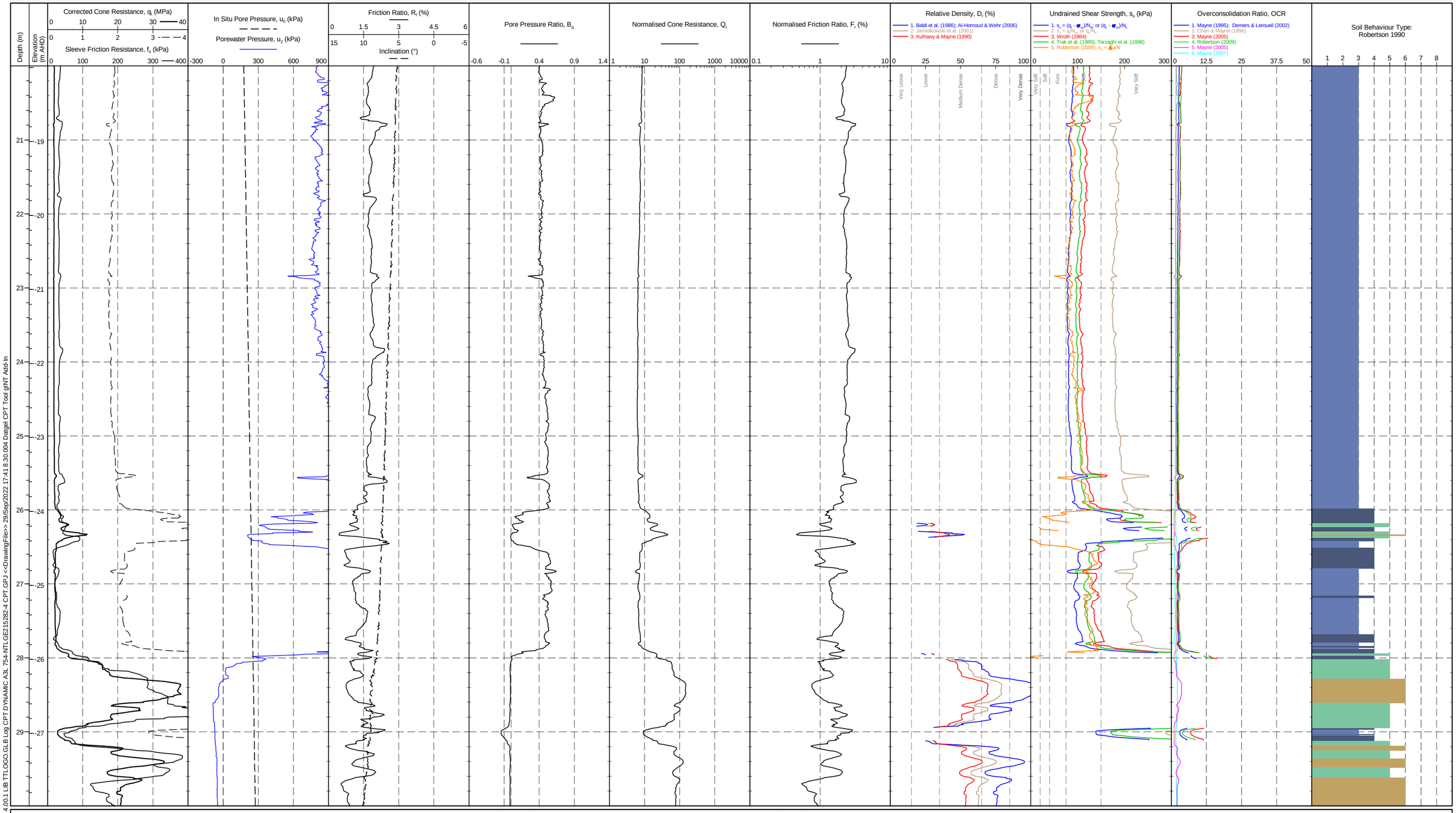
6 - SANDS - clean SAND to silty SAND
7 - Gravelly SAND to SAND
8 - Very stiff SAND to clayey SAND
9 - Very stiff fine grained

TETRA TECH COFFEY

CPT LOG

PointID **CPT01**

CLIENT : GWH BUILD PTY LTD	AREA :	RIG : NewSyd Track	CHECKED BY : SJB	REMARK	SHEET : 3 OF 4
ENGINEER :	EASTING : 384209.2 m	CONE TYPE : PC	CHECKED DATE : 29/09/2022		STATUS :
PROJECT : PROPOSED ONE NATIONAL PARK STREET DEVELOPMENT	NORTHING : 6356167.0 m	CONE ID : C10CFIIP.C21089	APPROVED BY : SJB		DATE : 15/08/2022
LOCATION : 1 NATIONAL PARK STREET NEWCASTLE WEST	COORD. SYS. : MGA94 Zone 56	OPERATOR : BT	APPROVED DATE : 29/09/2022		
PROJECT No. : 754-NTLGE215282-4	ELEVATION : 2.02 m AHD				



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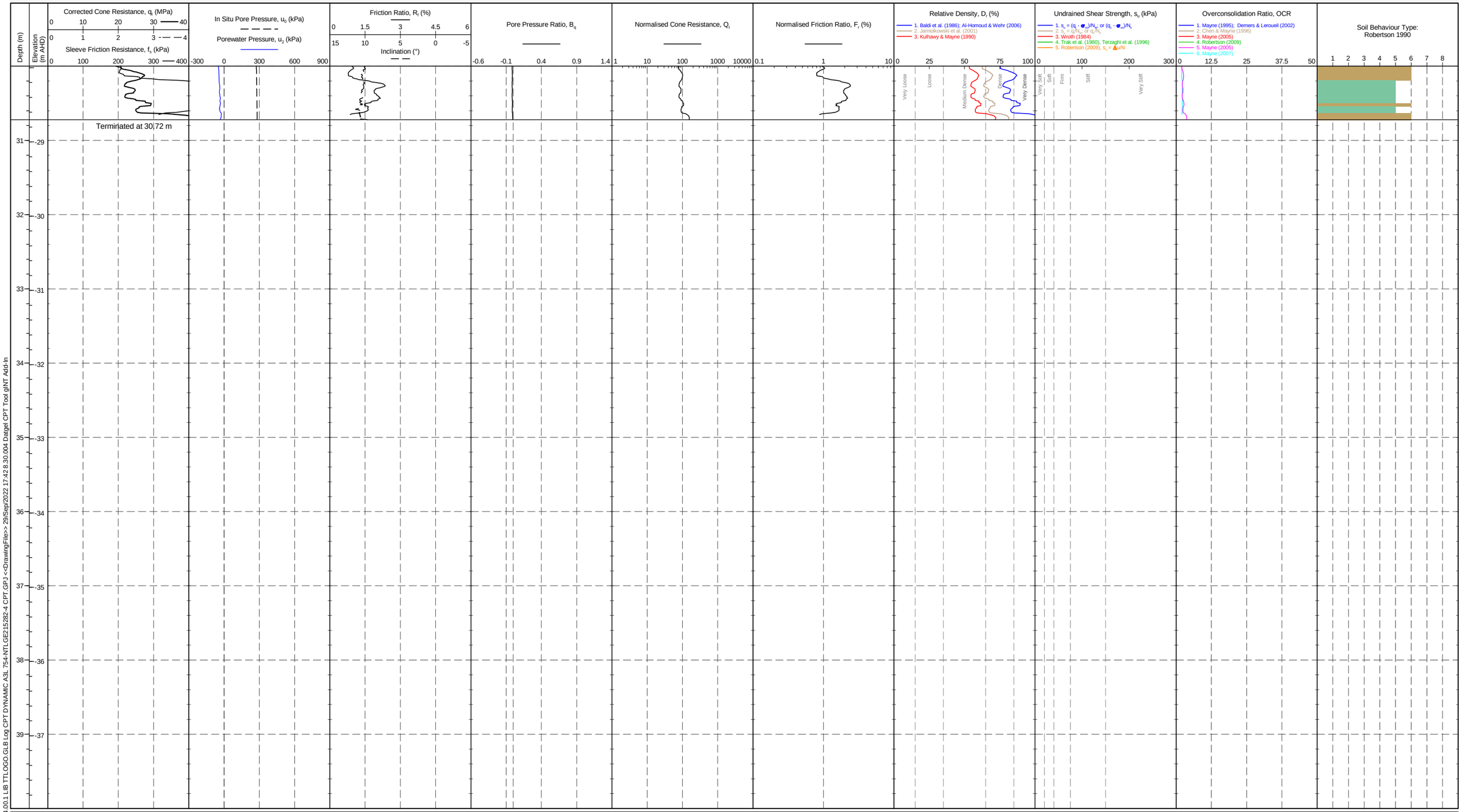
CPT LOG

TETRA TECH COFFEY

PointID **CPT01**

CLIENT : GWH BUILD PTY LTD	AREA :	RIG : NewSyd Track	CHECKED BY : SJB	REMARK	SHEET : 4 OF 4
ENGINEER :	EASTING : 384209.2 m	CONE TYPE : PC	CHECKED DATE : 29/09/2022		STATUS :
PROJECT : PROPOSED ONE NATIONAL PARK STREET DEVELOPMENT	NORTHING : 6356167.0 m	CONE ID : C10CFIIP.C21089	APPROVED BY : SJB		DATE : 15/08/2022
LOCATION : 1 NATIONAL PARK STREET NEWCASTLE WEST	COORD. SYS. : MGA94 Zone 56	OPERATOR : BT	APPROVED DATE : 29/09/2022		
PROJECT No. : 754-NTLGE215282-4	ELEVATION : 2.02 m AHD				



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Overconsolidation Ratio Method:
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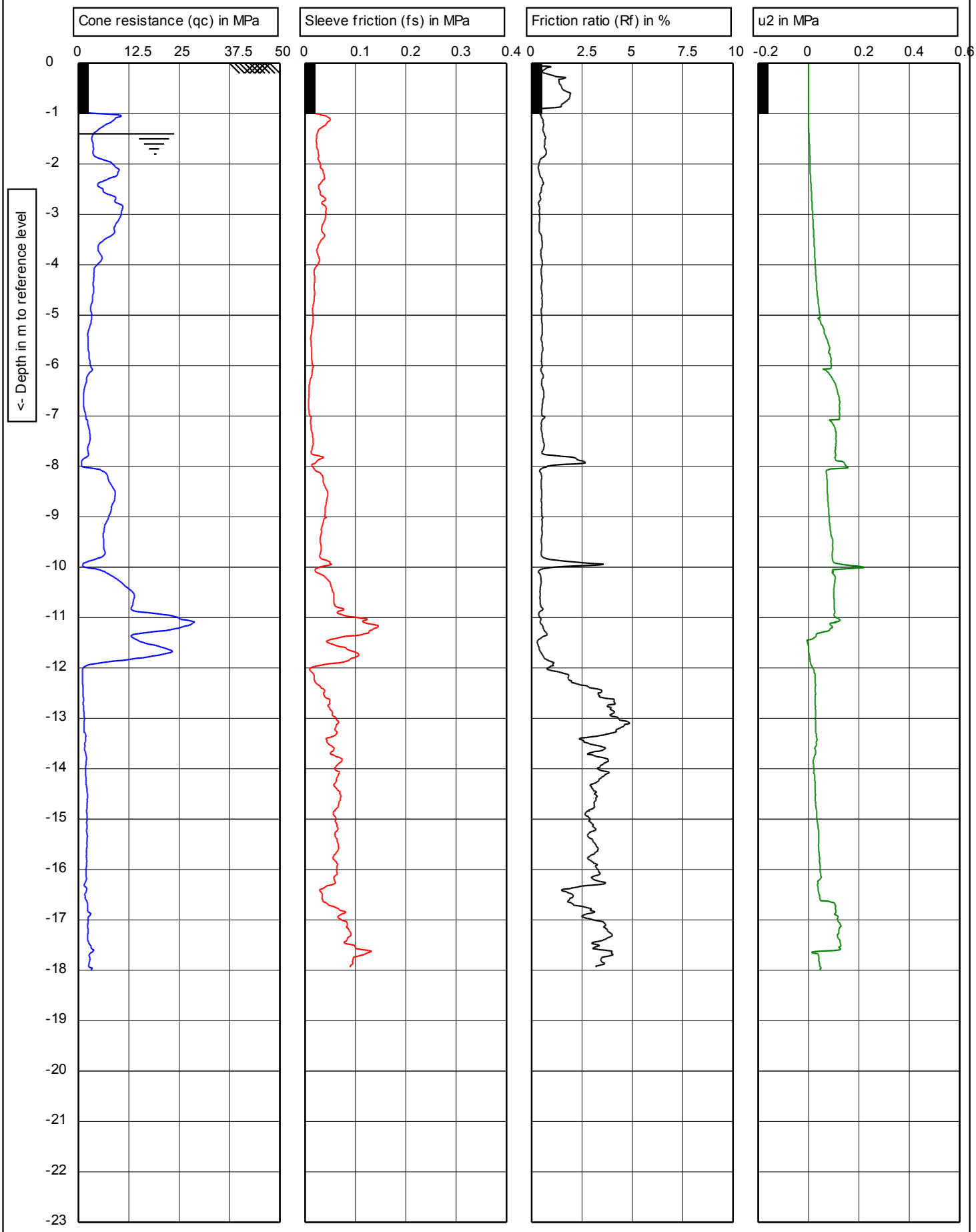


NEWSYD
GEOTECHNICAL
TESTING
Ph:0408292638

u2
150 cm²
10 cm²

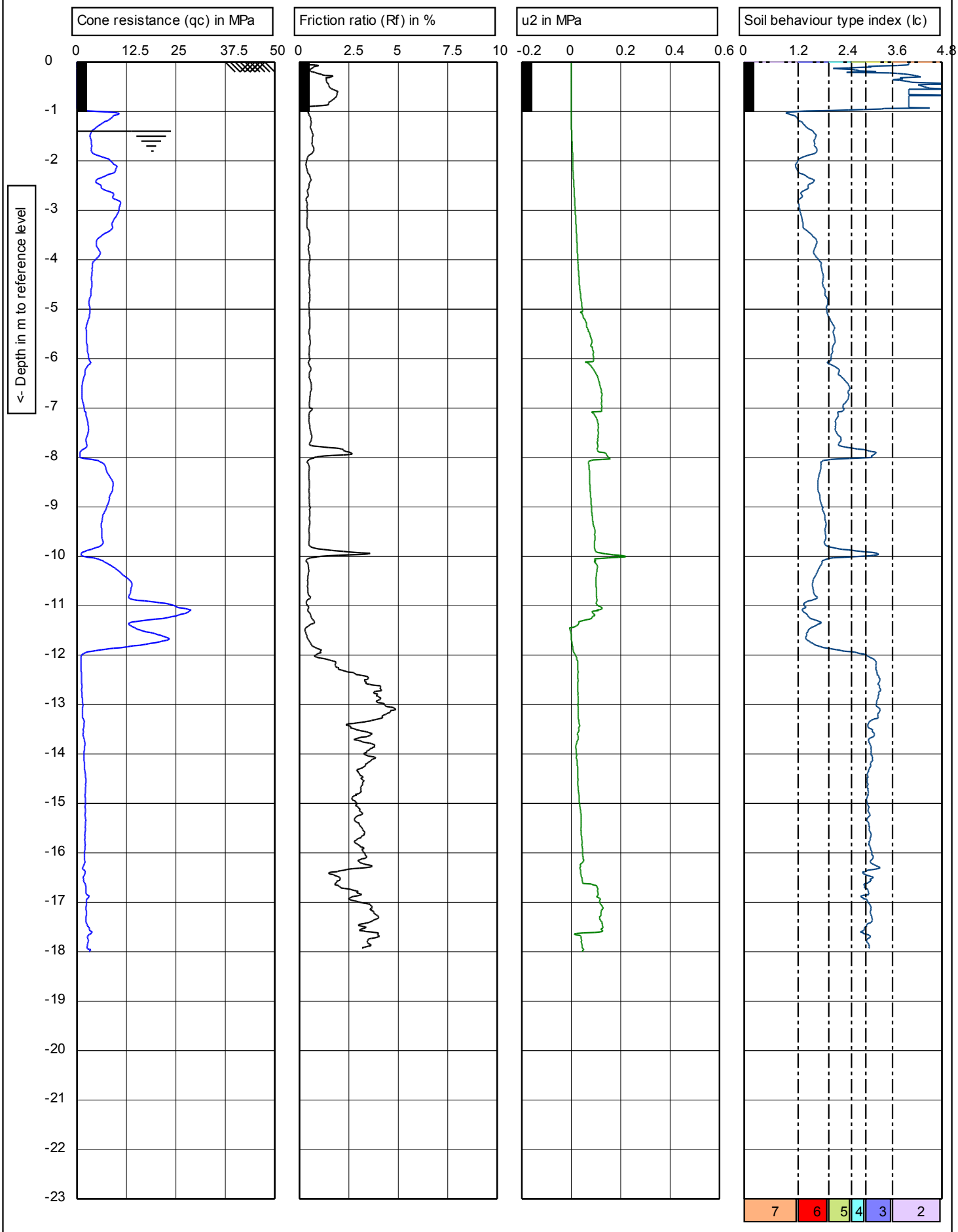
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.4**

Project: **Geotechnical Investigation**
Location: **Newcastle City Holden**
Position:

Predrill :	**1 m Predrilled**
Date:	**2/25/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 01219**
CPT no.:	**CPT-4** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

u2
150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.4**

Project: **Geotechnical Investigation**
Location: **Newcastle City Holden**
Position:

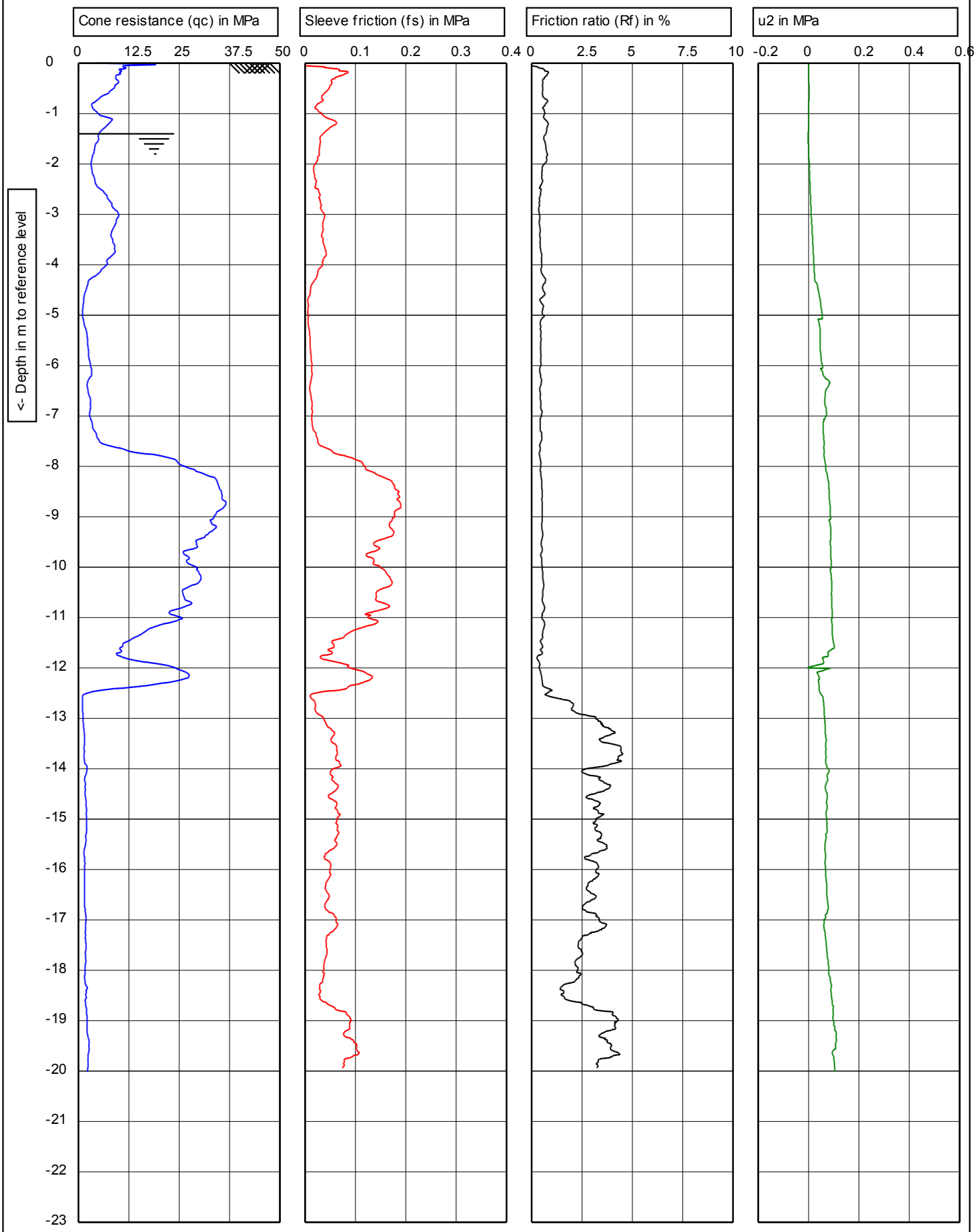
Predrill :	**1 m Predrilled**
Date:	**2/25/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 01219**
CPT no.:	**CPT-4** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**1 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.4**	Date:	**2/25/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Newcastle City Holden**		Project no.:	**RGS 01219**
	Position:			CPT no.:	**CPT-4** **3/3**

1.40



NEWSYD
GEOTECHNICAL
TESTING
Ph:0408292638

u2
150 cm²
10 cm²

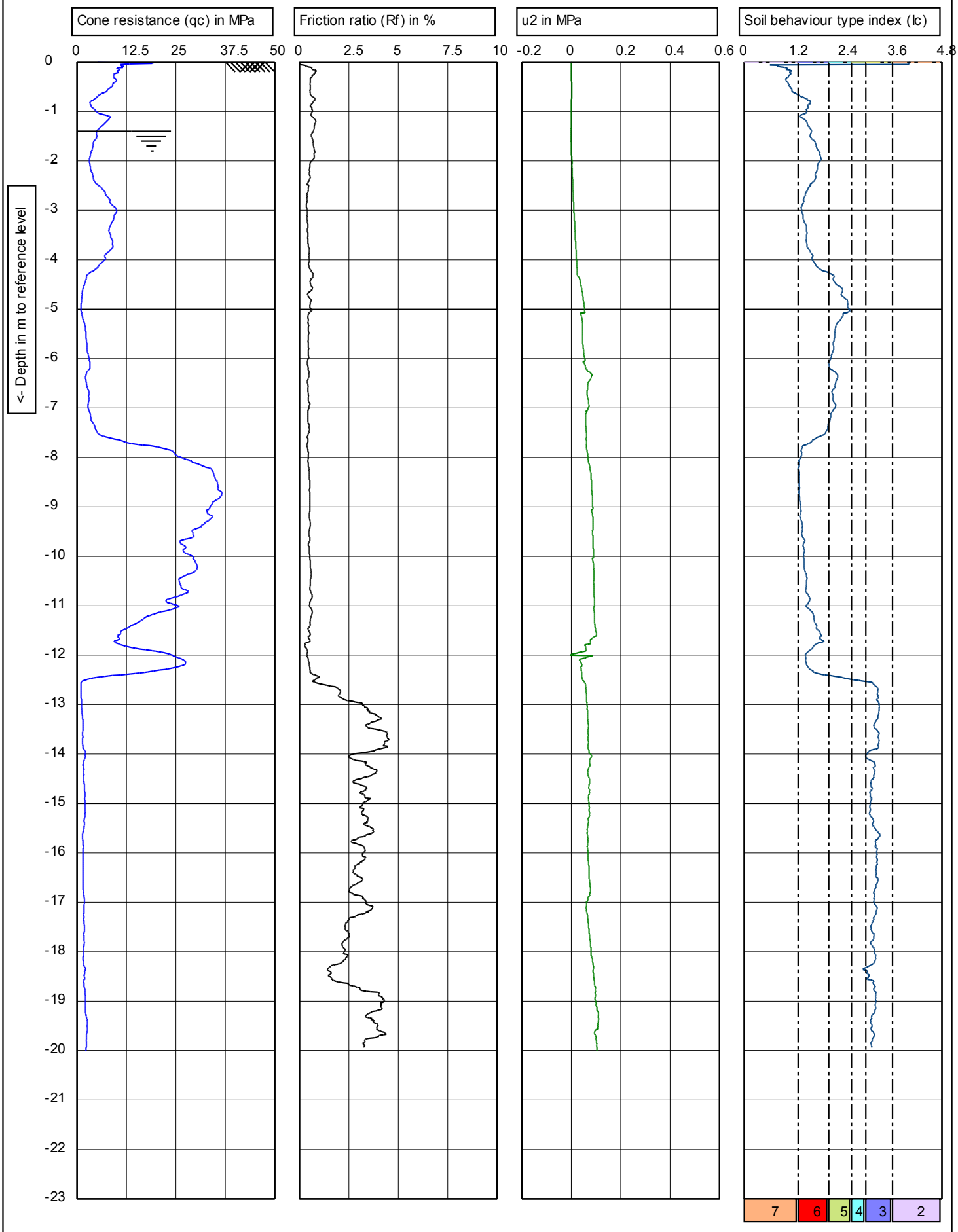
Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.4**

Project: **Geotechnical Investigation**
Location: **Newcastle City Holden**
Position:

Predrill :	**0 m Predrilled**
Date:	**2/25/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 01219**
CPT no.:	**CPT-5** 1/3

1.40



NEWSYD GEOTECHNICAL TESTING
Ph:0408292638

r u2
L 150 cm²
10 cm²

Test according NEN 5140 class 1

G.L. 0 NAP | W.L.: **-1.4**

Project: **Geotechnical Investigation**
Location: **Newcastle City Holden**
Position:

Predrill :	**0 m Predrilled**
Date:	**2/25/2016**
Cone no.:	**C10CFIIP.C14476**
Project no.:	**RGS 01219**
CPT no.:	**CPT-5** 2/3

1.40

(2) Organic soils
(3) Clay
(4) Silt mixture
(5) Sand mixture
(6) Sand clean to silty
(7) Gravelly sand

NEWSYD GEOTECHNICAL TESTING Ph:0408292638	┌ u2 └ 150 cm² 10 cm²	Test according NEN 5140 class 1		Predrill :	**0 m Predrilled**
		G.L. 0 NAP	W.L.: **-1.4**	Date:	**2/25/2016**
	Project:	**Geotechnical Investigation**		Cone no.:	**C10CFIIP.C14476**
	Location:	**Newcastle City Holden**		Project no.:	**RGS 01219**
	Position:			CPT no.:	**CPT-5** **3/3**

1.40

APPENDIX E: LAB RESULTS

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC22S-07706-1
Issue No: 1

Client: Tetra Tech Coffey Pty Ltd (Newcastle)
Unit 4, 60 Griffiths Road
Lambton NSW 2299

Principal:
Project No.: TESTNEWC00829AA
Project Name: 754-NTLGE293239 - 711 Hunter Street, Newcastle
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection and proficiency testing scheme providers reports.

Approved Signatory: Chris Blackford
(Construction Materials Manager)
NATA Accredited Laboratory Number:431
Date of Issue: 21/09/2022

Sample Details

Sample ID / Client ID:	NEWC22S-07706 / -
Date Sampled:	26/08/2022
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	Newcastle, NSW
Sample Location:	BH22-03 - 8.5m

Other Test Results

Description	Method	Result	Limits

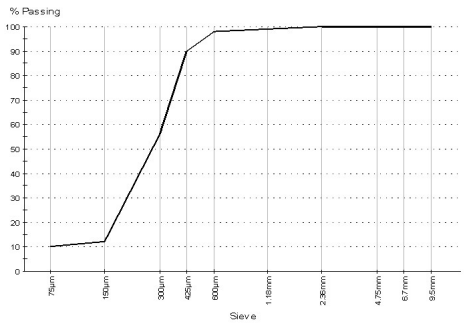
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 20/09/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
6.7mm	100	
4.75mm	100	
2.36mm	100	
1.18mm	99	
600µm	98	
425µm	90	
300µm	56	
150µm	12	
75µm	10	

Chart



Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC22S-07707-1
Issue No: 1

Client: Tetra Tech Coffey Pty Ltd (Newcastle)
Unit 4, 60 Griffiths Road
Lambton NSW 2299

Principal:
Project No.: TESTNEWC00829AA
Project Name: 754-NTLGE293239 - 711 Hunter Street, Newcastle
Lot No.: - **TRN:** -

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Approved Signatory: Chris Blackford
(Construction Materials Manager)
NATA Accredited Laboratory Number:431
Date of Issue: 21/09/2022

Sample Details

Sample ID / Client ID: NEWC22S-07707 / -
Date Sampled: 26/08/2022
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: Newcastle, NSW
Sample Location: BH22-03 - 13.5m

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	15.5	
Mould Length (mm)		254	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	68	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	25	
Plasticity Index (%)	AS 1289.3.3.1	43	
Date Tested		14/09/2022	

Comments

*Results relate only to the items tested or sampled.

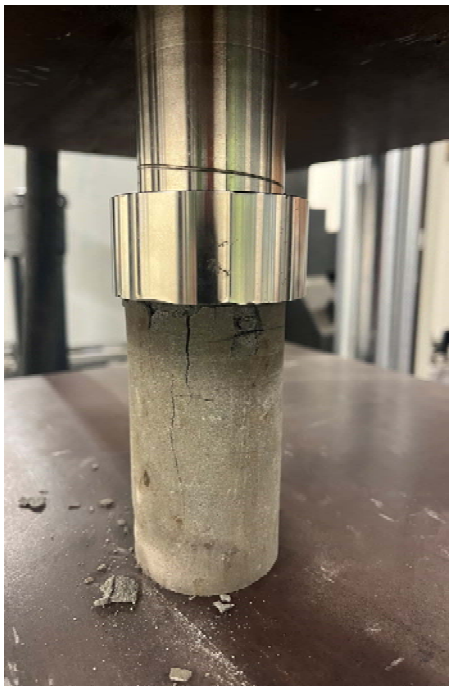
Australian Research Council Centre of Excellence
CGSE
Geotechnical Science & Engineering

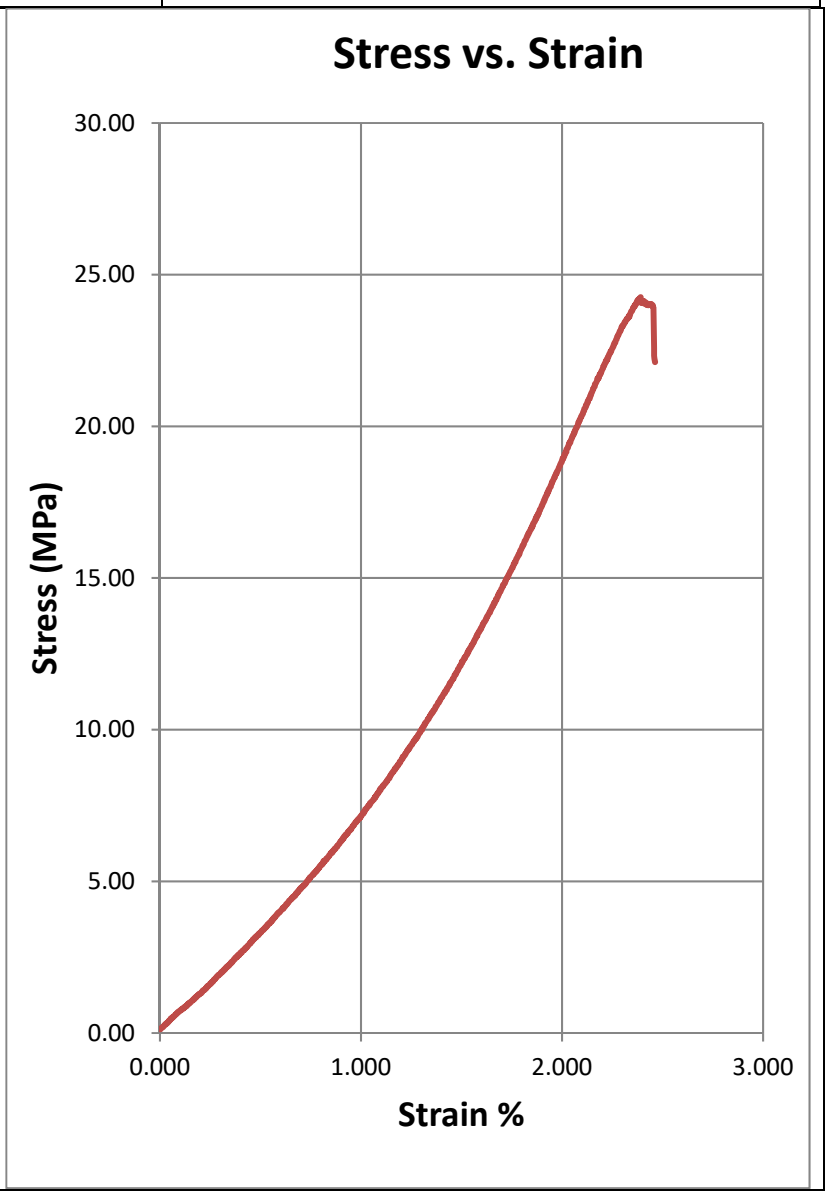
UCS TEST REPORT

Client: Coffey	Test Methods: AS 4133.4.2.2-2013
Job Reference: 754-NTLGE293239	Test By: Lachlan Bates
Test Date: 19-10-22	Reported By: Lachlan Bates
Bore Hole: BH22-03	
Depth (m): 39.7 – 39.9.0mm	

Sample Description:
Sandstone, Grey

Length (mm): 93.37
Diameter (mm): 60.12
Mass (g): 645.50
Water Content (%): 4.5
Dry density (g/cm3): 2.33
UCS (MPa) = 24.3
*Length /Diameter ratio<2





ARC Centre of Excellence for Geotechnical Science & Engineering
The University of Newcastle, Callaghan NSW 2308 Australia

T: +61 2 4921 6141
M: 0408 292638
E: Lachlan.Bates@newcastle.edu.au
www.cgse.edu.au

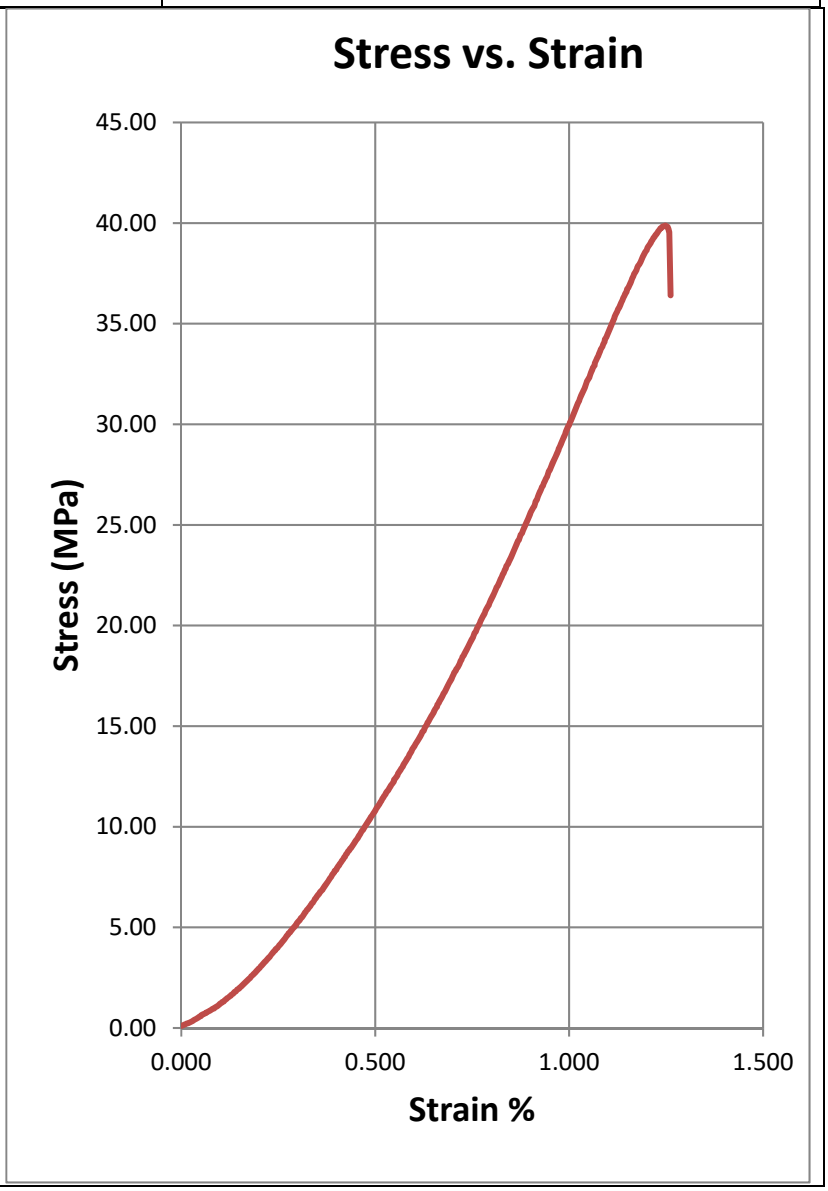
Australian Research Council Centre of Excellence
CGSE
Geotechnical Science & Engineering

UCS TEST REPORT

Client: Coffey	Test Methods: AS 4133.4.2.2-2013
Job Reference: 754-NTLGE293239	Test By: Lachlan Bates
Test Date: 19-10-22	Reported By: Lachlan Bates
Bore Hole: BH22-03	
Depth (m): 40.5 – 41.0mm	

Sample Description:
Sandstone, Grey

Length (mm):160.94
Diameter (mm): 60.37
Mass (g): 1112.54
Water Content (%): 4.8
Dry density (g/cm3): 2.304
UCS (MPa) = 39.9



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The University of Newcastle, Callaghan NSW 2308 Australia

T: +61 2 4921 6141
M: 0408 292638
E: Lachlan.Bates@newcastle.edu.au
www.cgse.edu.au

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2230548**	Page	: 1 of 3
Client	: **TETRA TECH COFFEY PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: PAUL WRIGHT	Contact	: Khaleda Ataei
Address	: 4/60 Griffiths Rd Lambton 2299	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: + 61 2 8784 8555
Project	: 711 Huter St - 754-NTLGE293239	Date Samples Received	: 12-Oct-2022 15:37
Order number	: ----	Date Analysis Commenced	: 19-Oct-2022
C-O-C number	: ----	Issue Date	: 25-Oct-2022 11:27
Sampler	: Osman Baig		
Site	: ----		
Quote number	: NE/021/22 BQ		
No. of samples received	: 4		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Corrosion assessment for Concrete and Steel piles in soil per Australian Standard AS2159-2009 uses a combination of soil and groundwater data (Tables 6.4.2 C & 6.5.2 C). In the absence of groundwater data, assessment has been made against soil criteria only. Refer to AS2159-2009 section 6.4 for further interpretation of corrosion assessment. ALS is not NATA accredited for Corrosion Assessment comments
- EA167: Soil Condition A – High permeability soils (e.g. sands and gravels) which are in groundwater
- EA167: Soil Condition B – Low permeability soils (e.g. silts and clays) or all soils above groundwater

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH22-03_7	BH22-03_10	BH22-03_14.5	BH22-03_26.5	----
			Sampling date / time	26-Aug-2022 00:00	27-Aug-2022 00:00	27-Aug-2022 00:00	29-Aug-2022 00:00	----
Compound	CAS Number	LOR	Unit	EB2230548-001	EB2230548-002	EB2230548-003	EB2230548-004	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.4**	**6.9**	**7.9**	**8.1**	**----**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**308**	**176**	**457**	**547**	**----**
EA080: Resistivity								
Resistivity at 25°C	----	1	ohm cm	**3250**	**5680**	**2190**	**1830**	**----**
EA167: Corrosion Classification (per AS2159-2009)								
Ø **Exposure Classification - Concrete Piles Soil Condition A**	----	-	-	**Moderate**	**Mild**	**Mild**	**Mild**	**----**
Ø **Exposure Classification - Concrete Piles Soil Condition B**	----	-	-	**Mild**	**Non Aggressive**	**Non Aggressive**	**Non Aggressive**	**----**
Ø **Exposure Classification - Steel Piles Soil Condition A**	----	-	-	**Mild**	**Non Aggressive**	**Mild**	**Moderate**	**----**
Ø **Exposure Classification - Steel Piles Soil Condition B**	----	-	-	**Non Aggressive**	**Non Aggressive**	**Non Aggressive**	**Mild**	**----**
ED040S: Soluble Major Anions								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**650**	**290**	**220**	**80**	**----**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**30**	**50**	**360**	**680**	**----**

APPENDIX F: LIQUEFACTION ASSESSMENT

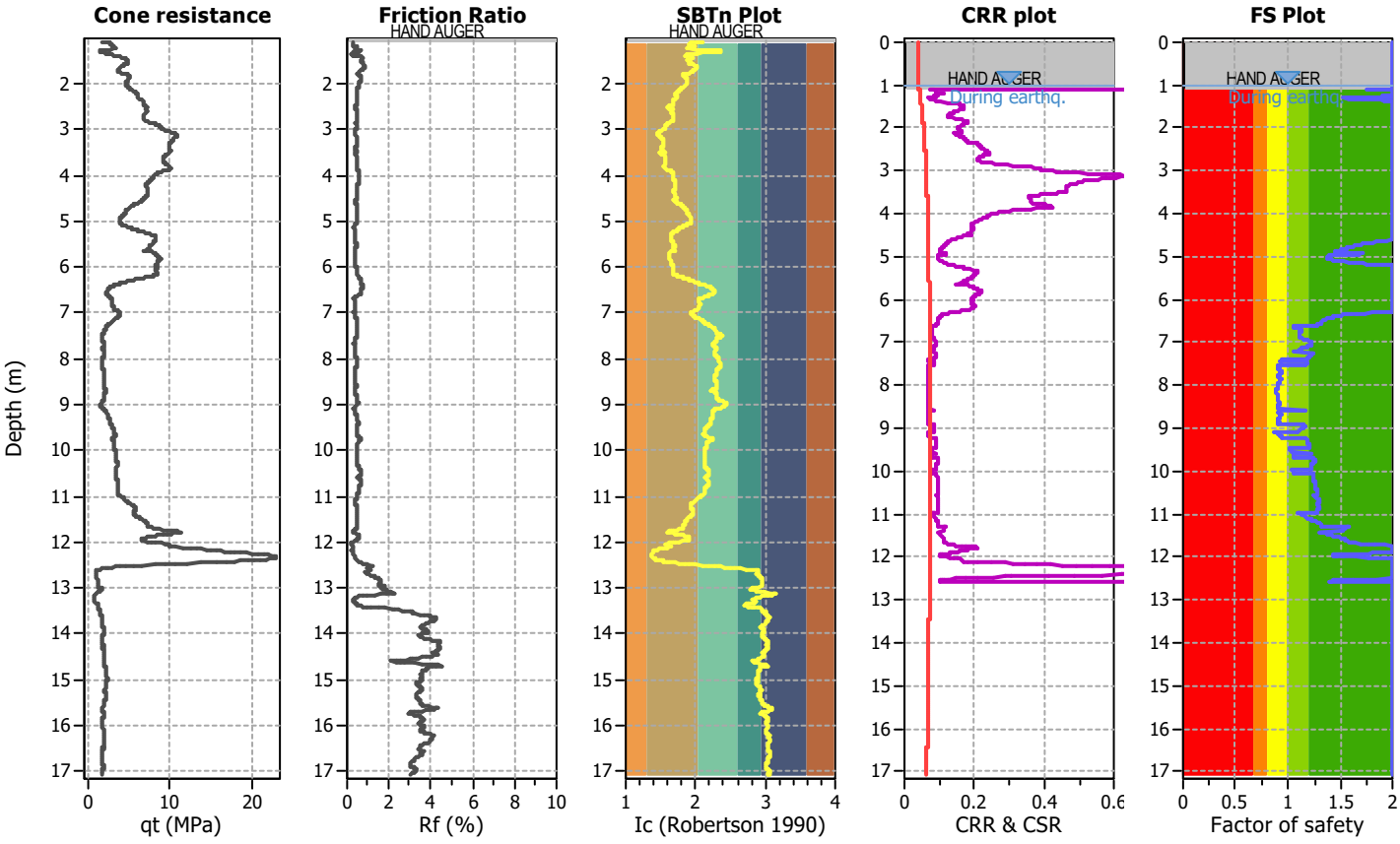
LIQUEFACTION ANALYSIS REPORT

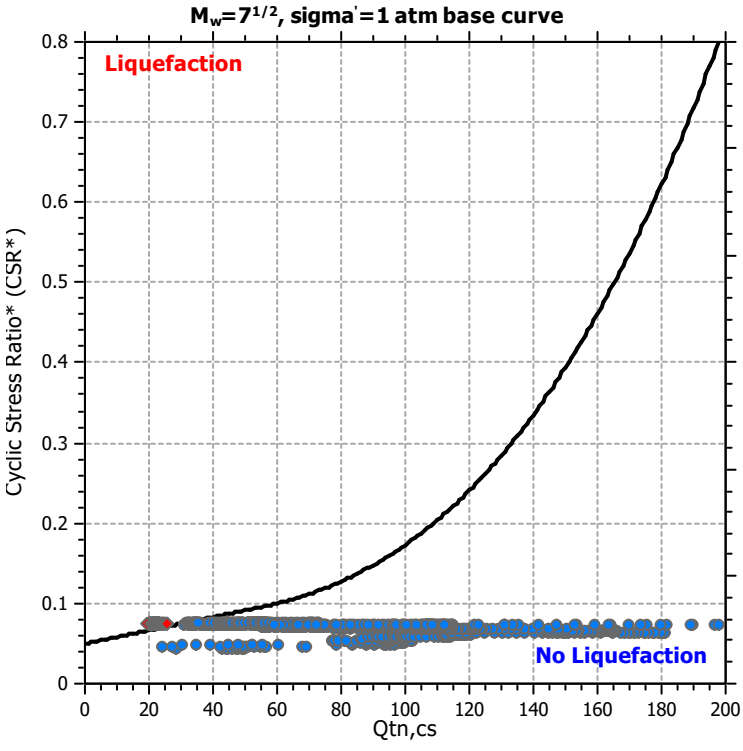
Project title : 711 Hunter Street **Location : Newcastle West**

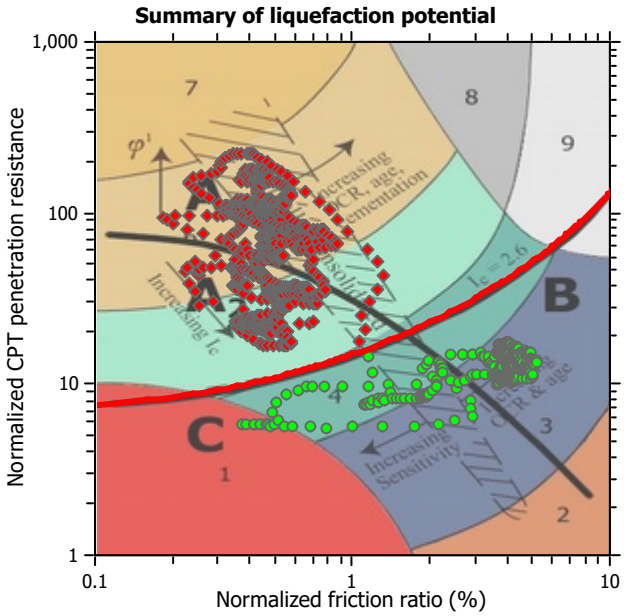
CPT file : DataCPT22-01A

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.11	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

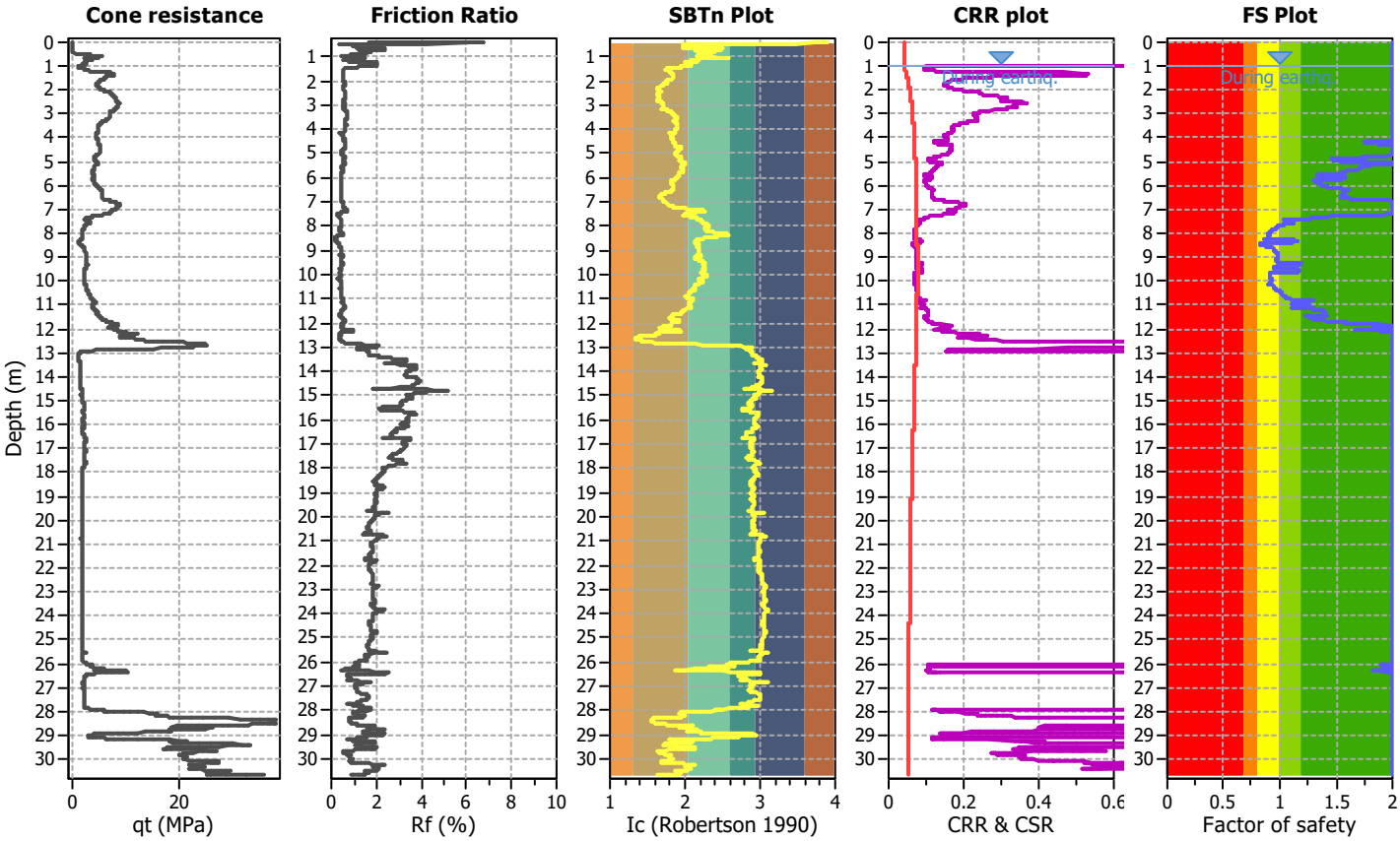
LIQUEFACTION ANALYSIS REPORT

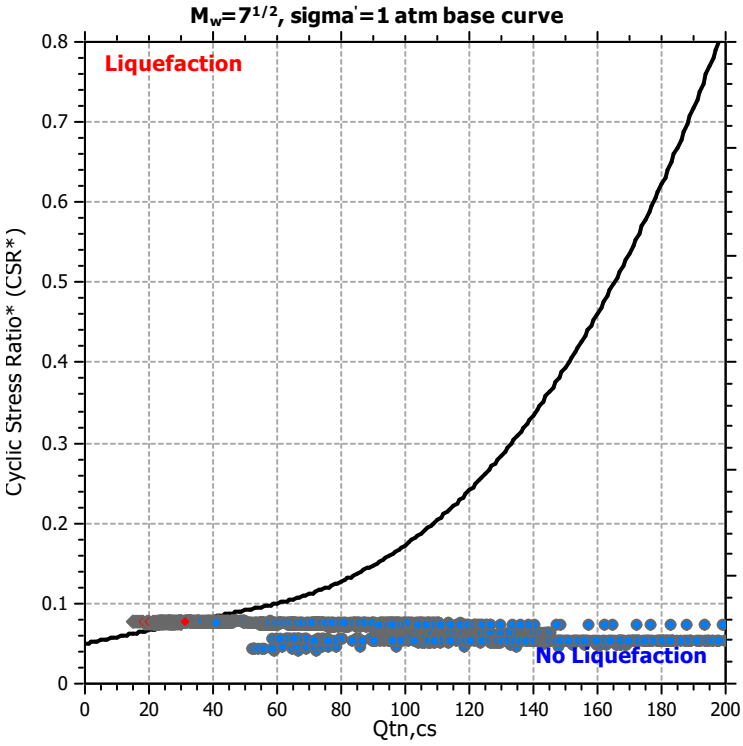
Project title : **Location :**

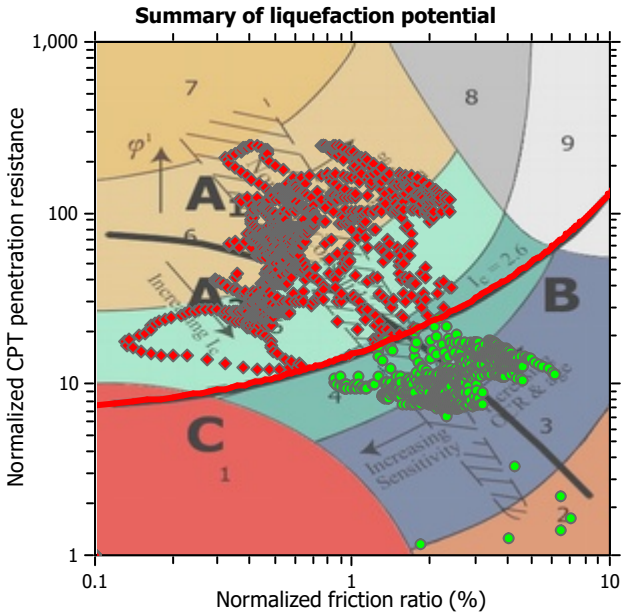
CPT file : CPT01

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.00	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.11	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry