Stage 1 Residential Detailed Development Application Submission

Stage 1 Geotechnical Site Investigation & Groundwater Inflow Assessment Report

The Uniting Church in Australia Property Trust (NSW) for Uniting (NSW.ACT)
(c-/ Midson Group Pty Ltd)

Reference: SYDGE330330AB Rev.1

5 September 2024

STAGE 1 RESIDENTIAL DETAILED DEVELOPMENT APPLICATION SUBMISSION

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EXECUTIVE SUMMARY

Tetra Tech Coffey (Coffey) was engaged by The Uniting Church in Australia Property Trust (NSW) for Uniting (NSW.ACT) (c/- Midson Group Pty Ltd) to prepare this Geotechnical Site Investigation Report to support Stage 1 Residential Detailed Development Application Submission at 171 Wattle Road, Shellharbour City Centre and is legally described at Lot 2 DP1043053 (the “site”).

The first residential stage of an approved Seniors Housing development comprising of 4 buildings, between 4 and 6 storeys in height and containing 152 independent living units, common area uses, 2 levels of basement parking and the construction of a new roadway servicing the development.

A separate Preliminary Site Investigation (contamination) report was also prepared by Coffey. The construction of this project will be done in 2 stages. **This report covers Stage 1 only**, providing a comprehensive overview of the encountered ground conditions, geotechnical model, and recommendations for site preparation, earthworks, and foundation design.

The subsurface investigation revealed that the site predominantly consists of five geotechnical units: topsoil, alluvium, residual soil, and Class III and II sandstone bedrock. Topsoil is a thin layer, typically silty clay with some gravel, ranging from 0.15m to 0.25m in thickness. Below this, alluvium comprises stiff consistency, low to medium plasticity silty clay and clay, encountered at depths of 0.15m to 1.5m. Residual soil, identified as low to medium plasticity, very stiff to hard gravelly clay, was found at depths between 0.75m and 4.75m. Sandstone bedrock, with occasional conglomerate bands was encountered during the investigation, varies from slightly weathered to fresh.

Groundwater was not observed within the borehole and test pit depth during drilling. A standpipe was installed in borehole BH2 within the sandstone bedrock to monitor groundwater levels. The hydraulic conductivity in the bedrock was assessed as less than 1×10^{-8} m/s, indicating low permeability. Consequently, groundwater inflow into the R1 and R3 buildings is expected to be negligible.

Laboratory tests on samples revealed that the alluvium and residual soil have relatively low swell and shrink values, suitable for reuse as fill material. Sandstone materials, though strong, may require additional testing if used for drainage material or rockfill.

For earthworks, it is essential to remove and stockpile topsoil, proof roll subgrade layers, and use granular fill to improve trafficability in clayey subgrades. Engineered fill should be compacted to achieve specific density ratios. For excavation, conventional methods are appropriate for soil units, while hard rock techniques are required for sandstone. Unsupported excavations should adhere to recommended batter slopes, with potential use of retaining walls where necessary. Building foundations can be shallow or pier/pile based, with specified bearing capacities. Pavement design should consider a CBR value of 2.0% for the clayey subgrade, with proper drainage measures to ensure durability. Soil aggressivity testing indicates non-aggressive conditions for concrete and mild-aggressive for buried steel elements.

The geotechnical investigation provides a detailed assessment of subsurface conditions and offers practical recommendations for site preparation, earthworks, and foundation design. It is crucial to consider the variability of subsurface conditions and conduct further investigations if project scope changes or additional details are required.

1. INTRODUCTION

Tetra Tech Coffey Pty Ltd (Coffey) was engaged by The Uniting Church in Australia Property Trust (Uniting) to carry out geotechnical and contamination investigation works in support of the Stage 1 Residential Detailed Development Application Submission for the proposed seniors housing development project situated on Wattle Road in Shellharbour. The Stage 1 investigations were undertaken generally in accordance with our fee proposal (Ref: SYDGE330330AA dated 2 August 2023).

This report presents the results of geotechnical investigation and provide advice and recommendations for the proposed seniors housing development including the followings:

- Site description.
- Investigation procedure and methodology.
- Local geology and encountered ground conditions at borehole and test pit locations.
- Borehole and test pit logs with a location plan.
- Groundwater condition and inflow assessment.
- Earthworks, site preparation and compaction requirement.
- Advice on acceptability of excavated material to be used as fill.
- The engineering properties and parameters of soils/rock for the foundation design and shoring wall design.
- Recommendations on foundation types and foundation design guidelines.
- Recommendations on shoring wall design parameters.
- Recommendations on the shrink swell potential of residual clay and site reactive classification.
- Design CBR values and pavement design.
- Soil aggressivity testing results and advice on concrete/steel exposure classification.

Contamination investigation results are provided in a separate report (Ref: SYDGE330330AC dated 20 November 2023).

2. PROJECT DESCRIPTION

The first residential stage of an approved Seniors Housing development comprising of 4 buildings, between 4 and 6 storeys in height and containing 152 independent living units, common area uses, 2 levels of basement parking and the construction of a new roadway servicing the development.

3. SITE INFORMATION

3.1 SITE DESCRIPTION & LOCALITY

The site is located at 171 Wattle Road, Shellharbour City Centre and is legally described as Lot 2 DP1043053 (the “site”).

The site encompasses an area of 4.263ha, with Stage 1 occupying nearly one-third of the site. It exhibits a predominantly rectangular shape, featuring a curved boundary along Wattle Road. Its southern boundary stretches approximately 107m in width, while the northern boundary measures around 56m wide. The eastern and western boundaries each extend for roughly 430m in length.

The site is bounded by Wattle Road to the east, residential land and a drainage reserve to the north and west, and a residential housing development owned by the NSW Land and Housing Corporation (NSW LHC) to the south.

Figure 1 below illustrates the site boundaries and current surface conditions.

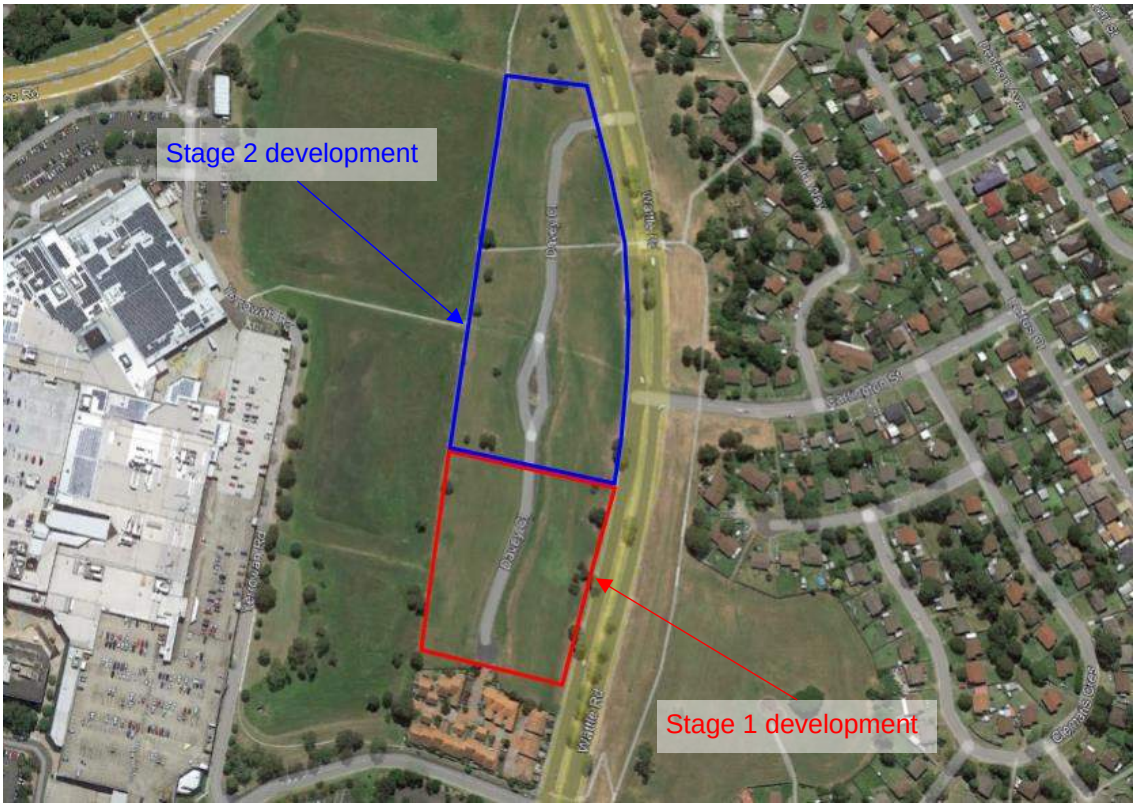


Figure 1: The senior housing development site

3.2 TOPOGRAPHY

The site is sloping down from Wattle Rd towards west, and its currently areas of vegetation with pedestrian paths.

Stage 1 of the development is separated by Davey Cl into two distinct portions. The eastern portion of the Stage 1 site ranges in elevation from approximately RL 43m AHD along Wattle Road to RL 35m AHD, while the western portion of Stage 1 varies from approximately RL 35m AHD to RL 27m AHD.

3.3 PROPOSED DEVELOPMENT

The construction of this project will be done in 2 stages and this report focuses exclusively on Stage 1 only.

Stage 1 will cover an area of approximately 2 ha and will consist of four (4) buildings at the southern end of the site (R1 to R4), landscaped central courtyards between these buildings, basement parking associated with them, the access road coming off Wattle Road and running along the western edge of the site, and associated works across the site and along the Wattle Road frontage.

Stage 2 will cover an area of approximately 2.2 ha and will consist of six (6) buildings at the northern end of the site (R5 to R10), landscaped central courtyards between these buildings, basement parking associated with them, the access road coming off Wattle Road and running along the western edge of the site, and associated works across the site and along the Wattle Road frontage.

3.4 LOCAL GEOLOGY

Reference to the Minview Surface Geological Mapping, indicates that the site is located at the contact between two geological formations, the Broughton formation of Shoalhaven Group and Alluvial Valley Deposits in the west. Broughton formation typically comprises red-brown or green-grey, lithic to feldspathic sandstone (sporadically quartzose) with minor interbedded siltstone and polymictic pebble conglomerate, sporadic shelly fossils, varying degrees of bioturbation. Alluvial Valley Deposits are described as silt, clay, fluvially deposited lithic to quartz-lithic sand, gravel.

Figure 2: Regional geology of site (Minview Surface Geological Mapping)

4. METHOD OF INVESTIGATION

4.1 FIELDWORK

The borehole drilling and test pit excavations were carried out by Coffey on the 4th to 6th of October 2023 and comprising the followings:

- Drilling of six (6) cored boreholes BH1 to BH6 up to max depth of 11.31m below the existing ground surface.
- Excavation of three (3) test pits TP1 to PT3 up to max depth of 2m below the existing ground surface using large diameter augers, for pavement design and construction purposes.
- Installation of one (1) standpipe with datalogger in borehole BH2 for groundwater monitoring and testing.

Boreholes BH1 to BH3 exceeded the target depth of 8m, terminating between 8.84m and 11.31m into the medium to high strength sandstone bedrock. Boreholes BH4 to BH6 were shallower, terminated between 7.22m and 7.79m due to the proposed shallow basement, situated approximately 0.5mto 3m below the existing ground surface at these borehole locations.

The large diameter auger test pit TP1 terminated at a depth of due to auger refusal on sandstone bedrock. Meanwhile, TP2 and TP3 were terminated at target depth of 2m.

Prior to any ground penetration, a Before You Dig Australia (BYDA) request was made for the subject site. Each borehole and test pit location were compared with the BYDA plans and services located by an accredited service locator.

The boreholes were drilled using a track mounted drilling rig. Solid flight augers were used for drilling in soils up to TC bit refusal and continue using HQ rock core drilling methods to a maximum depth of 11.31m. Standard Penetration Tests (SPT) were carried out at selected depths to assess soil strength and to obtain samples for logging and laboratory testing. On completion of drilling, the boreholes without standpipes and test pit holes were backfilled with cuttings and sand.

A Coffey geotechnical engineer was present during fieldwork to identify drilling locations, record test results, log the encountered ground conditions and box the rock cores. The borehole logs and rock core photographs are attached in Appendix B together with Coffey soil and rock description and explanation sheets.

Following completion of fieldwork, selected soil samples were sent to NATA accredited laboratory testing, and the rock cores were sent to our core storage area for point load testing. The Point Load Index Strength test results are included on the attached borehole logs in Appendix B.

4.2 STANDPIPE

A standpipe was installed in BH2 to provide information on the existing groundwater level for basement design. The standpipe was screened over the interval from 1.84m to 7.84m depth and completed with a flush mounted Gatic cover. After the piezometer standpipe was installed, groundwater levels were monitored using a HOBO datalogger for a period of approximately 4 weeks.

4.3 LABORATORY TESTING

On completion of fieldwork, selected soil samples from the boreholes were sent to the NATA accredited laboratory for laboratory testing. Table 1 below provides the testing schedule that Coffey submitted.

Table 1: Geotechnical laboratory testing schedule

Laboratory Testing	Quantities	Method
Moisture Contents	3	AS 1289.2.1.1
Atterberg Limit	2	AS 1289.3.1.1 / 2.1
Linear Shrinkage	2	AS 1289.3.4.1
California Bearing Ratio (CBR)	2	AS 1289.6.1.1
Soil aggressivity suite (pH, Sulphate, Chloride and Resistivity)	3	Inorg-001, Inorg-002 and Inorg-081
U75 undisturbed samples	2	-
Shrink-Swell Index	2	AS 1289.6.7.3
Dry Density/Moisture Content Relation (Standard Compactive Effort)	3	AS 1289.5.1.1
Point Load Strength Index	39	AS 4133.4.1-2007

Additional samples were collected from the investigation locations for the purposes of contamination assessment, which is presented in a separate Coffey Report (Ref: SYDGE330330AC dated 20 November 2023).

5. RESULTS OF INVESTIGATION

5.1 ENCOUNTERED GROUND CONDITIONS

The encountered subsurface ground conditions at the Stage 1 stie were consistent with the published and anticipated geology. During the drilling of boreholes and test pits, the following strata were presented on site:

Topsoil

A thin layer of topsoil was present across the site. Topsoil was encountered in all boreholes and test pits and the thickness ranging from 0.15m to 0.25m. Topsoil typically consists of silty clay with some root fibres and trace fine grained gravel.

Alluvium

Typically, alluvium comprised low to medium plasticity silty clay and clay, and is pale brown, brown and dark brown in colour. Alluvium is generally of stiff consistency and was encountered in all boreholes and test pits, at depths ranging between 0.15m and 1.5m, overlying residual soil.

Residual Soil

Residual soil typically consists of low to medium plasticity gravelly clay of very stiff to hard consistency. Generally, SPT refusal was encountered in this unit. Residual soil was encountered in all boreholes at depths ranging between 0.75m and 4.75m.

Sandstone Bedrock

Sandstone was encountered during the investigation, while occasional bands of conglomerate also making appearances. The encountered sandstone is fine grained, brown, dark brown and red brown in colour, and indistinctly bedded to massive. The weathering profile of sandstone is mainly slightly weathered to fresh.

5.2 GEOTECHNICAL MODEL

For specific information on the encountered subsurface conditions at each borehole location, reference should be made to the attached borehole logs in Attachment B with the accompanying Tetra Tech Coffey Soil and Rock Explanation Sheets, which describe the terms and symbols used in log preparation.

Using the subsurface information from the geotechnical investigation, the encountered ground conditions have been characterised into the geotechnical units presented in Table 2 below. Typical geotechnical cross sections have been created showing the subsurface geotechnical model and the geotechnical unit distribution with depth and elevation. The typical section location plan and the associated geotechnical sections are included in Appendix A.

Table 2: Summary of site geotechnical model

Unit / Material	Description	Typical Unit Thickness (m) (1)	Typical Soil Consistency / Rock Strength
Unit 1 – Topsoil	Silty Clay, low to medium plasticity, with root fibres and trace fine grained gravel.	0.15 – 0.25	-
Unit 2 – Alluvium	Silty Clay, Clayey Silt, low to medium plasticity, brown, dark brown, trace sand and gravel.	0.6 – 1.3	Stiff

Unit / Material	Description	Typical Unit Thickness (m) [1]	Typical Soil Consistency / Rock Strength
Unit 3 – Residual Soil	Gravelly Clay, Clay, low to medium plasticity, brown and red-brown, fine to medium grained gravel.	0.4 – 4.0	Very Stiff to Hard
Unit 4 – Sandstone Class III	Sandstone, highly to slight weathered, typically Class IV Sandstone	0.5 – 4.6	Medium to High Strength
Unit 5 – Sandstone Class II	Sandstone, slightly weathered to fresh, typically Class III /II Sandstone	Unproven	Medium to Very High Strength

Notes:
[1] The unit thicknesses are based on the boreholes and may not represent the stratigraphy or the maximum or minimum depths and thicknesses of stratigraphic units across the entire site.
[2] Rock classified as Sandstone in accordance with Pells et al (1998) "Foundations on Sandstone and Shale in the Sydney region" Australian Geomechanics Journal, Dec 1998.

5.3 GROUNDWATER

Groundwater was not observed within the borehole and test pit depth during drilling. Observation of groundwater levels during rock coring was not possible due to the use of water as drilling fluid.

A standpipe of 8.84m depth, screened from 1.84 to 7.84 m below ground, has been installed in borehole BH2 within the sandstone bedrock to monitor groundwater levels. Details of the standpipe construction are provided in Appendix B.

5.4 LABORATORY TESTING RESULTS

On completion of fieldwork, selected fill samples from the test pits excavation were sent to the NATA accredited laboratory for laboratory testing. A summary of the laboratory testing results is provided in Table 3 to Table 5. The laboratory certificates are included in Appendix C.

Table 3: Moisture content and Atterberg limit testing results

Location	Details			MC (%)	Atterberg Limits and Linear Shrinkage			
	Depth (m)	Unit	Material		LL (%)	PL (%)	PI (%)	LS (%)
BH2	1 – 1.2	Alluvium	Sandy Clayey Silt	23.3	--	--	--	--
BH4	1 – 1.05	Residual	Silty Clay/Gravelly Clay	--	47	21	26	--
BH5	1 – 1.45	Residual	Silty Clay/Gravelly Clay	18.3	42	18	24	8.0
BH6	1 – 1.45	Residual	Silty Clay/Gravelly Clay	26.6	--	--	--	--

Notes: **MC**: Moisture Content, **LL**: Liquid Limit, **PL**: Plastic Limit, **PI**: Plasticity Index, **LS**: Linear Shrinkage.

Table 4: CBR and compaction testing results

Location	Details			CBR and Compaction Testing				
	Depth (m)	Unit	Material	Max Dry Density (t/m^3)	Optimum Moisture Content (%)	Dry Density after Soaking (t/m^3)	Specimen Swell (%)	CBR Value (%)
BH1	0.2 – 0.8	Alluvium	Silty Clay	1.59	24.2	--	--	--
BH3	0.1 – 1.0	Alluvium	Silty Sandy Clay	1.49	26.6	--	--	--

Location	Details			CBR and Compaction Testing				
	Depth (m)	Unit	Material	Max Dry Density (t/m^3)	Optimum Moisture Content (%)	Dry Density after Soaking (t/m^3)	Specimen Swell (%)	CBR Value (%)
BH6	0.2 – 1.0	Alluvium	Silty Clay	1.64	21.9	--	--	---
TP2	0.2 – 1.0	Alluvium	Silty Clay	1.60	22.8	1.55	3.4	2.5
TP3	0.2 – 1.0	Alluvium	Silty Clay	1.63	21.9	1.58	2.6	3.0

Table 5: Shrink-Swell Index testing results

Location	Details			Swell Test			Shrink Test		Shrink-Swell Index
	Depth (m)	Unit	Material	Esw (%)	MC before Test (%)	MC after Test (%)	Esh (%)	MC (%)	Iss (%)
BH2	1 – 1.2	Alluvium	Sandy Clayey Silt	0.3	23.3	28.9	2.7	22.4	1.6
BH6	1 – 1.45	Residual	Silty Clay/Gravelly Clay	0.5	26.6	26.1	1.0	24.3	0.7

Notes: **Esw**: Swell on Saturation, **MC**: Moisture Content, **Esh**: Shrinkage on Drying, **Iss**: percent vertical strain per pF change in total suction.

6. GROUNDWATER INFLOW ASSESSMENT

6.1 GROUNDWATER LEVELS

Groundwater levels were manually measured at BH2 on 3 November 2023 with the results shown in Table 6.

Continuous groundwater level monitoring has been undertaken at BH2 since 6 October using an electronic data logger. The results are shown in Figure 3.

In early October, the stabilisation of groundwater levels at BH2 following borehole drilling can be seen, with levels falling from 35.6 mAHD to approximately 31 mAHD. The higher levels were as a result of fluids in the borehole following drilling. Between 15 October and 3 November, groundwater levels at BH2 were relatively stable at between 31.0 and 31.2 mAHD.

Table 6: Manual groundwater level measurements

Location	Date and time	Depth to groundwater (m below ground)	Groundwater level (m AHD)
BH2	3 November 2023 8:46am	7.86	31.14

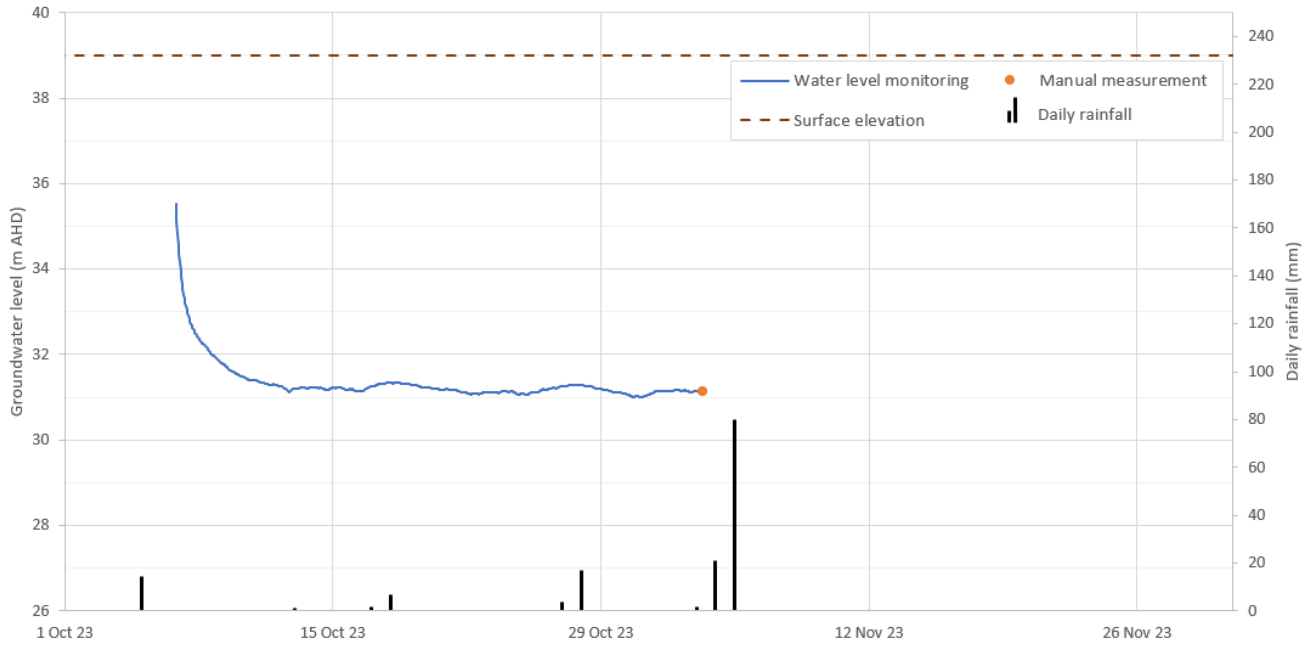


Figure 3: Groundwater level monitoring at BH2

6.2 HYDRAULIC CONDUCTIVITY

During the site visit on 3 November 2023, a rising head test was carried out at BH2. The water level in the well was lowered from 7.86 m below ground to 8.54 m below ground via the use of a pump. A Coffey field engineer then monitored the recovery of water levels using an electronic data logger and a manual dip meter. Water levels had recovered 5 mm in the first hour of the test and less than 5 mm in the second hour. These results are assessed to indicate a hydraulic conductivity of less than 1 x 10^{-8} m/s in the bedrock surrounding the wells screen at BH2.

An assessment of the falling groundwater levels in BH2 between 6 October and 12 October according to the method of Hvorslev (1951) was completed. The assessed hydraulic conductivity was 1.5 x 10^{-9} m/s. Due to the presence of mud in the drilling fluid, this result may be lower than the hydraulic conductivity of the aquifer due to a possible reduction of permeability around the well due to the mud. Considering this point, the results are assessed to indicate a hydraulic conductivity of less than 1 x 10^{-8} m/s in the bedrock surrounding the well screen at BH2.

Table 7: Assessed hydraulic conductivity from rising/falling head tests

Location	Date	Test type	Assessed hydraulic conductivity (m/s)
BH2	3 November 2023	Rising head	Less than 1 x 10^{-8}
BH2	6 to 12 October 2023	Falling head	Less than 1 x 10^{-8}

6.3 INFLOW ASSESSMENT

Groundwater levels observed at BH2 were between 31 and 31.5 mAHD between 15 October and 3 November 2023. The lowest floor level elevation for the R1 and R3 buildings, located near BH2, is 36.7 mAHD.

The estimated groundwater inflow to R1 and R3 buildings is assessed to be negligible based on current observations of groundwater levels at BH2, as it is unlikely that the excavation for the R1 and R3 buildings will intersect groundwater.

The groundwater inflow assessment will be revised following results of the Stage 2 site investigations which will provide groundwater level observations at two additional standpipes to be constructed at lower side of the site. Coffey also recommends further groundwater monitoring to be undertaken in the constructed groundwater well in BH2.

7. DISCUSSION AND RECOMMENDATIONS

7.1 EARTHWORKS

7.1.1 Site Preparation

It is expected that Unit 2 Alluvium below the existing ground surface would likely be encountered subgrade over the Stage 1 site. General guidelines for site preparation are as follows:

- Prior to the construction of subgrade layers (by engineered fill), the existing topsoil should be removed and stockpiled separately for appropriate reuse.
- The exposed subgrade material should be proof rolled with at least 4 passes of a non-vibratory smooth drum roller of minimum 12 tonne dead weight.
- Any soft or heaving areas should be excavated and replaced with engineered fill.
- An experienced earthwork practitioner should observe the proof rolling to detect soft, wet or heaving zones. Where these zones are encountered, the affected area should be improved by appropriate methods, such as excavation of the affected soil and replacement with Engineered Fill.
- It is expected that trafficability in clayey material (Units 2 and 3) for wheeled vehicles can be difficult during and following a rainfall event due to surface heaving and/or rutting. Granular fill is recommended for area underlain by clayey subgrade to improve trafficability.

7.1.2 Engineering Fill Compaction

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

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

Earthworks construction should be constructed under Level 1 geotechnical inspection and testing at defined in AS 3798-2007 (Guidelines on earthworks for commercial and residual development).

7.1.3 Re-use of Site-won Materials

Unit 1 (Topsoil) can be stockpiled and re-used as landscaping materials.

For the re-use of site-won materials, Unit 2 (Alluvium – stiff silty clay) and Unit 3 (Residual Soil – very stiff to hard gravelly clay), the Shrink-Swell testing results, as presented in Table 5, reveals the following:

- The swell on saturation values for both units are relatively low (0.3% for Unit 2 and 0.5% for Unit 3), which indicates that both units are not highly expansive clay.
- The shrinkage on drying values is also relatively low (2.7% for Unit 2 and 1% for Unit 3), which indicating moderate shrinkage potential.
- The moisture content values before and after testing showed that Unit 2 has a higher moisture content after testing (28.9%) compared to before testing (23.3%). While the moisture content of Unit 3 remains relatively consistent (26.1% after testing and 26.6% before testing). Unit 2 may be more sensitive to moisture changes.
- The shrink-swell index provides a measure of the soil's potential for volume change due to moisture variations. Unit 2 has a higher shrink-swell index (1.6%) compared to Unit 3 (0.7%). Although Unit 2 has a higher index, it is still relatively low and suggesting moderate volume change potential.

In summary, the laboratory testing results show that both Unit 2 and Unit 3 exhibit relatively low swell and shrink values (i.e., estimated 20mm to 40mm swelling over 2m thick filling), indicating that they are not highly expansive and reactive soils. Consequently, they are deemed suitable for re-use as general fill materials.

Unit 4 (Class III Sandstone) and Unit 5 (Class II Sandstone) should meet the material criteria for most of the backfill materials in accordance with RMS Specifications R44 and B30, except for drainage and rockfill materials, where a maximum 35% of wet/dry strength variation criteria is required. Moist of sandstone would be unlikely to meet this wet/dry strength variation criteria. Additional wet/dry strength variation testing and material grading management/control are required should Unit 4 and Unit 5 sandstone is to be used as drainage material or rockfill.

7.2 EXCAVATION CONDITIONS

It is understood that the proposed 1 level basement carparking is between approximate 3m depth (i.e., at building R4 location) and 8m depth (i.e., at building R1 location) below the existing ground surface level. Excavation will penetrate through Unit 1 to Unit 5.

Excavation in Unit 1 to Unit 3 should be practicable using conventional plant such as tracked excavator with toothed bucket. For excavation in Unit 4 and Unit 5, hard rock excavation techniques such as large dozers fitted with rippers, or large excavators fitted with rock saws, rock grinders and rock hammers should be used. The use of hard rock excavation techniques will cause vibrations that could damage vibration sensitive structures, infrastructure and underground services. Assessment of the potential impacts of excavation induced vibrations should be considered as part of the detailed design and excavation planning.

7.3 UNSUPPORTED EXCAVATIONS

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

Table 8 below provides a summary of the recommended batter slopes for unsupported excavation up to 3m depth and above groundwater table. It should be noted that the proposed batters in rock are subject to

assessment by a geotechnical engineer during construction. If adverse joints or other defects are present, flatter batters or slope stabilisation may be required.

Table 8: Recommended unsupported excavation batter

Unit / Material	Maximum Temporary Batter (1)	Maximum Permanent Batter
Unit 2 – Alluvium	1.5H:1V	3H:1V
Unit 3 – Residual Soil	1H:1V	2H:1V
Unit 4 – Sandstone Class III	Vertical (2)	Vertical (2)
Unit 5 – Sandstone Class II	Vertical (3)	Vertical (3)

Note: (1) Up to 3 months maximum; (2) Rock bolts or shotcrete be required to stabilise rock wedges or blocks formed by unfavourably oriented defects. (3) Random rock bolts may be required subject to rock cut face inspection by engineering geologist.

7.4 RETAINING WALL DESIGN

Where there is insufficient room to form temporary batters or adjacent to sensitive structures, then a retention system will be required which could be incorporated into the permanent structure.

Excavation in soil can be battered (as suggested in Table 8) where shallow soil profile is encountered. Where deep soil profile is encountered (i.e., in the vicinity of borehole BH6 location), sheet pile walls or soldier pile walls with infill panels (usually shotcrete or precast concrete panels) can be used to retain Units 1 to 3. Excavation in Unit 4 can be vertical with rock bolts or shotcrete due to adverse joints or defects were presented. Excavation in Unit 5 can be unsupported with localised rock bolts subject to rock cut face inspection by experienced engineering geologist.

Table 9 presents recommended design parameters for the design of retaining wall where there is a level retained ground surface. Retaining wall analyses will need to consider surcharges, footing loads from adjacent structures and hydrostatic pressure.

Table 9: Recommended retaining wall design parameters

Unit	ɣ (kN/m^3)	S_u (kPa)	c' (kPa)	ϕ' (°)	E_u (MPa)	E' (MPa)	K_a	K_p	K_o	*v*	Ultimate Achor Bond Stress (kPa)
Unit 2 – Alluvium (Stiff)	19	50	5	27	15	12	0.38	2.66	0.5	0.3	50
Unit 3 – Residual Soil (Very Stiff to Hard)	20	150	8	28	30	25	0.36	2.77	0.5	0.3	100
Unit 4 – Sandstone Class III	24	-	300	38	-	1000	-	-	-	0.25	1000
Unit 5 – Sandstone Class II	24	-	500	40	-	2000	-	-	-	0.2	2000

Notes: **ɣ** = bulk unit weight, **S_u** = undrained shear strength, **c'** = drained cohesion, **ϕ'** is drained friction angle, **E_u** = undrained Young's modulus, **E'** = drained Young's modulus, K_a = coefficient of active earth pressure, **K_p** = passive earth pressure, **K_o** = initial horizontal stress ratio, horizontal stress in high strength sandstone is relatively high. However, it would be relieved immediately upon excavation resulted in horizontal movement of the rock cut face. Based on our previous experience, horizontal movement rate of 1mm per metre excavation depth in sandstone may be expected.

If temporary anchors are required, they should be designed for an ultimate bond stress provided in Table 9 and to be proof loaded to at least 1.5 times their design working load. Anchor designs should be based on

allowing effective bonding to be developed behind the 'active zone' which is determined by drawing a line at 45° from the base of the retaining wall intersecting the ground surface behind the excavated face.

7.5 BUILDING FOUNDATIONS

It is expected that bulk excavation will expose Unit 3 to Unit 5 across the site. We consider that shallow or pier/pile foundations may be suitable for this site.

Shallow foundations such as pad or strip footings maybe founded in the very stiff to hard residual clay (Unit 3) or Sandstone bedrock (Units 4 or 5). An allowable bearing capacity of 200kPa and 1500kPa can be adopted for shallow footings founded in Unit 3 (the very stiff to hard residual clay) or in the Unit 4 (Class III Sandstone) respectively at or below 1m depth below existing ground surface. Please noted that Unit 3 may be softened due to exposure to moisture or water during excavation. It is recommended that the excavated foundation subgrade be bearing capacity inspected and be protected from being softening asap by applying a blinding layer.

The recommended geotechnical parameters for pier of pile foundation (such as driven pile, bored pile or continuous flight auger (CFA) piles) design are provided in Table 10. These recommended design parameters are based on Sydney Rock Classification by Pells et al (1998).

Table 10: Recommended piled foundation design parameters

Unit	Working Stress Design Values		Limit State Design Values		Elastic Modulus (MPa)
	Allowable End Bearing [1] (MPa)	Allowable Shaft Adhesion (kPa)	Ultimate End Bearing [1] (MPa)	Ultimate Shaft Adhesion [2] (kPa)	
Unit 3 – Residual Soil (Very Stiff to Hard)	0.3	30	0.9	75	25
Unit 4 – Sandstone Class III	3.8	400	20	1000	1000
Unit 5 – Sandstone Class II	8	800	80	2000	2000

Notes:
[1] Bearing capacity values assume a minimum embedment depth of at least 0.5m into the relevant bearing stratum or one pile diameter, whichever is deeper.
[2] Shaft adhesion assumes a rough socket (at least grooves of depth 1mm to 4mm and width greater than 5mm at spacing of 50mm to 200mm).

For limit state design of piles, the design ultimate geotechnical pile capacity is derived by applying a geotechnical strength reduction factor (Φg) to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 8. In accordance with AS2159- 2009, Φg is dependent on an Average Risk Rating (ARR) which considers various geotechnical uncertainties, foundation system redundancy, construction supervision, quantity and type of pile testing. Based on the available information, we suggest Φg of 0.50 could be adopted for pile design. For uplift loads a Φg of 0.45 should be adopted and shaft adhesion values presented in table above should be multiplied by 0.7. The final Φg should be reviewed by Coffey at the detailed design stage.

The use of limit state design also requires assessment of the serviceability performance of the foundation system. This should be carried out by an experienced geotechnical professional using well-established and soundly based methods. The elastic modulus value given in Table 8 may be adopted but it should be noted that the accuracy of settlement prediction is dependent on construction methods as well as material stiffness, both of which can involve degree of uncertainty.

All excavated subgrade and piled foundations should be inspected by an experienced geotechnical engineer to confirm that a suitable founding stratum has been reached.

Pile capacity assessment should be carried out to determine appropriate pile diameter and socket length considering the encountered ground condition.

7.6 DESIGN CBR VALUES AND PAVEMENT DESIGN

It is expected that new pavement along the western boundary of the Stage 1 site will be constructed at, or near existing ground surface level. Therefore, it is likely that the pavement subgrade will be in Unit 2 (Silty Clay).

CBR testing of soil samples collected from Unit 2 (Silty Clay) at TP2 and TP3 locations (0.2 to 1.0m depth) indicated soaked CBR values of 2.5% and 3%. We recommended a CBR values of 2.0% be adopted for pavement design on Unit 2 clayey subgrade.

Satisfactory performance of pavements will require careful attention to surface and subsurface drainage to prevent the subgrade soil from wetting up. Site landscaping should be designed to prevent the ponding of water adjacent to pavements and also structures. Sub-surface drainage should be provided.

7.7 SOIL AGGRESSIVITY

The soil aggressivity test results are provided in Table x and compared with the exposure classifications defined in Australian Standard AS2159-2009 Piling – 'Design and Installation'. The chemical test results indicated "***Non-aggressive***" to "***Mild-aggressive***" ground conditions to buried concrete element and "***Non-aggressive***" ground conditions to buried steel elements.

Table 11: Soil Aggressivity testing results

Location	Details		Soil Aggressivity			Corrosion Classification	
	Depth (m)	Material	pH	Sulphate as SO_4 (mg/kg)	Chloride (mg/kg)	Exposure – Concrete Piles	Exposure – Steel Piles
BH1	0.8 – 1.0	Silty Clay	7.8	20	<50	Non-aggressive	Non-aggressive
BH2	0.9 – 1.0	Silty Clay	7.8	60	390	Non-aggressive	Non-aggressive
TP2	1.8 – 2.0	Gravelly Clay	5.3	190	280	Mild-aggressive	Non-aggressive

7.8 SITE CLASSIFICATION

Soil classification testing has been conducted for clayey soil in boreholes BH4 and BH5. Additional shrink-swell testing has been also carried out in boreholes BH2 and BH6. The testing results are summarised in Table 3 and Table 5. Coffey recommends adopting a shrink-swell index of 1% to 2% for the Stage 1 site. The estimated characteristic ground surface movement is approximately between 20mm and 40mm, which is corresponding with site Class S (Slightly Reactive) to Class M (Moderately Reactive) in accordance with AS 2870.

8. CLOSURE

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

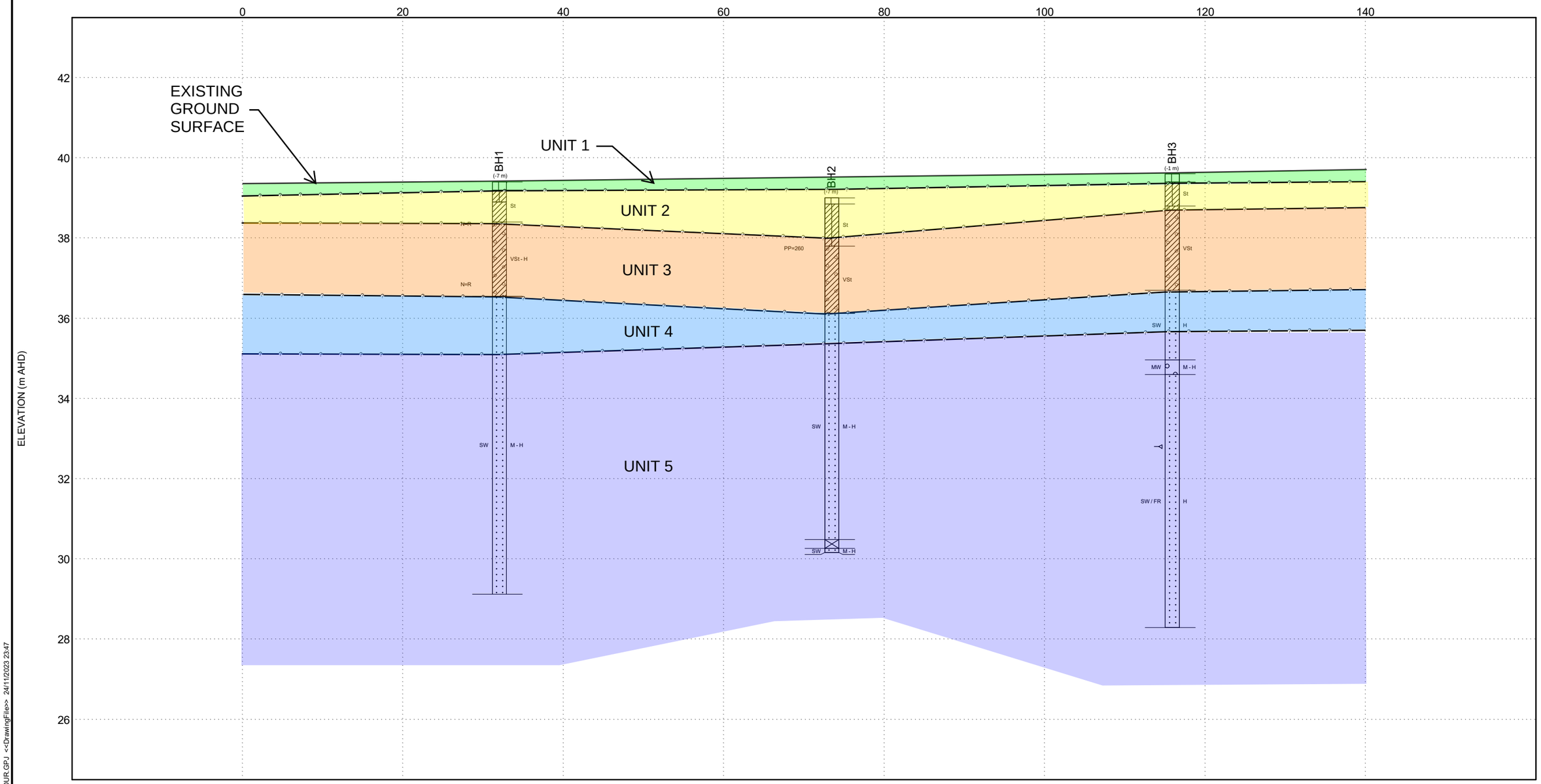
N

LEGEND

Test Pit

Borehole

drawn	IG	TETRA TECH COFFEY	client:	Midson Group Pty Ltd / The Uniting Church in Australia Property Trust
approved	VN		project:	Shellharbour ILUs
date	31/10/2023		title:	Borehole and Test Pit Location Plan
scale	NTC		project no: SYDGE330330	figure no: 1
original size	A4			



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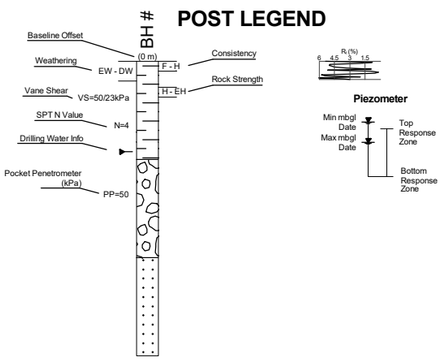

MATERIAL GRAPHIC

- TOPSOIL
- GRAVELLY CLAY
- CONGLOMERATE
- SILTY CLAY
- SANDSTONE
- CLAY
- NO CORE

H 1:500
0 5 10 15 20 25m
V 1:100
0 1 2 3 4 5m
Coord.System: GDA2020 MGA Height Datum: AHD

PROJECT UNIT

- UNIT 1 - TOPSOIL
- UNIT 2 - ALLUVIUM (SILTY CLAY - STIFF)
- UNIT 3 - RESIDUAL SOIL (GRAVELLY CLAY - VERY STIFF TO HARD)
- UNIT 4 - SANDSTONE (CLASS III)
- UNIT 5 - SANDSTONE (CLASS II)

drawn	IG
approved	VN
date	**24/11/2023**
scale	**H 1:500 V 1:100**
original size	**A3**

TETRA TECH COFFEY

client: Midson Group Pty Ltd

project: Shellharbour ILUs

title: **GEOTECHNICAL SECTION A-A'**

project no: 754-SYDGE330330 | fig no: 2 | rev:

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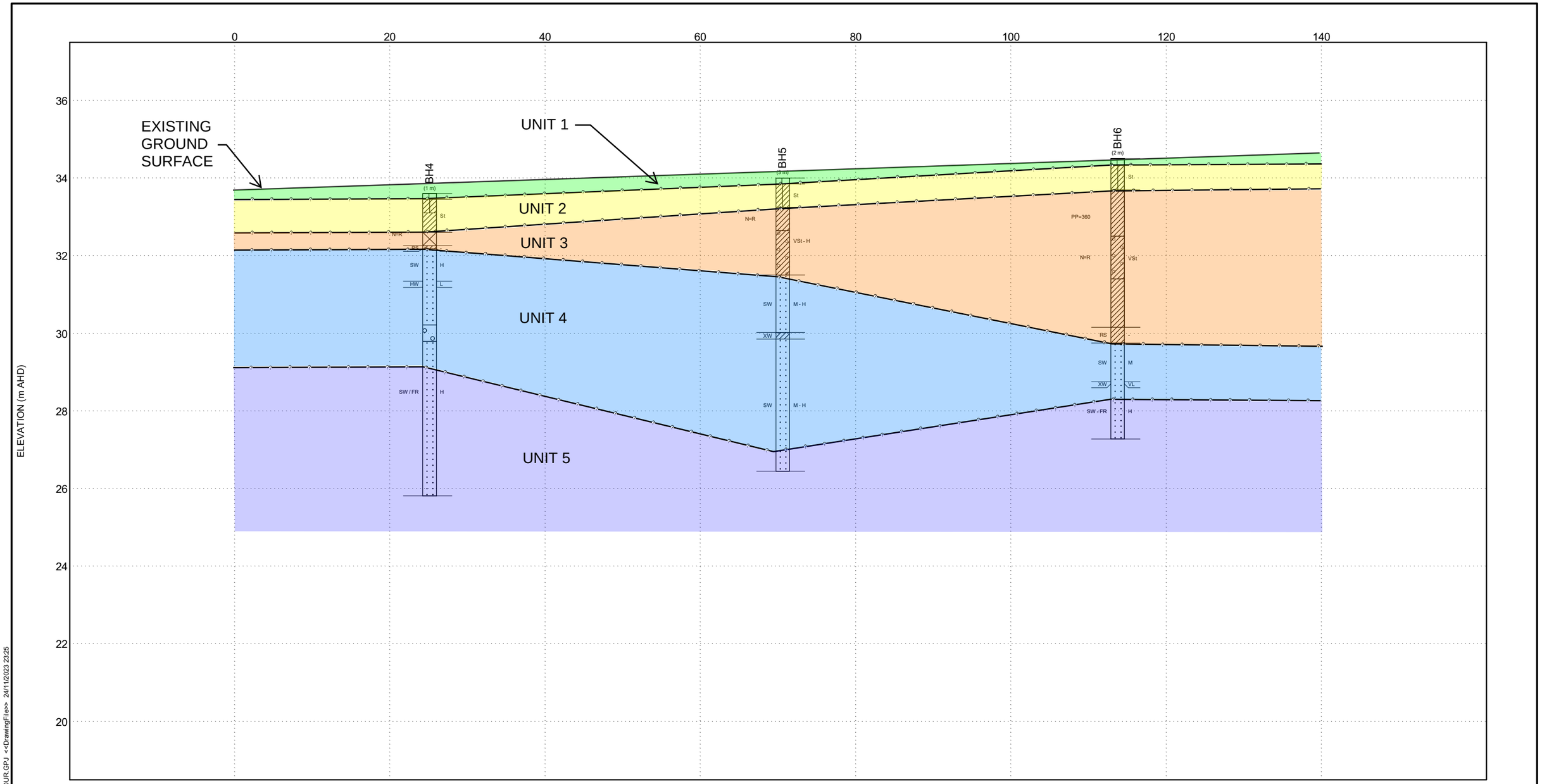

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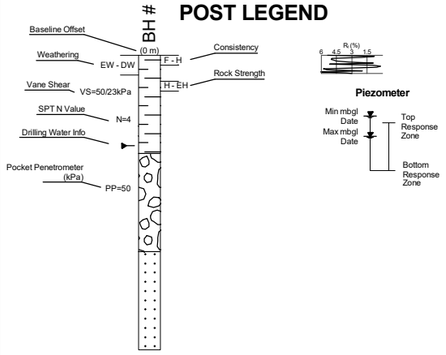

MATERIAL GRAPHIC

- TOPSOIL
- NO CORE
- CONGLOMERATE
- SILTY CLAY
- GRAVELLY CLAY
- SANDY CLAY
- CLAY
- SANDSTONE

PROJECT UNIT

- UNIT 1 - TOPSOIL
- UNIT 2 - ALLUVIUM (SILTY CLAY - STIFF)
- UNIT 3 - RESIDUAL SOIL (GRAVELLY CLAY - VERY STIFF TO HARD)
- UNIT 4 - SANDSTONE (CLASS III)
- UNIT 5 - SANDSTONE (CLASS II)

H 1:500
0 5 10 15 20 25m
V 1:100
0 1 2 3 4 5m
Coord.System: GDA2020 MGA Height Datum: AHD

drawn	IG
approved	VN
date	**24/11/2023**
scale	**H 1:500 V 1:100**
original size	**A3**

TETRA TECH COFFEY

client: Midson Group Pty Ltd

project: Shellharbour ILUs

title: **GEOTECHNICAL SECTION B-B'**

project no: 754-SYDGE330330 | fig no: 3 | rev:

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WATTLE RD

ELEVATION (m AHD)

EXISTING GROUND SURFACE

EXISTING DAVEY CL

UNIT 1

UNIT 2

UNIT 3

UNIT 4

UNIT 5

TP2 (-3.1 m)

BH5 (-19 m)

BH2 (-28 m)

POST LEGEND

Baseline Offset (0 m)
Weathering EW - DW F - H H - EH Consistency Rock Strength
Vane Shear VS=50/23kPa
SPT N Value N=4
Drilling Water Info
Pocket Penetrometer (kPa) PP=50
BH #
R (%) 6 4.5 3 1.5
Piezometer
Min mbgl Date
Max mbgl Date
Top Response Zone
Bottom Response Zone

MATERIAL GRAPHIC

TOPSOIL
SILTY CLAY
GRAVELLY CLAY
SANDSTONE
NO CORE
CLAY
SANDY CLAY

PROJECT UNIT

UNIT 1 - TOPSOIL
UNIT 2 - ALLUVIUM (SILTY CLAY - STIFF)
UNIT 3 - RESIDUAL SOIL (GRAVELLY CLAY - VERY STIFF TO HARD)
UNIT 4 - SANDSTONE (CLASS III)
UNIT 5 - SANDSTONE (CLASS II)

H 1:350
0 4 8 12 16 20m
V 1:150
0 1 2 3 4 5m
Coord.System: GDA2020 MGA Height Datum: AHD

drawn	IG
approved	VN
date	**24/11/2023**
scale	**H 1:350 V 1:150**
original size	**A3**

TETRA TECH COFFEY

client: Midson Group Pty Ltd
project: Shellharbour ILUs
title: **GEOTECHNICAL SECTION C-C'**
project no: 754-SYDGE330330 fig no: 4 rev:

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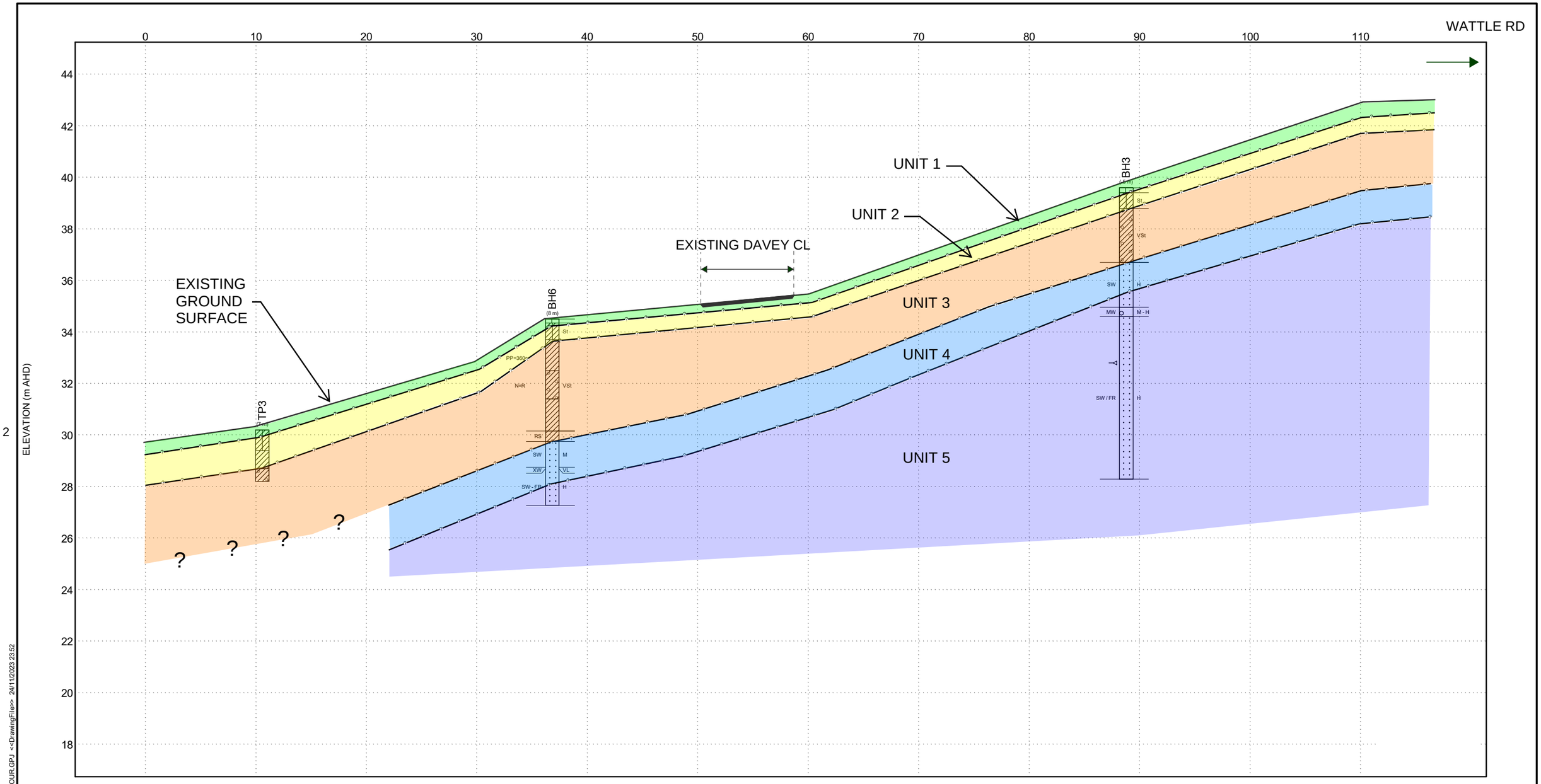

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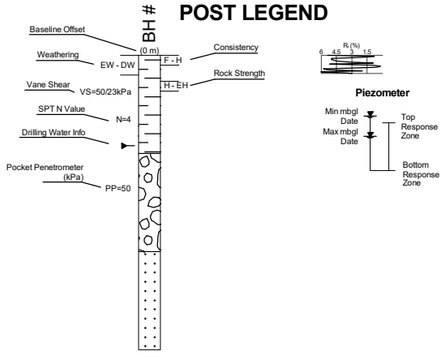

MATERIAL GRAPHIC

- TOPSOIL
- SILTY CLAY
- GRAVELLY CLAY
- SANDSTONE
- CONGLOMERATE
- CLAY

PROJECT UNIT

- UNIT 1 - TOPSOIL
- UNIT 2 - ALLUVIUM (SILTY CLAY - STIFF)
- UNIT 3 - RESIDUAL SOIL (GRAVELLY CLAY - VERY STIFF TO HARD)
- UNIT 4 - SANDSTONE (CLASS III)
- UNIT 5 - SANDSTONE (CLASS II)

H 1:350
0 4 8 12 16 20m
V 1:150
0 1 2 3 4 5m
Coord.System: GDA2020 MGA Height Datum: AHD

drawn	IG
approved	VN
date	**24/11/2023**
scale	**H 1:350 V 1:150**
original size	**A3**

TETRA TECH COFFEY

client: Midson Group Pty Ltd

project: Shellharbour ILUs

title: **GEOTECHNICAL SECTION D-D'**

project no: 754-SYDGE330330 | fig no: 5 | rev:

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APPENDIX B: ENGINEERING BOREHOLE AND TEST PIT LOGS

SOIL DESCRIPTION EXPLANATION SHEET

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 disaggregated 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 AS 1726:2017 as shown in the table on Sheet 2.

PARTICLE SIZE DEFINITIONS

Components	Subdivision	Size (mm)
Boulders Cobbles		>200 63 - 200
Gravel	Coarse Medium Fine	19 - 63 6.7 - 19 2.36 - 6.7
Sand	Coarse Medium Fine	0.6 - 2.36 0.210 - 0.6 0.075 - 0.21
Silt Clay		0.002 – 0.075 < 0.002

MOISTURE CONDITION

Coarse Grained Soil

Dry (D)	Non-cohesive and free-running
Moist (M)	Soil feels cool, darked in colour. Soil tends to stick together.
Wet (W)	As for moist, with free water forming when handled.

Fine Grained Soil

Moist, dry of plastic limit ($w<W_P$)	Hard and friable or powdery
Moist, near plastic limit ($w\approx W_P$)	Can be moulded at a moisture content approximately equal to the plastic limit.
Moist, wet of plastic limit ($w>W_P$)	Soils usually weakened and free water forms on hands when handling.
Wet, near liquid limit ($w\approx W_L$)	Near liquid limit.
Wet, wet of liquid limit ($w>W_L$)	Wet of liquid limit.

CONSISTENCY OF COHESIVE SOILS

Term (Abbreviation)	Indicative undrained shear strength s_u (kPa)	Field guide
Very Soft (VS)	<12	Soil exudes between fingers when squeezed in hand.
Soft (S)	12 – 25	Soil can be moulded by light finger pressure.
Firm (F)	25 – 50	Soil can be moulded by strong finger pressure.
Stiff (St)	50 – 100	Soil cannot be moulded by fingers.
Very Stiff (VSt)	100 – 200	Soil can be indented by thumb nail.
Hard (H)	>200	Soil can be indented with difficulty by thumb nail.
Friable (Fb)	–	Soil can be easily crumbled or broken into small pieces by hand.

RELATIVE DENSITY OF NON-COHESIVE SOILS

Term (Abbreviation)	Density index (%)
Very Loose (VL)	Less than 15
Loose (L)	15 – 35
Medium Dense (MD)	35 – 65
Dense (D)	65 – 85
Very Dense (VD)	Greater than 85

MINOR COMPONENTS

Term	Assessment Guide	Proportion of minor component in:
Trace	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: Fines - <5%, Accessory coarse fraction - <15% Fine grained soils: sand/gravel <15%
With	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: Fines - 5 to 12%, Accessory coarse fraction – 15 to 30% Fine grained soils: sand/gravel 15 to 30%

SOIL STRUCTURE AND CEMENTATION

Zoning		Cementation	
Layer	Zone is continuous across exposure or sample.	Weakly cemented	Easily disaggregated by hand in air or water.
Lense	Discontinuous layer of different material, with lenticular shape.	Moderately cemented	Effort is required to disaggregate the soil by hand in air or water.
Pocket	Irregular inclusion of different material.		

GEOLOGICAL ORIGIN

Residual soil	Structure and fabric of parent rock not visible.
Extremely weathered material	Structure and/or fabric of parent rock is visible.
Alluvial soil	Deposited by streams and rivers.
Estuarine soil	Deposited in coastal estuaries, including sediments carried by inflowing rivers and streams, or tidal currents.
Marine soil	Deposited in a marine environment
Lacustrine soil	Deposited in freshwater lakes
Aeolian soil	Carried and deposited by wind
Colluvial soil	Deposited on slopes (transported downslope by gravity, with or without assistance of water).
Topsoil	Mantle of surface or near surface material, often defined by high levels of organic material.
Fill	Any material which has been placed by anthropogenic processes. Fill may be significantly more variable between tested locations than naturally occurring soils.

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 63 mm and basing fractions on estimated mass)							GROUP SYMBOL	SOIL NAME
COARSE GRAINED SOIL: More than 65% 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)	GRAVEL: More than half of coarse fraction is larger than 2.36 mm	CLEAN GRAVEL (Fines less than 5%)	Wide range in grain size and substantial amounts of all intermediate particle sizes, not enough fines to bind coarse grains, no dry strength.			GW	GRAVEL
				Predominantly one size or a range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength.			GP	GRAVEL
			GRAVEL with FINES (Fines greater than 12%)	'Dirty' materials with excess of non-plastic fines (for identification procedures see ML below).			GM	Silty GRAVEL
				'Dirty' materials with excess of plastic fines (for identification procedures see CL below).			GC	Clayey GRAVEL
		SAND: More than half of coarse fraction is smaller than 2.36	CLEAN SAND (Fines less than 5%)	Wide range in grain sizes and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength.			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength.			SP	SAND
			SAND with FINES (Fines greater than 12%)	'Dirty' materials with excess of non-plastic fines (for identification procedures see ML below).			SM	Silty SAND
				'Dirty' materials with excess of plastic fines (for identification procedures see CL below).			SC	Clayey SAND
FINE GRAINED SOIL: More than 35% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm					
		SILT & CLAY: Liquid limit less	DRY STRENGTH	DILATANCY	TOUGHNESS			
			None to low	Slow to rapid	Low		ML	SILT
			Medium to high	None to slow	Medium		CL, CI	CLAY
			Low to medium	Slow	Low		OL	Organic SILT
		SILT & CLAY: Liquid limit	Low to medium	None to slow	Low to medium		MH	SILT
			High to very high	None	High		CH	CLAY
			Medium to high	None to very slow	Low to medium		OH	Organic CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				PT	Peat

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

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
Parting	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (e g. bedding). May be open or closed.	
Fissure	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. May include desiccation cracks.	
Sheared Seam	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
Sheared Surface	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect	

TERM	DEFINITION	DIAGRAM
Softened Zone	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere	
Tube	Tubular cavity. May occur singly or as one of a large number of separate or interconnected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter. Origins include root holes, animal burrows, tunnel erosion.	
Tube cast	An infilled tube. The infill may be uncemented or weakly cemented soil or have rock properties.	
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 defects.	

ROCK DESCRIPTION EXPLANATION SHEET

The descriptive terms used by Tetra Tech Coffey are given below. They are broadly consistent with Australian Standard AS1726:2017.

DEFINITIONS: Rock material, defect, structure and rock mass are defined as follows:

Rock material	In engineering terms rock material is any naturally occurring aggregate of minerals and/or organic materials that cannot be disaggregated by hand in air or water without prior soaking. Rock material is intact rock that is bounded by defects. Material which can be disaggregated or remoulded should be described as a soil.
Defect	Discontinuity, fracture, break or void in the material or materials across which there is little or no tensile strength.
Structure	Nature and configuration of the different defects within the rock mass and their relationship with each other.
Rock mass	It is the entirety of the system formed by all of the rock material and all of the defects. That is, it is a body of material which is not effectively homogeneous.

MATERIAL 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	When grains show an alignment, a preferred orientation or a layering (e.g. bedding or lamination for sedimentary rocks, and foliation or cleavage for metamorphic rocks) the terms used are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on strength properties.
Distinct	Layering or fabric is easily visible. Rock may break more easily parallel to the fabric.

CLASSIFICATION OF MATERIAL WEATHERING

Term	Abbreviation	Definition
Residual Soil	**RS**	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible. Soil has not been significantly transported.
Extremely Weathered	**XW**	Material is weathered to such an extent that it has soil properties, i.e. it either disaggregates or can be remoulded in water. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered[1]	**HW**	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of weathering products in pores.
Moderately Weathered[1]	**MW**	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is no longer recognisable. Little or no change of strength from fresh rock.
Slightly Weathered	**SW**	Rock is partially discoloured with staining or bleaching adjacent to defects, but shows little or no change of strength from fresh rock.
Fresh	**FR**	Rock shows no sign of decomposition of individual minerals or colour changes.

Notes on Weathering:

1. The term 'Distinctly Weathered' (DW) may be used where it is not practicable (or it is judged that there is no advantage in making such a distinction) to distinguish between 'Highly Weathered' and 'Moderately Weathered'. 'Distinctly Weathered' is defined as follows: 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'.
2. Where physical and chemical changes of the rock material are caused by hot gases or liquids at depth (process called alteration) the term 'altered' may be substituted for 'weathering' to give the abbreviations XA, HA, MA, SA and DA.

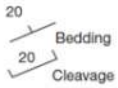
ROCK MATERIAL STRENGTH TERMS

Term (Abbreviation)	Guide to Strength: Point Load Strength Index, $I_{s(50)}$ (MPa)	Guide to Strength: Field Assessment
Very Low (VL)	0.03 - 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand; pieces up to 30mm thick can be broken by finger pressure.
Low (L)	0.1 - 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. A piece 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 diameter cannot 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; rock rings under hammer.
Extremely High (EH)	More than 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Notes on Rock Material Strength:

1. Material with strength less than 'Very Low' should be described using soil characteristics.
2. The method of measuring the $I_{s(50)}$ should be in accordance with AS 4133.4.2.
3. The rock strength should be determined perpendicular to any anisotropy in the rock. High strength anisotropic rocks may readily break parallel to the planar anisotropy.
4. Although AS1726:2017 provides a basis for rock strength terms based on Unconfined Compressive Strength (UCS), the ratio between UCS and $I_{s(50)}$ may vary from less than 10 to over 30 depending on the rock type and overall strength. The UCS/$I_{s(50)}$ strength ratio should be determined for each rock material.
5. The rock strength classification using $I_{s(50)}$ above should be considered indicative only. The rock strength classified in accordance with AS1726:2017 may be higher or lower if UCS results are available.

COMMON ROCK DEFECT TYPES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering (e.g. bedding) or a planar anisotropy in the rock material (e.g. cleavage). May be open or closed.			
Joint	A surface or crack with no apparent shear displacement and across which the rock has little or no tensile strength, but which is not parallel or sub-parallel to layering or to planar anisotropy in the rock material. May be open or closed.			
Sheared Zone/Seam (Note 3)	Zone of rock material 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 and which shows evidence of shear displacement.			
Crushed Seam (Note 3)	Seam of soil material with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock material which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams up to 1mm thick may be described as veneer or coating on a joint surface.			
Extremely Weathered Seam	Seam of soil material, often with gradational boundaries. Formed by weathering of the rock material in place.			

Notes on Defects:

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

DEFECT ROUGHNESS TERMS

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

DEFECT COATING TERMS

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

DIMENSION OF DEFECTS

Spacing, length, openness and thickness

The spacing, length, aperture (openness), and seam thickness should generally be described directly in millimetres or metres.

Block Shape

Where it is considered significant, block shape (e.g. tabular, prismatic, columnar) should be described using the terms in Table 23 of AS 1726:2017.

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH1***
sheet:	1 of 3
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***05 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***05 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302135; N: 6173115 (GDA2020 MGA) | surface elevation: 39.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD/T, C		Not Observed	E B	39			CL	**TOPSOIL: Silty CLAY**: low to medium plasticity, dark brown, with root fibres.	<Wp	St		**TOPSOIL** **ALLUVIUM**
							CL	**Silty CLAY**: low to medium plasticity, dark brown to brown.	~Wp			
			SPT 7/100mm HB N*=R	38	1.0		CL	**CLAY**: medium plasticity, pale brown. **Gravelly CLAY**: medium plasticity, brown-red, mottled grey.	<Wp	VSt - H		**RESIDUAL SOIL**
			E		2.0							
			SPT 2/50mm HB N*=R	37			CL	**Gravelly CLAY**: medium plasticity, pale red-brown, gravel is fine grained, sub-rounded to sub-angular.	D			
					3.0			Borehole BH1 continued as cored hole				
				36								
					4.0							
				35								
					5.0							
				34								
					6.0							
				33								
					7.0							
				32								

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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.	***BH1***
sheet:	2 of 3
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***05 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***05 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302135; N: 6173115 (GDA2020 MGA) | surface elevation: 39.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information				material substance						rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general

RL (m)	depth (m)	material description	weathering & alteration	samples, field tests & Is(50) (MPa)	core run & RQD	additional observations and defect descriptions (particular)
39	1.0					
38	2.0					
37		started coring at 2.85m				
36	3.0	**SANDSTONE**: fine grained, brown to dark brown, indistinctly bedded at 0° - 5°, occasional bands of conglomerate.	SW	a=2.34 d=4.15		JT, 70°, PL, RO, CN JT, 85°, PL, VR, Clay CO
35	4.0			a=3.39 d=3.82	88%	JT, 50°, PL, RO, Clay CO PT, 0°, UN, VR, CN JT, 60 - 85°, CU, RO, CN PT, 5°, PL, RO, Clay CO PT, 5°, PL, RO, Clay CO CS, 5°, PL, RO, Clay, 10 mm PT, 5 - 10°, PL, RO, Clay CO
34	5.0	**SANDSTONE**: fine grained, brown and dark brown, trace conglomerate bands.				
33	6.0			a=3.06 d=3.45		PT, 10°, PL, VR, CN JT, 50 - 85°, CU, RO, CN JT, 75 - 90°, ST, VR, CN
32	7.0			a=1.42 d=0.88	100%	PT, 5°, UN, RO, CN
		SANDSTONE: fine grained, brown to dark brown, indistinctly bedded at 0° - 5°, occasional bands of conglomerate.		a=2.70 d=2.10		PT, 5°, PL, RO, CN

HQ — Not Observed

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.	**BH1**
sheet:	3 of 3
project no.	**754-SYDGE330330**
client:	**Midson Group Pty Ltd**
date started:	**05 Oct 2023**
principal:	**The Uniting Church in Australia Property Trust (NSW)**
date completed:	**05 Oct 2023**
project:	**Shellharbour ILUs**
logged by:	**RZ**
location:	**Wattle Road, Shellharbour, NSW**
checked by:	**VN**

position: E: 302135; N: 6173115 (GDA2020 MGA) | surface elevation: 39.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	Not Observed	31	9.0		**SANDSTONE**: fine grained, brown to dark brown, indistinctly bedded at 0° - 5°, occasional bands of conglomerate. *(continued)*	SW	X	a=2.88 d=2.76	100%		
		30	10.0		**SANDSTONE**: fine grained, brown, massive, with pale grey bands.		X O	a=1.63 d=1.14 a=1.18 d=0.45	100%		JT, 65°, PL, RO, CN CS, 5°, PL, VR, Sandstone, 10 mm PT, 5°, PL, RO, CO PT, 5 - 15°, PL, VR, Clay CO
		29	11.0		Borehole BH1 terminated at 10.28 m Target depth						
		28	12.0								
		27	13.0								
		26	14.0								
		25	15.0								
		24									

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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

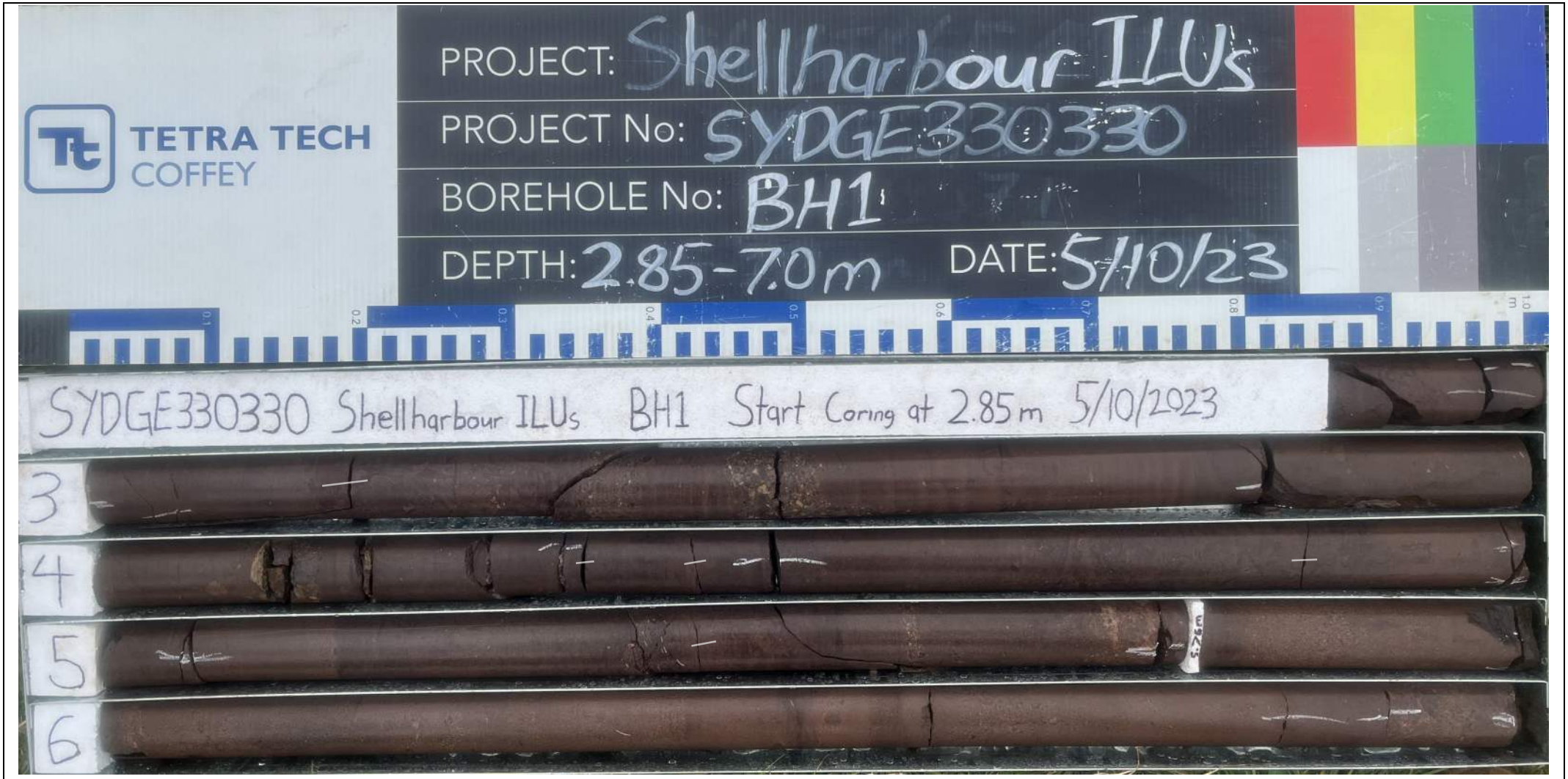
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

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

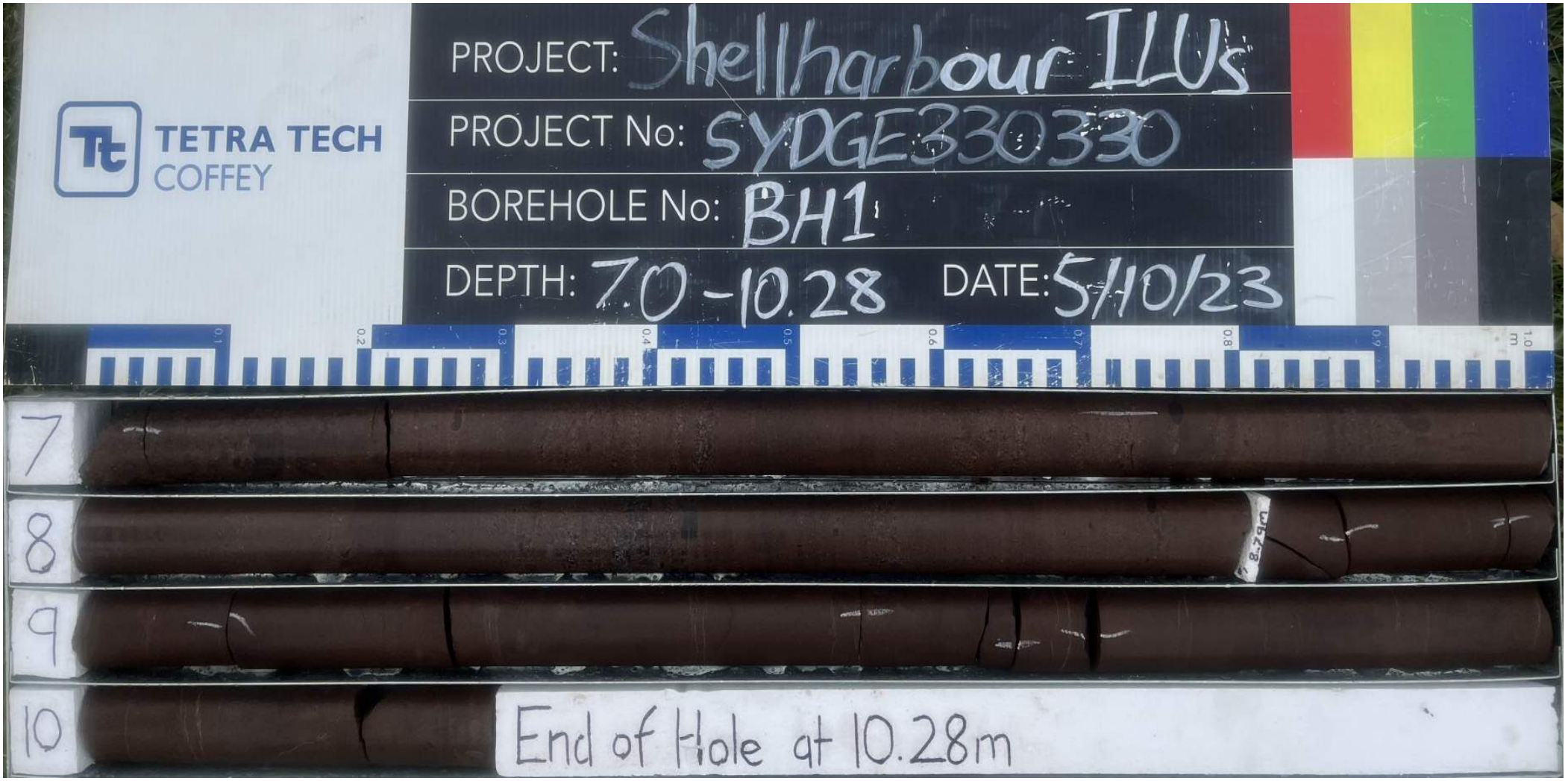
roughness
VR very rough
RO rough
SO smooth
POL polished
SL slickensided

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

coating
CN clean
SN stained
VN veneer
CO coating



drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH1**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 1**
original	**A4**			



drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH1**
scale	**N/A**			
original	**A4**		project no: **754-SYDGE330330**	**Figure 2**

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH2***
sheet:	1 of 3
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***06 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***06 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	

position: E: 302126; N: 6173070 (GDA2020 MGA) | surface elevation: 39.00 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information				material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetro-meter (kPa) 100 200 300 400	soil origin, structure and additional observations
AD/T C		Not Observed	E E U75	39 38 37	1.0 2.0		CL CL	**TOPSOIL: Silty CLAY**: low to medium plasticity, dark brown, with root fibres. **Silty CLAY**: low to medium plasticity, dark brown. **Gravelly CLAY**: low to medium plasticity, pale brown-red, fine grained, sub-angular gravel.	<Wp ~Wp <Wp	 St VSt	 ×	**TOPSOIL** **ALLUVIUM** **RESIDUAL SOIL** HP 260 kPa
				36 35 34 33 32	3.0 4.0 5.0 6.0 7.0			Borehole BH2 continued as cored hole				

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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.	***BH2***
sheet:	2 of 3
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***06 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***06 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	

position: E: 302126; N: 6173070 (GDA2020 MGA) | surface elevation: 39.00 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		39									
		38	1.0								
		37	2.0		started coring at 2.88m						
HQ	Not Observed	36	3.0		**SANDSTONE**: fine grained, brown, massive, occassional bands of conglomerate, and dark grey lenses.	SW		a=1.39 d=0.54	97%		PT, 0 - 5°, PL, VR, CN JT, 80 - 90°, IR, VR, CN
		35	4.0					a=1.87 d=2.05			
		34	5.0					a=1.98 d=2.07			JT, 75°, PL, RO, CN
		33	6.0		6.00 to 6.40 m: indistinctly bedded at 5°						JT, 45 - 70°, PL, RO, CN
		32	7.0					a=1.72 d=1.37	88%		
								a=0.54 d=0.78			

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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

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.	***BH2***
sheet:	3 of 3
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***06 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***06 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	

position: E: 302126; N: 6173070 (GDA2020 MGA) | surface elevation: 39.00 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	Not Observed	31			**SANDSTONE**: fine grained, brown, massive, occassional bands of conglomerate, and dark grey lenses. *(continued)*	SW	X	a=0.28 d=0.43	88%		CS, 10°, PL, VR, 5 mm
					NO CORE: 0.22 m						fractured rock
					SANDSTONE: fine grained, brown.	SW					CS, 5°, PL, RO, 5 mm JT, 70°, PL, RO, Clay CO
		30	9.0		Borehole BH2 terminated at 8.84 m Target depth						
		29	10.0								
		28	11.0								
		27	12.0								
		26	13.0								
		25	14.0								
		24	15.0								

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 01/11/2023 15:41

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

Piezometer Installation Log

Hole ID.	***BH2***
sheet:	1 of 1
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
project:	***Shellharbour ILUs***
location:	***Wattle Road, Shellharbour, NSW***
date started:	***06 Oct 2023***
date completed:	***06 Oct 2023***
logged by:	***RZ***
checked by:	

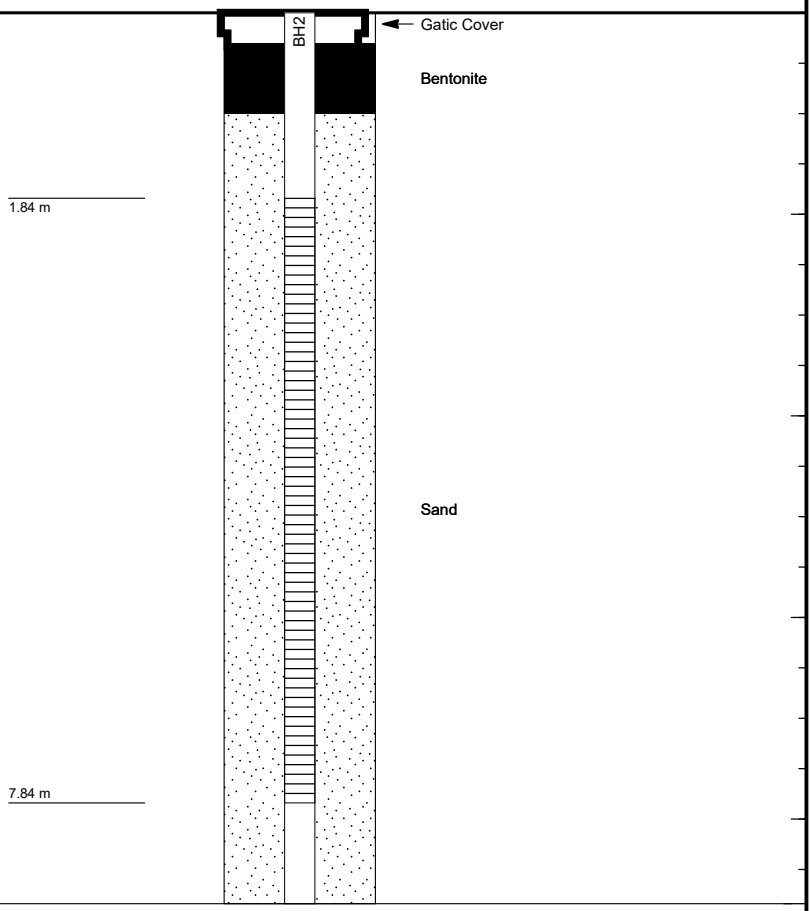
position: E: 302126; N: 6173070 (GDA2020 MGA) | surface elevation: 39.00 m (AHD) | angle from horizontal: 90°

equipment type: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

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

method & support	water	RL (m)	depth (m)	graphic log	material description (refer to engineering log for full description)
AD/T	Not Observed	38	1		**TOPSOIL**
					ALLUVIUM
C			2		**RESIDUAL SOIL**
HQ		36	3		
			4		
		34	5		
			6		
		32	7		
			8		
		30	9		
			10		
		28	11		

completion details: Gatic Cover | bore construction license:
pvc type: | drilling company:
sand type: | driller:
grout type: | driller's permit no.:



method & support
see engineering log for details

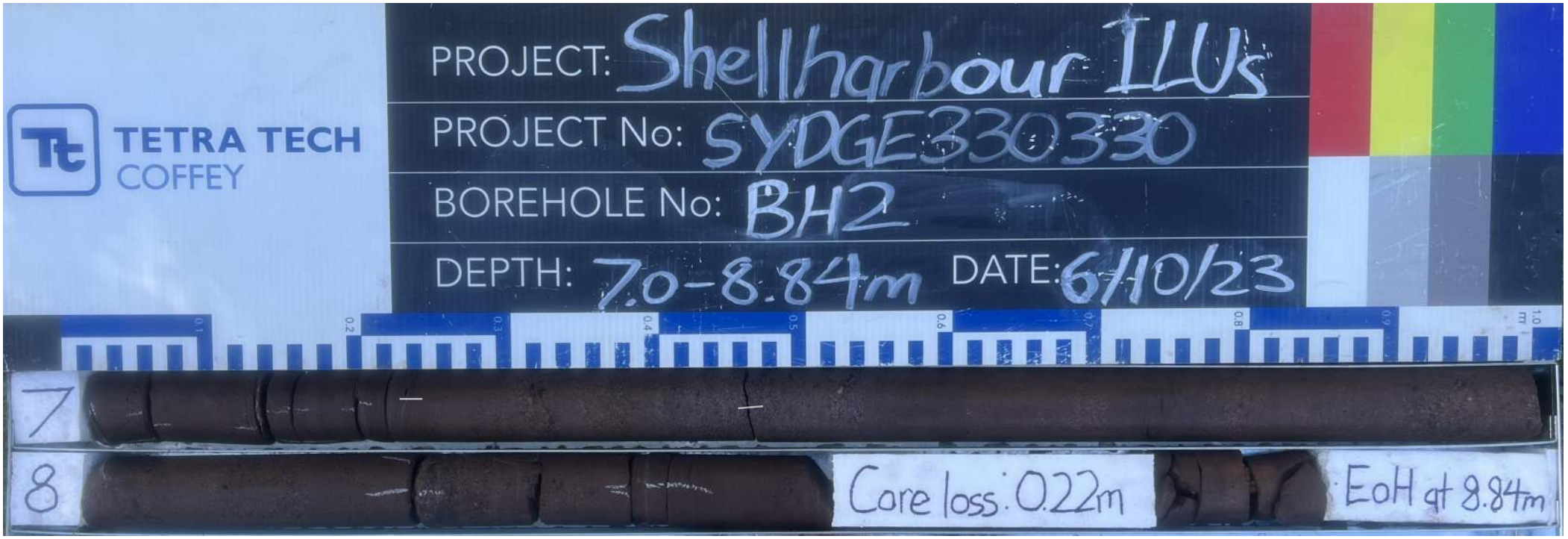
water
- 10-Oct-12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25 water pressure test result (lugeons) for depth interval shown

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

ID	type	installation date	development date	stickup (m)	tip depth (m)	water level (m)	Relative Levels (AHD) stickup	tip	water level
BH2	standpipe				8.84 m			30.16	

CDF_0_10_00.4_LIBRARY.GLB rev:CDF_0_10_00.4 2021-09-30 Log COF PIEZOMETER ONE PAGE SUMMARY SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 10/11/2023 16:23

drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH2**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 1**
original	**A4**			



drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH2**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 2**
original	**A4**			

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH3***
sheet:	1 of 3
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***06 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***06 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302118; N: 6173023 (GDA2020 MGA) | surface elevation: 39.60 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD/T — N			E					**TOPSOIL: Silty CLAY**: medium plasticity, dark brown, trace rootlets.	~Wp			**TOPSOIL**
							CL	**Silty CLAY**: low to medium plasticity, dark brown, trace fine grained sub-angular to sub-rounded gravel.	<Wp	St		**ALLUVIUM**
			E	39								
					1.0		CL	**Gravelly CLAY**: low to medium plasticity, brown, fine grained sub-angular gravel.		VSt		**RESIDUAL SOIL**
				38								water added to hole at 1.0 m
					2.0							
				37								
					3.0			Borehole BH3 continued as cored hole				
				36								
					4.0							
				35								
					5.0							
				34								
					6.0							
				33								
					7.0							
				32								

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: NON CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:23

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.	***BH3***
sheet:	2 of 3
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***06 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***06 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302118; N: 6173023 (GDA2020 MGA) | surface elevation: 39.60 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		39	1.0		started coring at 2.90m						
HQ		38	2.0		**SANDSTONE**: fine grained, pale grey-brown, occasional bands of conglomerate and carbonaceous lenses.	SW		a=2.44 d=2.35	96%		JT, 75 - 90°, ST, RO, partial closed JT, 25 - 40°, CU, RO, CN PT, 5°, PL, RO, CN PT, 5°, PL, RO, CN PT, 0°, PL, RO, CN JT, 20 - 35°, CU, RO, CN JT, 50 - 70°, PL, VR, CO - Clay
		37	3.0								
		36	4.0								
		35	5.0		**CONGLOMERATE**: fine grained, pale grey, mottled dark grey lenses.	MW		a=1.10 d=1.14			PT, 25°, PL, RO, CN JT, 40 - 85°, PL, VR, CN PT, 0 - 5°, PL, VR
		34	6.0		**SANDSTONE**: fine grained, pale grey-brown, occasional bands of conglomerate. 5.42 to 5.66 m: indistinctly bedded between 5-15°	SW / FR		a=2.62 d=1.67	73%		PT, 0°, PL, RO, CN
	10-25% Water loss	33	7.0		6.60 to 6.82 m: band of clay			a=1.14 d=1.46			CS, 5 - 40°, IR, VR, CO - Clay PT, 0°, PL, VR, CO - Clay PT, 0 - 5°, PL, VR, CO - Clay
		32			**SANDSTONE**: fine grained, pale grey-brown, indistinctly bedded between 0-5°, occasional bands of conglomerate.			a=2.65 d=2.76	100%		

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:26

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.	**BH3**
sheet:	3 of 3
project no.	**754-SYDGE330330**
client:	**Midson Group Pty Ltd**
date started:	**06 Oct 2023**
principal:	**The Uniting Church in Australia Property Trust (NSW)**
date completed:	**06 Oct 2023**
project:	**Shellharbour ILUs**
logged by:	**RZ**
location:	**Wattle Road, Shellharbour, NSW**
checked by:	**VN**

position: E: 302118; N: 6173023 (GDA2020 MGA) | surface elevation: 39.60 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	10-25% Water loss	31	9.0		**SANDSTONE**: fine grained, pale grey-brown, indistinctly bedded between 0-5°, occasional bands of conglomerate. *(continued)* 8.06 to 8.14 m: dark brown lenses becoming indistinctly bedded between 5-15°	SW / FR		a=1.30 d=0.45	100%		PT, 0°, PL, RO, CN
		30	10.0		becoming indistinctly bedded between 0-5°			a=3.65 d=3.84	94%		JT, ST, RO, CO - Clay fractured rock PT, 10°, PL, RO, CO - Clay
		29	11.0		10.64 to 10.66 m: dark brown lenses			a=0.92 d=0.65	100%		
								a=2.34 d=2.65			
		28	12.0		Borehole BH3 terminated at 11.31 m Target depth						
		27	13.0								
		26	14.0								
		25	15.0								
		24									

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:26

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

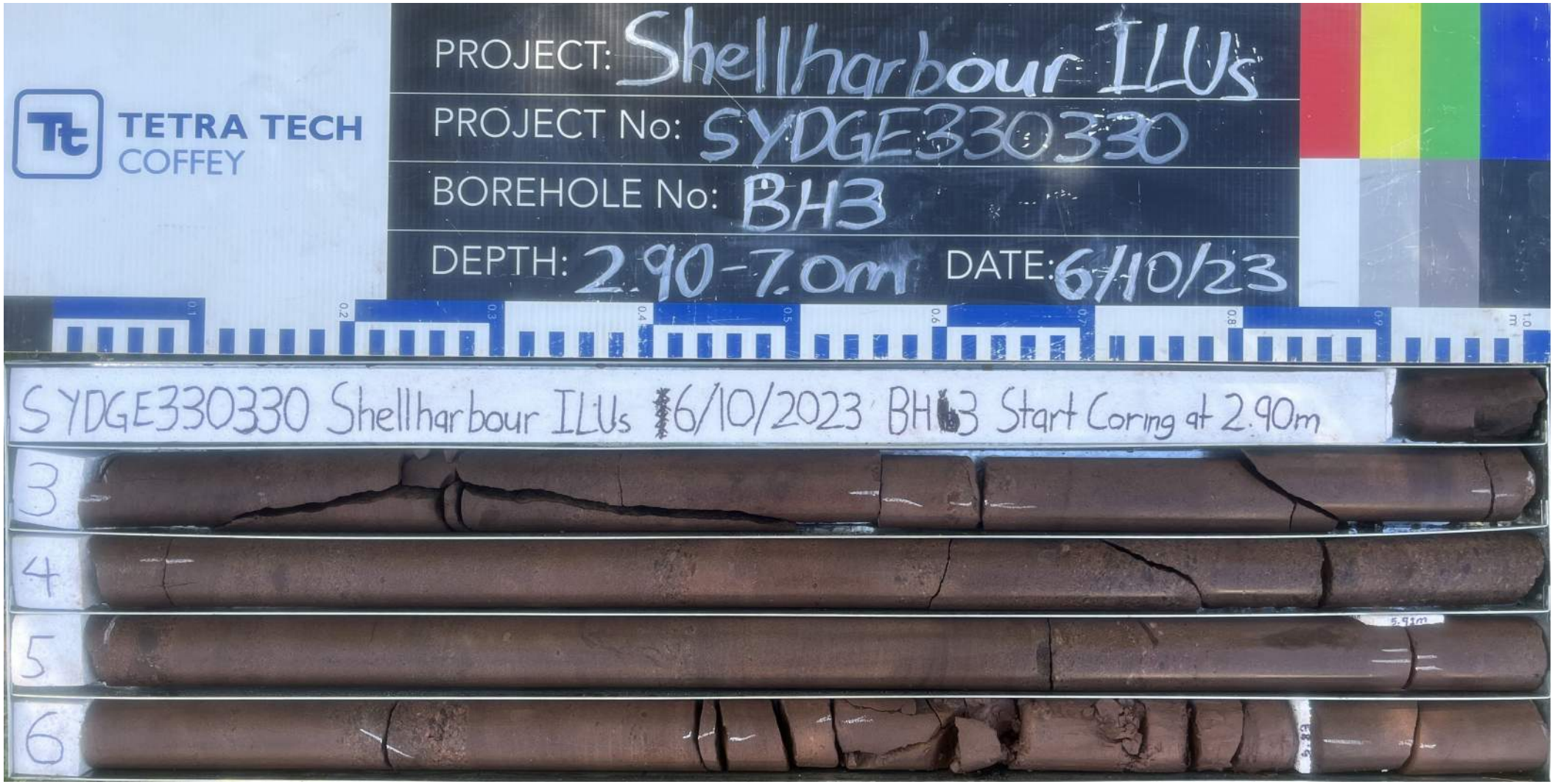
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

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

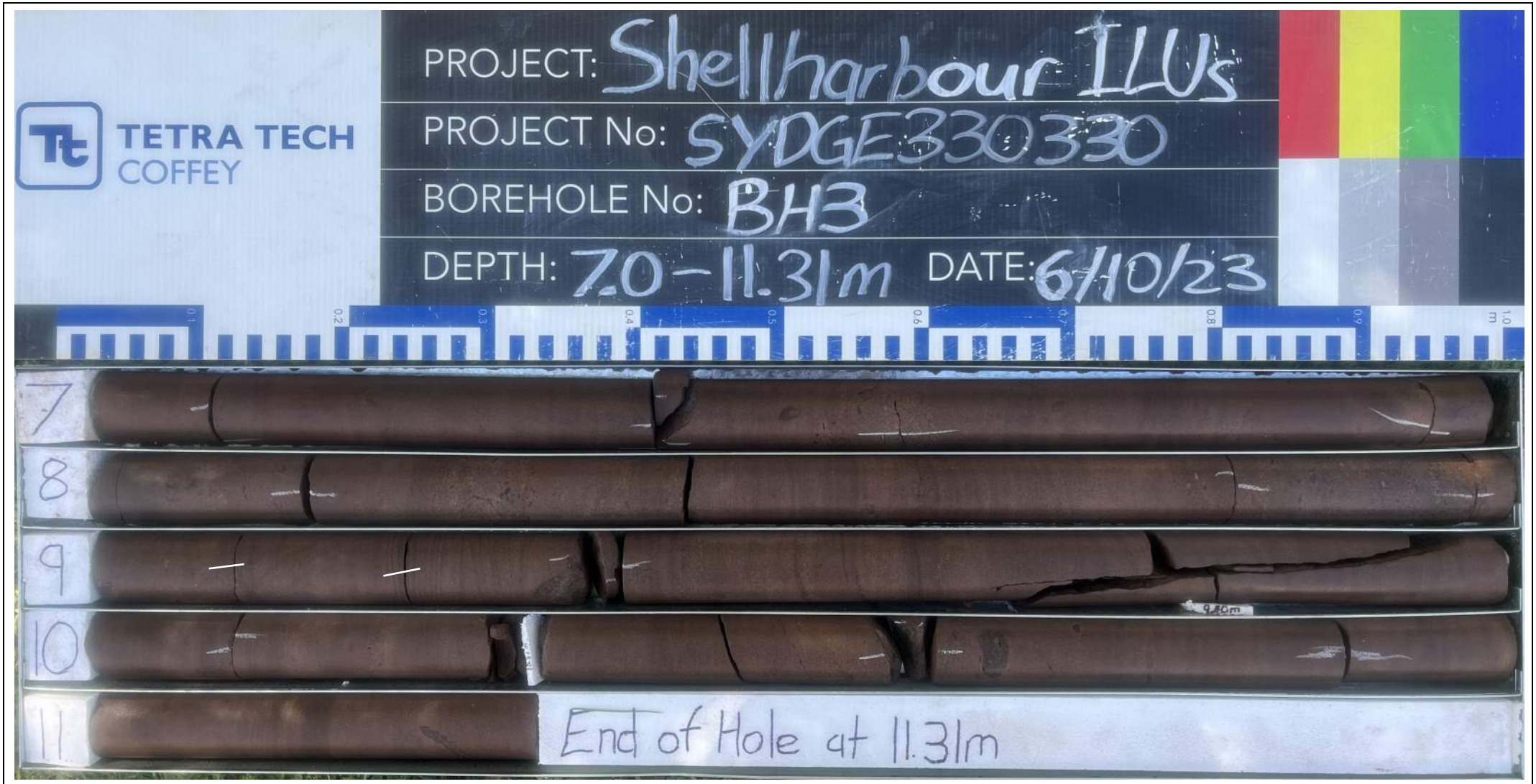
roughness
VR very rough
RO rough
SO smooth
POL polished
SL slickensided

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

coating
CN clean
SN stained
VN veneer
CO coating



drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH3**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 1**
original	**A4**			



drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH3**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 2**
original	**A4**			

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH4***
sheet:	1 of 2
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***04 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***04 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302087; N: 6173134 (GDA2020 MGA) | surface elevation: 33.60 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	soil origin, structure and additional observations
AD/T — C		Not Observed		33	0.0		CL	**TOPSOIL: Silty CLAY**: low plasticity, dark brown to brown, trace fine grained, sub-angular gravel, and root fibres.	<Wp	St	100 200 300 400	**TOPSOIL**
							CL	**Silty CLAY**: low plasticity, dark brown to brown, trace fine grained sand.	~Wp			**ALLUVIUM**
								CLAY: low to medium plasticity, brown, trace fine grained sand.				
				32	1.0			Borehole BH4 continued as cored hole				
				31	2.0							
				30	3.0							
				29	4.0							
				28	5.0							
				27	6.0							
				26	7.0							

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: NON CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:23

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.	**BH4**
sheet:	2 of 2
project no.	**754-SYDGE330330**
client:	**Midson Group Pty Ltd**
date started:	**04 Oct 2023**
principal:	**The Uniting Church in Australia Property Trust (NSW)**
date completed:	**04 Oct 2023**
project:	**Shellharbour ILUs**
logged by:	**RZ**
location:	**Wattle Road, Shellharbour, NSW**
checked by:	**VN**

position: E: 302087; N: 6173134 (GDA2020 MGA) | surface elevation: 33.60 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 X = axial; O = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		33			started coring at 1.00m						
HQ	Not Observed		1.0		**NO CORE:** 0.34 m			SPT 5/50mm HB N*=R			
		32			**Gravelly CLAY**: medium plasticity, red-brown, trace fine grained, sub-angular gravel.	RS / SW					
			2.0		**SANDSTONE**: fine grained, red-brown, bands of orange, indistinctly bedded at 5° - 10°.			d=1.30 a=1.05	83%		PT, 50°, PL, RO, Clay VN CS, 10 - 15°, PL, RO, Clay CO
		31				HW / SW / FR					SM, 5°, PL, RO, Gravelly Clay, 10 mm CS, Gravelly Clay, 70 mm CS, 5°, PL, RO, X, 10 mm PT, 5 - 20°, CU, RO, CN
			3.0					d=2.09 a=2.24			
		30			**CONGLOMERATE**: fine grained, red-brown, with carbonaceous lenses.				68%		JT, 65 - 80°, ST, RO, X CO
			4.0		**SANDSTONE**: fine grained, brown, massive.			d=2.44 a=2.55			PT, 10 - 45°, PL, RO, closed PT, 20°, PL, RO, CN PT, 25°, PL, RO, Clay CO PT, 5 - 25°, PL, RO, CN JT, 85 - 90°, PL, RO, CN
		29									
			5.0					d=2.75 a=2.19			
		28									
			6.0					d=3.28 a=3.07			
									88%		PT, 10°, PL, RO, Clay CO
		27									JT, 55 - 60°, PL, RO, CN
								d=2.65 a=1.73			
			7.0								fractured rock JT, 35 - 40°, PL, RO, CN
		26									PT, 0 - 5°, PL, RO, CN JT, 70°, PL, closed
								d=1.46 a=1.87			
					Borehole BH4 terminated at 7.79 m Target depth						

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:26

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

drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH4**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 1**
original	**A4**			

drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project :	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH4**
scale	**N/A**			
original	**A4**		project no: **754-SYDGE330330**	**Figure 2**

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH5***
sheet:	1 of 2
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***05 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***05 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302080; N: 6173089 (GDA2020 MGA) | surface elevation: 34.00 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description **SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD/T — N		Not Observed	E	34			CL	**TOPSOIL: Silty CLAY**: medium plasticity, dark brown to brown, trace fine grained sand.	M ~Wp	St		**TOPSOIL** **ALLUVIUM**
								Silty CLAY: medium plasticity, brown.				
			E				CL	**CLAY**: medium plasticity, brown.		VSt - H		**RESIDUAL SOIL**
			SPT 11, 13, 11/100mm HB N*=R	33	1.0							
							CL	**Gravelly CLAY**: medium plasticity, brown-red, fine to medium grained sub-angular to sub-rounded gravel.	<Wp			
				32	2.0		CL	**Gravelly CLAY**: medium plasticity, red-brown, fine to medium grained sub-angular to sub-rounded gravel, trace fine grained sand.				
								Borehole BH5 continued as cored hole				
				31	3.0							
				30	4.0							
				29	5.0							
				28	6.0							
				27	7.0							

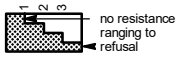
CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: NON CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:24

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

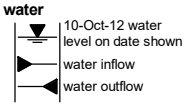
* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

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 - Cored Borehole

Borehole ID.	**BH5**
sheet:	2 of 2
project no.	**754-SYDGE330330**
client:	**Midson Group Pty Ltd**
date started:	**05 Oct 2023**
principal:	**The Uniting Church in Australia Property Trust (NSW)**
date completed:	**05 Oct 2023**
project:	**Shellharbour ILUs**
logged by:	**RZ**
location:	**Wattle Road, Shellharbour, NSW**
checked by:	**VN**

position: E: 302080; N: 6173089 (GDA2020 MGA) | surface elevation: 34.00 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		34									
		33	1.0								
		32	2.0		started coring at 2.50m						
HQ	Not Observed	31	3.0		**SANDSTONE**: medium to coarse grained, red brown, mottled pale grey, occasional iron induration and carbonaceous.	SW		a=1.83 d=2.14 a=0.54 d=0.75	69%		fractured rock JT, 70 - 80°, ST, RO, Fe SN PT, 15°, PL, RO, VN PT, 10°, PL, RO, CN CS, 5 - 10°, PL, sandstone 20 mm JT, 40 - 85°, CU, RO, Fe SN JT, 45 - 80°, PL, Fe, healed
		30	4.0		**Sandy CLAY (CL-CH)**: medium to high plasticity, red brown, with sandstone fragments.	XW					fractured rock
					SANDSTONE: medium to coarse grained, red-brown, occasional iron indurated and carbonaceous.	SW		a=0.54 d=0.80			JT, 30 - 45°, IR, RO, CN
		29	5.0					a=0.99 d=0.94	65%		JT, 85 - 90°, PL, RO, CN
		28	6.0								fractured rock fractured rock
								a=0.53 d=0.54	68%		JT, 40°, PL, RO, CN fractured rock JT, 20 - 25°, PL, RO, CN fractured rock fractured rock
		27	7.0					a=1.23 d=0.99			
					Borehole BH5 terminated at 7.55 m Target depth						

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:27

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

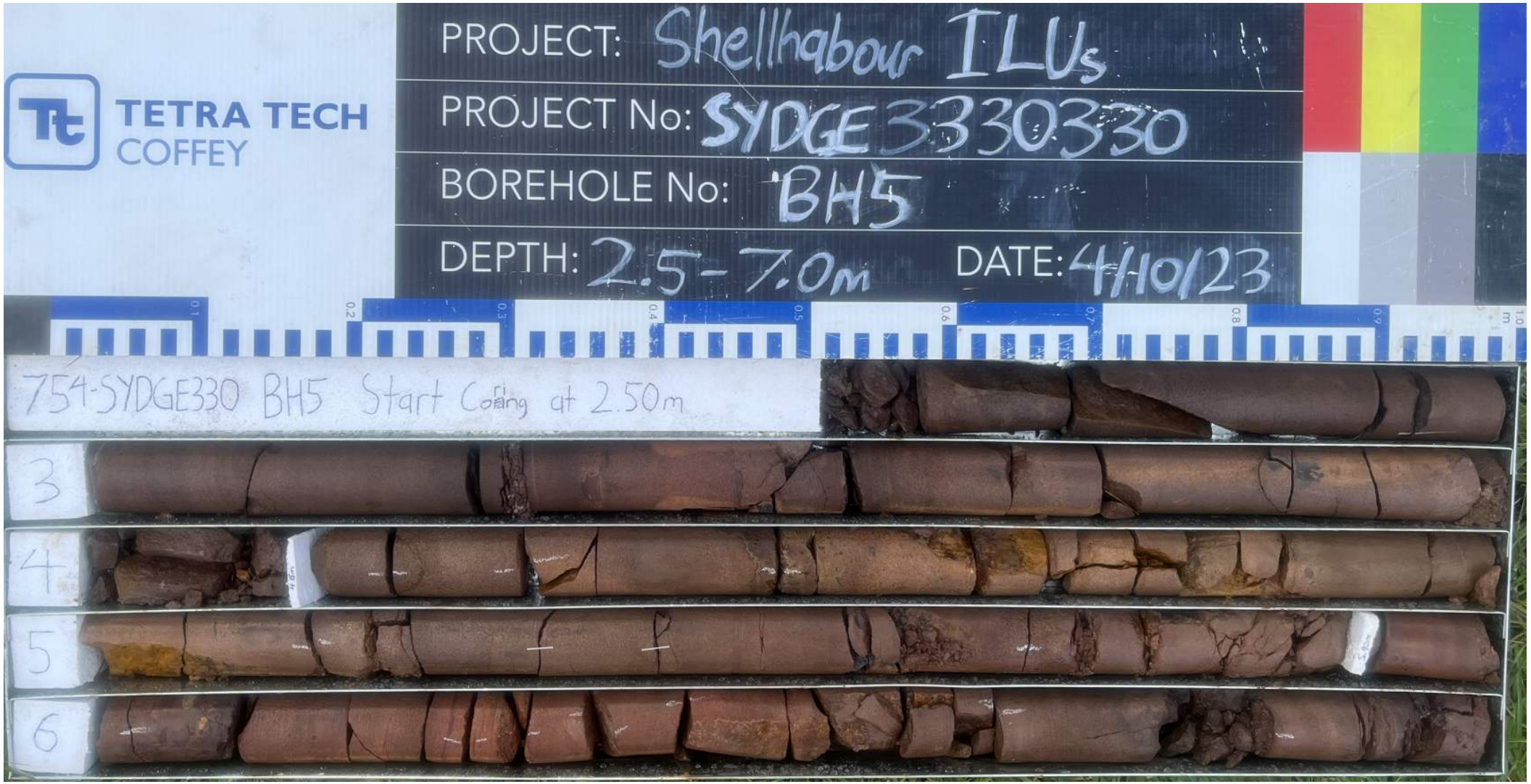
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

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



drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH5**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 1**
original	**A4**			

drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH5**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 2**
original	**A4**			

TETRA TECH COFFEY

Engineering Log - Borehole

Borehole ID.	***BH6***
sheet:	1 of 2
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date started:	***05 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***05 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302070; N: 6173047 (GDA2020 MGA) | surface elevation: 34.50 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD/T, N		Not Observed	E					**TOPSOIL: Silty CLAY**: medium plasticity, dark brown, with root fibres.	<Wp			**TOPSOIL**
			B: (0.2-1.0m)	34			CL	**Silty CLAY**: medium plasticity, dark brown to brown.		St		**ALLUVIUM**
			E: Dup1		1.0		CL-CH	**CLAY**: medium to high plasticity, pale brown, trace silt.	>Wp	VSt		**RESIDUAL SOIL**
			U75	33							×	HP 360 kPa
					2.0		CL	**Gravelly CLAY**: medium plasticity, red-brown, fine to medium grained sub-angular to sub-rounded gravel.	<Wp			
			SPT 5/50mm HB N*=R	32	3.0		CL	**CLAY**: medium plasticity, brown, trace fine to medium grained sub-angular gravel.				
				31								
					4.0			Borehole BH6 continued as cored hole				
				30								
					5.0							
				29								
					6.0							
				28								
					7.0							
				27								

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: NON CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:24

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.	**BH6**
sheet:	2 of 2
project no.	**754-SYDGE330330**
client:	***Midson Group Pty Ltd***
date started:	***05 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***05 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302070; N: 6173047 (GDA2020 MGA) | surface elevation: 34.50 m (AHD) | angle from horizontal: 90°

drill model: Comacchio GEO 205, Track mounted | drilling fluid: Water | hole diameter : 125 mm

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		34	1.0		started coring at 4.34m						
HQ	Not Observed	30	5.0		**CLAY (CL-CH)**: medium to high plasticity, brown-orange, trace medium to coarse grained sand.	RS		a=1.41 d=1.26	88%		PT, 5 - 15°, PL, RO, CN PT, 15 - 20°, PL, healed
		29	6.0		**SANDSTONE**: medium grained, brown-orange, indistinctly bedded at 0-20°. 5.60 m: cavity dark grey band at 15°	SW XW SW - FR		a=1.73 d=1.23 a=1.44 d=1.83	93%		PT, 0 - 5°, PL, RO, CN PT, 0 - 5°, PL, RO, CN PT, 0 - 5°, PL, RO, CN PT, 0 - 5°, PL, RO, CN PT, 0°, PL, RO, CN CS, Gravelly Clay, 20 mm PT, 0 - 5°, PL, RO, CN fractured rock PT, 0 - 5°, PL, VR, CN PT, 0 - 5°, PL, VR, CN PT, 0°, PL, RO, CN PT, 5 - 10°, PL, RO, CN PT, 20 - 25°, PL, RO, CN
		28	7.0								PT, 25°, PL, RO, CN JT, 45°, PL, RO, CN
		27			Borehole BH6 terminated at 7.22 m Target depth						

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF BOREHOLE: CORED SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:27

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

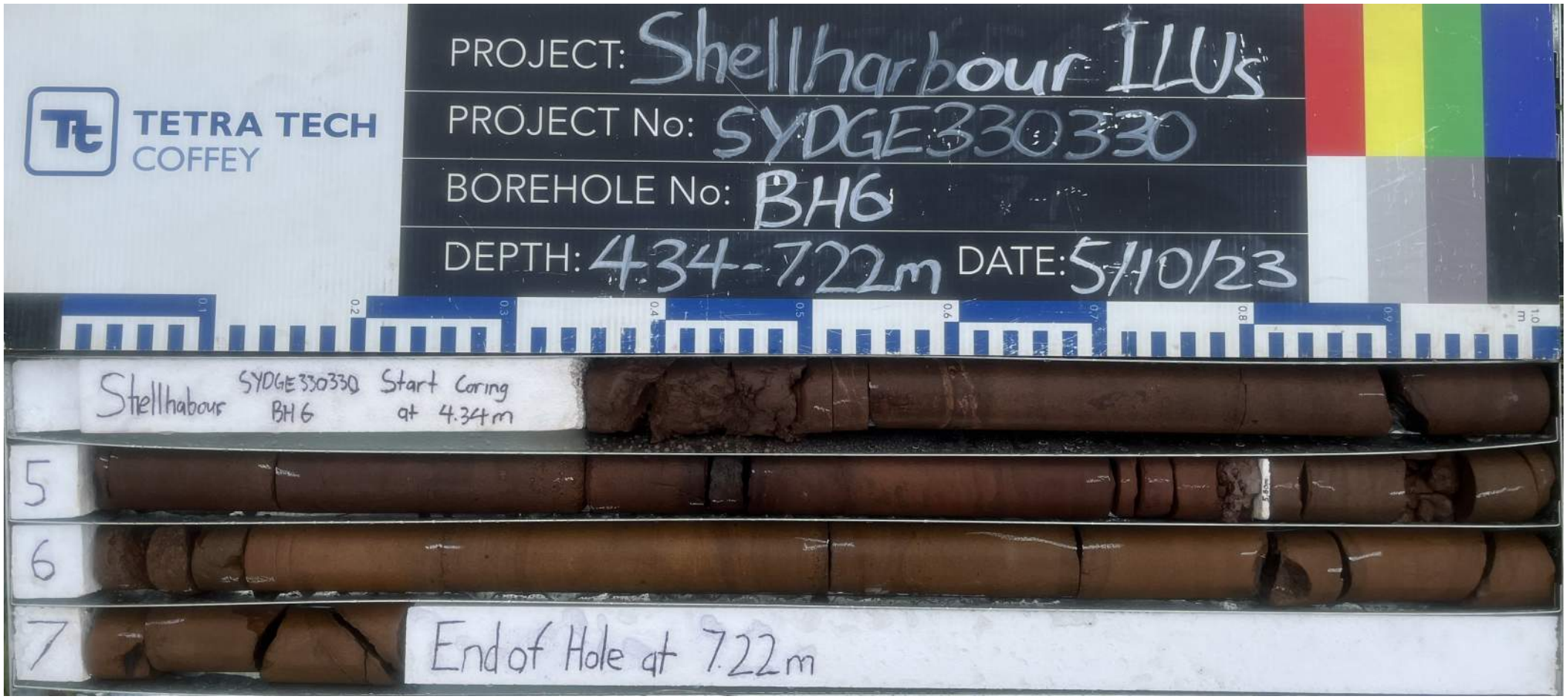
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

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



drawn	RZ	TETRA TECH COFFEY	client:	**Midson Group Pty Ltd**
approved			project:	**Shellharbour ILUs**
date	12/10/2023		title:	**CORE PHOTOGRAPH BH6**
scale	**N/A**		project no: **754-SYDGE330330**	**Figure 1**
original	**A4**			

TETRA TECH COFFEY

Engineering Log - Excavation

Excavation ID.	***TP1***
sheet:	1 of 1
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date excavated:	***05 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***05 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302065; N: 6173135 (GDA2020 MGA) | surface elevation: 29.90 m (AHD) | pit orientation:

equipment type: Comacchio GEO 205 Track | excavation method: N/A | excavation dimensions:

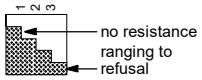
excavation information | **material substance**

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
AD/T	N		Not Encountered	E	29.5	0.5		CL	**TOPSOIL: Silty CLAY**: medium plasticity, dark brown to brown, trace rootlets.	~Wp			**TOPSOIL**
									Silty CLAY: medium plasticity, dark brown to brown.				**ALLUVIUM**
				E	29.0	1.0		CL	**CLAY**: medium plasticity, brown, with fine grained angular to sub-angular gravel.				
									Test pit TP1 terminated at 1.0 m Refusal Top of Rock				
					28.5	1.5							
					28.0	2.0							
					27.5	2.5							
					27.0	3.0							
					26.5	3.5							
					26.0								

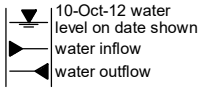
method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration



water



samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

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 - Excavation

Excavation ID.	***TP2***
sheet:	1 of 1
project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***
date excavated:	***05 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***
date completed:	***05 Oct 2023***
project:	***Shellharbour ILUs***
logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***
checked by:	***VN***

position: E: 302053; N: 6173082 (GDA2020 MGA) | surface elevation: 29.90 m (AHD) | pit orientation:

equipment type: Comacchio GEO 205 Track | excavation method: N/A | excavation dimensions:

excavation information | **material substance**

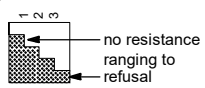
method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (SOIL NAME: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD/T	N		Not Encountered	E: Dup 2					**TOPSOIL: Silty CLAY**: low to medium plasticity, dark brown, trace rootlets.	<Wp			**TOPSOIL**
				B	29.5	0.5		CL	**CLAY**: medium plasticity, dark brown.	>Wp			**ALLUVIUM**
									0.5 m: becoming brown				
					29.0	1.0							
					28.5	1.5		CL	**Gravelly CLAY**: low to medium plasticity, brown-red, fine grained sub-angular gravel.	<Wp			**RESIDUAL SOIL**
				E	28.0	2.0			Test pit TP2 terminated at 2.0 m Target depth				
					27.5	2.5							
					27.0	3.0							
					26.5	3.5							
					26.0								

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF EXCAVATION SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:25

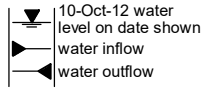
method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration



water



samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remoulded (kPa)

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 - Excavation

		Excavation ID.	***TP3***
		sheet:	1 of 1
		project no.	***754-SYDGE330330***
client:	***Midson Group Pty Ltd***	date excavated:	***05 Oct 2023***
principal:	***The Uniting Church in Australia Property Trust (NSW)***	date completed:	***05 Oct 2023***
project:	***Shellharbour ILUs***	logged by:	***RZ***
location:	***Wattle Road, Shellharbour, NSW***	checked by:	***VN***

position: E: 302044; N: 6173051 (GDA2020 MGA) | surface elevation: 30.20 m (AHD) | pit orientation:

equipment type: Comacchio GEO 205 Track | excavation method: N/A | excavation dimensions:

excavation information | **material substance**

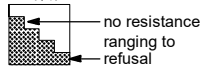
method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	soil group symbol	material description (**SOIL NAME**: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	soil origin, structure and additional observations
AD/T	N		Not Encountered	E	30.0	0			**TOPSOIL: Silty CLAY**: medium plasticity, brown to dark brown.	<Wp - ~Wp			**TOPSOIL**
				B				CL	**Silty CLAY**: low to medium plasticity, brown to dark brown.	~Wp			**ALLUVIUM**
					29.5	0.5							
								CL-CH	**CLAY**: medium to high plasticity, brown, with fine grained sub-angular gravel.				
				E		1.0							
					29.0								
						1.5		CL	**Gravelly CLAY**: low to medium plasticity, brown-red, fine grained sub-angular gravel.	<Wp			**RESIDUAL SOIL**
					28.5								
						2.0			Test pit TP3 terminated at 2.0 m Target depth				
					28.0								
						2.5							
					27.5								
						3.0							
					27.0								
						3.5							
					26.5								

CDF_0_10_00.4_LIBRARY (1).GLB rev:CDF_0_10_00.4 2021-09-30 Log COF EXCAVATION SYDGE330330 - SHELLHARBOUR.GPJ <<DrawingFile>> 25/11/2023 02:25

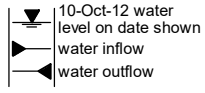
method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator
- HT hand tools

support
- N none
- S shoring

penetration



water



samples & field tests
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- VS vane shear peak/remouded (kPa)

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

APPENDIX C: LABORATORY TESTING RESULTS

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

Client	Tetra tech Coffey	**Source**	BH1_0.2-0.8 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No**	S90265-MDD
Job No	S23445-1	**Sample No**	S90265

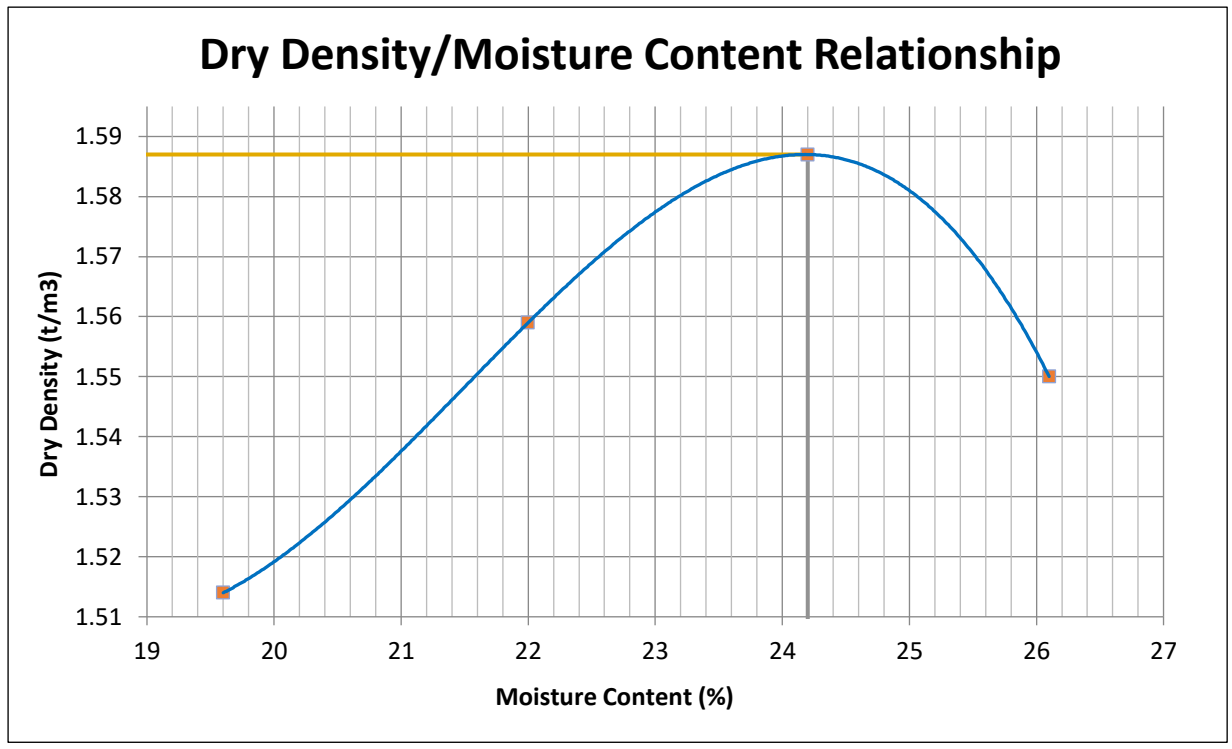
Test Procedure

☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction

☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method **Date Tested** 17/10/2023



Maximum Dry Density (t/m^3)	1.59
Optimum Moisture Content (%)	24.2
Oversize Retained on 19mm sieve (%)	0
Oversize Retained on 37.5mm sieve (%)	0
Curing Time	137 hrs
Liquid Limit Determination	Technician Assessment

Notes

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Results relate only to the samples tested.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

18/10/2023

Date:

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

Client	Tetra tech Coffey	**Source**	BH3_0.1-1.0 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty Sandy CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No**	S90266-MDD
Job No	S23445-1	**Sample No**	S90266

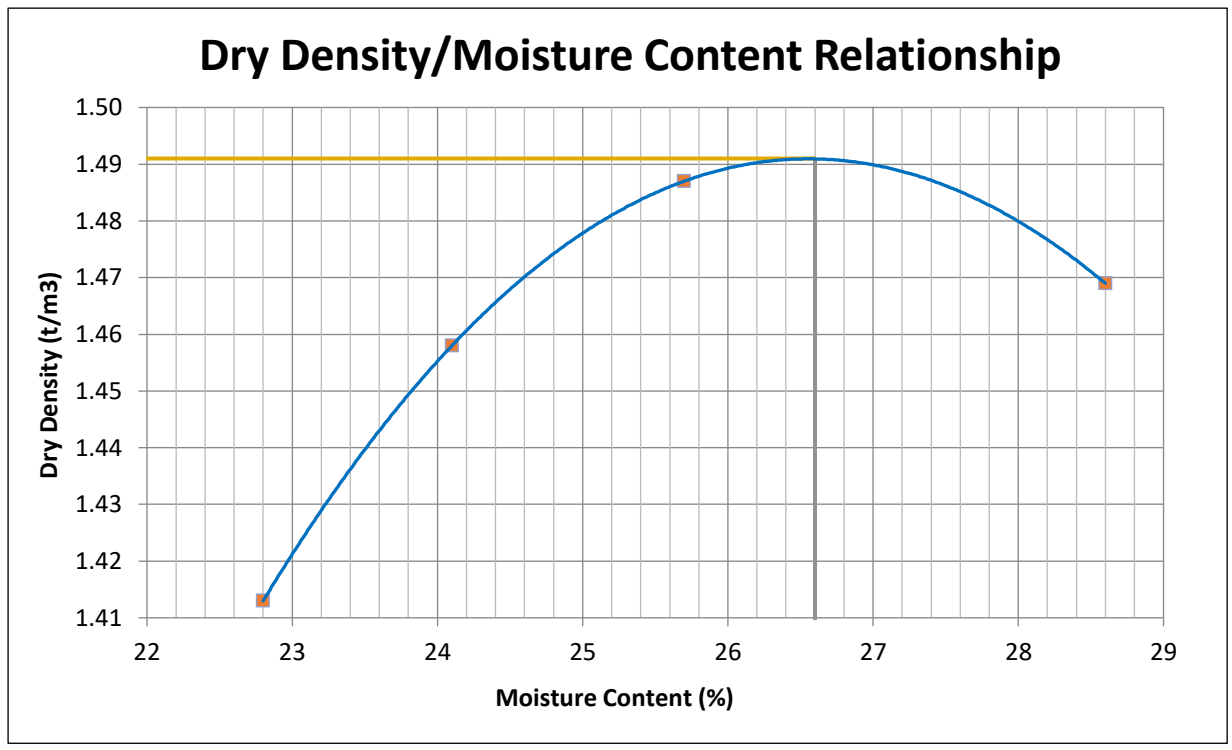
Test Procedure

☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction

☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method **Date Tested** 13/10/2023



Maximum Dry Density (t/m^3)	1.49
Optimum Moisture Content (%)	26.6
Oversize Retained on 19mm sieve (%)	0
Oversize Retained on 37.5mm sieve (%)	0
Curing Time	50 hrs
Liquid Limit Determination	Technician Assessment

Notes

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Authorised Signatory:

Chris Lloyd

17/10/2023

Date:

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Lidcombe NSW 2141

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

Client	Tetra tech Coffey	**Source**	BH6_0.2-1.0 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No**	S90267-MDD
Job No	S23445-1	**Sample No**	S90267

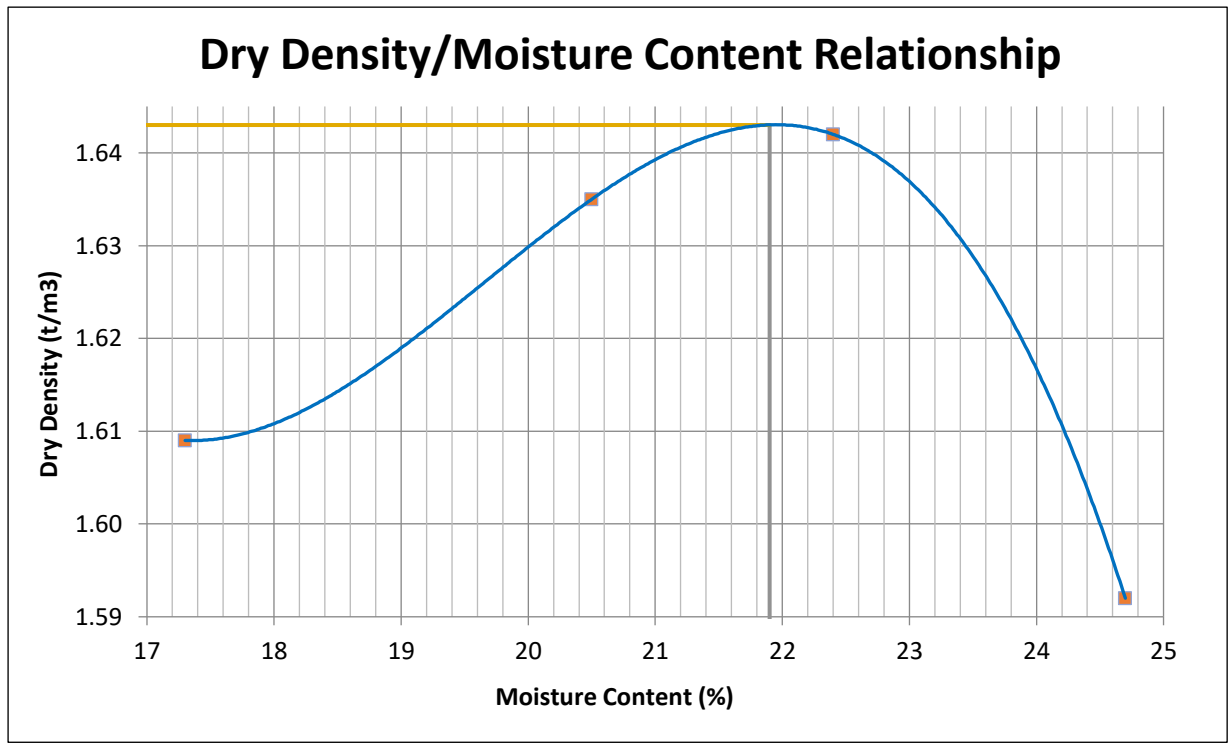
Test Procedure

☑ AS1289.5.1.1 Dry Density / Moisture Content Relationship - Standard Compaction

☑ AS1289.2.1.1 Moisture Content - Oven Drying Method (Standard Method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method **Date Tested** 17/10/2023



Maximum Dry Density (t/m^3)	1.64
Optimum Moisture Content (%)	21.9
Oversize Retained on 19mm sieve (%)	0
Oversize Retained on 37.5mm sieve (%)	0
Curing Time	119 hrs
Liquid Limit Determination	Technician Assessment

Notes

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18/10/2023

Date:

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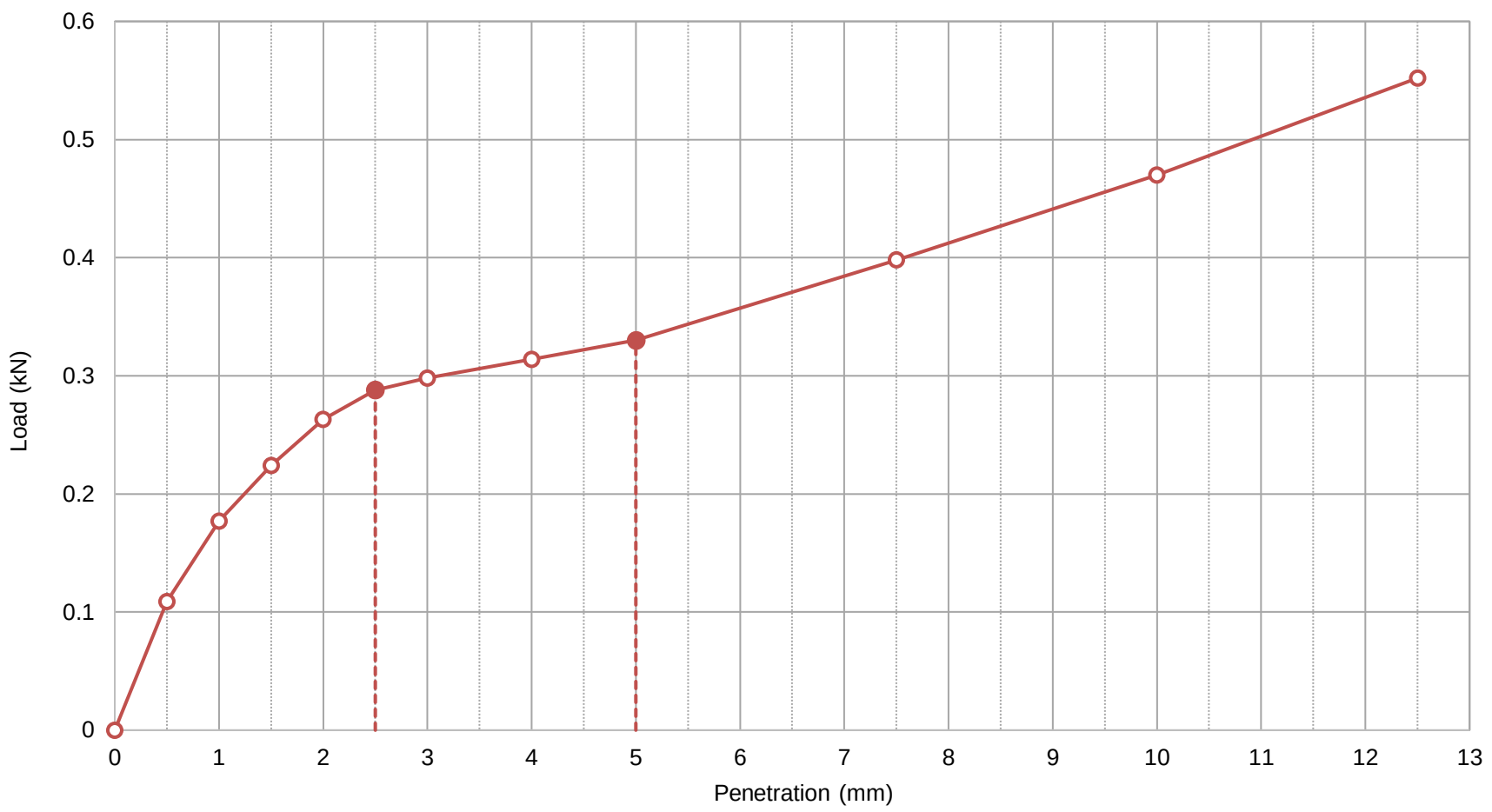
CALIFORNIA BEARING RATIO REPORT

Client	Tetra tech Coffey	**Source**	TP2_0.2-1.0 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No.**	S90268-CBR
Job No.	S23445-1	**Sample No.**	S90268

Test Procedure			
☐ AS 1289.6.1.1	☑ RMS T117	California Bearing Ratio
☐ AS 1289.5.1.1	☑ RMS T111	Dry Density / Moisture Content Relationship - Standard Compaction
☐ AS 1289.5.2.1	☐ RMS T112	Dry Density / Moisture Content Relationship - Modified Compaction
☐ AS 1289.2.1.1	☑ RMS T120	Moisture Content - Oven Drying Method (Standard Method)

Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	Unknown
Preparation	Prepared in accordance with the test method	**Date Tested**	27/10/2023



Preparation & Specification	
Retained on 19.0mm Sieve (%)	0
Method of Establishing Plasticity Level	Technician Assessment
Sample Curing Time (hrs)	120 hrs
Compaction Hammer Used	Standard
Surcharge Mass Applied (kg)	4.5
Period of Soaking (Days)	4
Maximum Dry Density - MDD (t/m³)	1.60
Optimum Moisture Content - OMC (%)	22.8

Density & Moisture	**Achieved**	**Target**
Lab Moisture Ratio - LMR (%)	99.5	100.0
Lab Density Ratio - LDR (%)	100.0	100.0
Dry Density - At Compaction (t/m³)	1.60	1.60
Dry Density - After Soaking (t/m³)	1.55	
Specimen Swell (%)	3.4	
Moisture Content - At Compaction (%)	22.7	
Moisture Content - Top 30mm (%)	31.9	
Moisture Content - Full Depth (%)	26.2	

Material CBR Value (%): 2 at a penetration of 2.5 mm

Notes

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Authorised Signatory:

Chris Lloyd Date: 30/10/2023

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Lidcombe NSW 2141

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

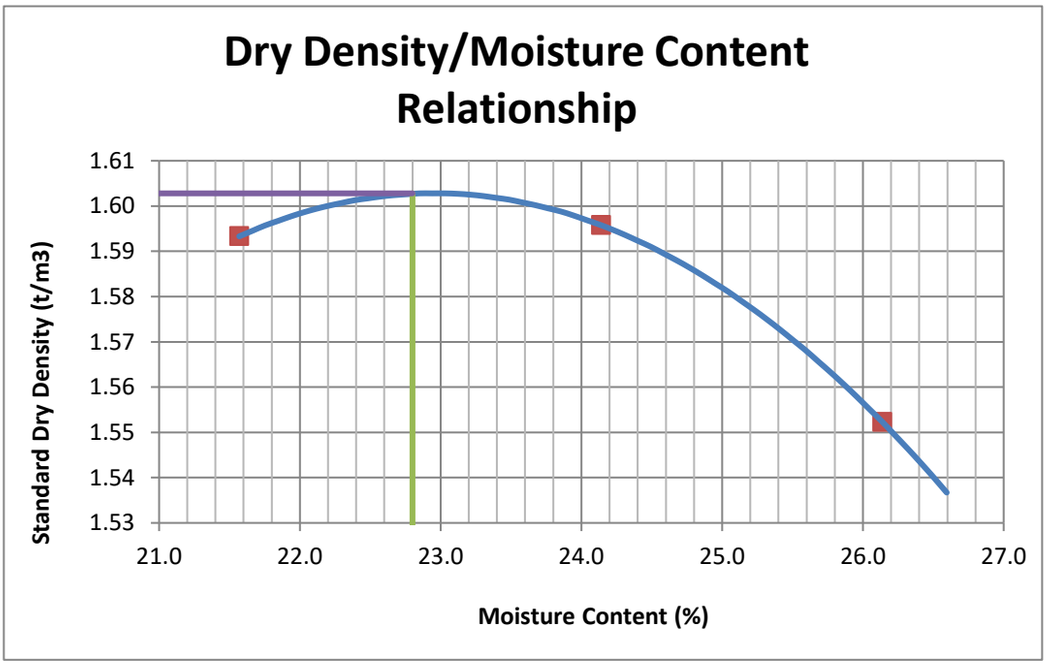
Client	Tetra tech Coffey	**Source**	TP2_0.2-1.0 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No**	S90268-MDD
Job No	S23445-	**Lab No**	S90268

Test Procedure

- ☑ RMS T111 — Dry Density / moisture Relationship of construction materials (Standard Compaction)
- ☐ RMS T112 — Dry Density / moisture Relationship of construction materials (Modified Compaction)
- ☑ RMS T120 — Moisture Content of road construction materials (Standard Method)

Sampling Sampled by Client - results apply to the sample as received — **Date Sampled** Unknown

Preparation Prepared in accordance with the test method — **Date Tested** 17/10/2023



Maximum Dry Density (t/m^3)	1.603
Optimum Moisture Content (%)	22.8
Percentage Oversize on 19mm sieve (%)	0.0
Percentage Oversize on 37.5mm sieve (%)	0.0

Notes

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18/10/2023

Date:

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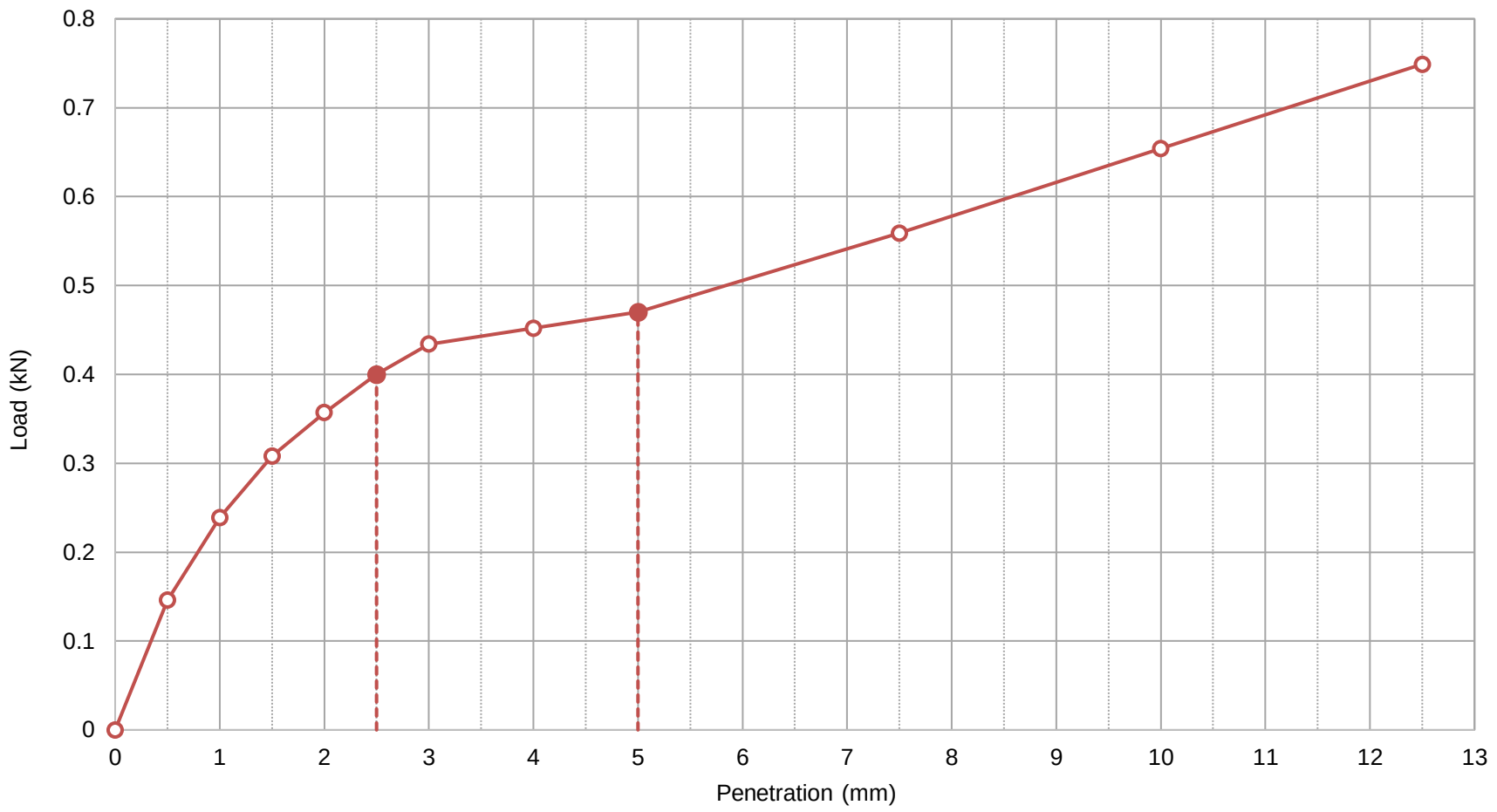
CALIFORNIA BEARING RATIO REPORT

Client	Tetra tech Coffey	**Source**	TP3_0.2-1.0 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No.**	S90269-CBR
Job No.	S23445-1	**Sample No.**	S90269

Test Procedure	☐ AS 1289.6.1.1	☑ RMS T117	California Bearing Ratio
	☐ AS 1289.5.1.1	☑ RMS T111	Dry Density / Moisture Content Relationship - Standard Compaction
	☐ AS 1289.5.2.1	☐ RMS T112	Dry Density / Moisture Content Relationship - Modified Compaction
	☐ AS 1289.2.1.1	☑ RMS T120	Moisture Content - Oven Drying Method (Standard Method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method **Date Tested** 20/10/2023



Preparation & Specification	
Retained on 19.0mm Sieve (%)	0
Method of Establishing Plasticity Level	Technician Assessment
Sample Curing Time (hrs)	51 hrs
Compaction Hammer Used	Standard
Surcharge Mass Applied (kg)	4.5
Period of Soaking (Days)	4
Maximum Dry Density - MDD (t/m³)	1.63
Optimum Moisture Content - OMC (%)	21.9

Density & Moisture	Achieved	Target
Lab Moisture Ratio - LMR (%)	99.5	100.0
Lab Density Ratio - LDR (%)	100.0	100.0
Dry Density - At Compaction (t/m³)	1.63	1.63
Dry Density - After Soaking (t/m³)	1.58	
Specimen Swell (%)	2.6	
Moisture Content - At Compaction (%)	21.8	
Moisture Content - Top 30mm (%)	27.1	
Moisture Content - Full Depth (%)	24.0	

Material CBR Value (%): 3 at a penetration of 2.5 mm

Notes

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Authorised Signatory:

Chris Lloyd Date: 23/10/2023

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14 Carter St
Lidcombe NSW 2141

DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

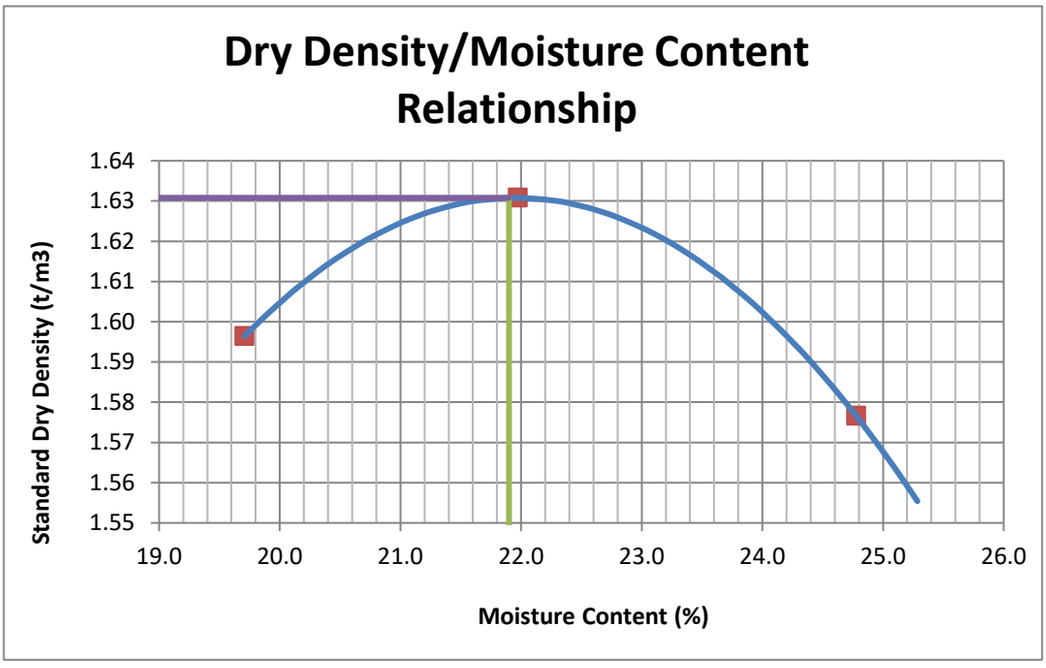
Client	Tetra tech Coffey	**Source**	TP3_0.2-1.0 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No**	S90269-MDD
Job No	S23445-	**Lab No**	S90269

Test Procedure

- ☑ RMS T111 — Dry Density / moisture Relationship of construction materials (Standard Compaction)
- ☐ RMS T112 — Dry Density / moisture Relationship of construction materials (Modified Compaction)
- ☑ RMS T120 — Moisture Content of road construction materials (Standard Method)

Sampling Sampled by Client - results apply to the sample as received — **Date Sampled** Unknown

Preparation Prepared in accordance with the test method — **Date Tested** 17/10/2023



Maximum Dry Density (t/m^3)	1.626
Optimum Moisture Content (%)	21.9
Percentage Oversize on 19mm sieve (%)	0.1
Percentage Oversize on 37.5mm sieve (%)	0.0

Notes

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MOISTURE CONTENT TEST REPORT

Client	Tetra tech Coffey	**Job #**	S23445-1
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Report #**	S90270-MC
Project	754-SYDGE330330 - Shellharbour		

Test Procedure

- ☑ AS 1289 2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method).
- ☐ AS4133 1.1.1 Determination of the moisture content of rock - Oven drying method (standard method)
- ☐ RMS T120 Moisture content of road construction materials (Standard method)
- ☐ RMS T262 Determination of moisture content of aggregates (Standard method)

Sampling Sampled by Client - results apply to the sample as received **Date Sampled** Unknown

Preparation Prepared in accordance with the test method **Date Tested** 12/10/2023

Sample #	Source	Sample Description	Moisture Content %
S90270	BH2_1-1.2 m	Sandy Clayey SILT	**23.3**
S90271	BH6_1-1.45 m	Silty CLAY	**26.6**
S90272	BH5_1-1.45 m	Silty CLAY	**18.3**

Notes

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NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

23/10/2023

Date:

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

Shrink-Swell Index Report

Client	Tetra tech Coffey	**Source**	BH2_1-1.2 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Sandy Clayey SILT
Project	754-SYDGE330330 - Shellharbour	**Report No**	S90270-SS
Job No	S23445-1	**Lab No**	S90270

Test Procedure	AS 1289.7.1.1 Soil reactivity tests - Determination of the shrinkage index of a soil - Shrink-swell index		
Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	Unknown
Preparation	Prepared in accordance with the test method	**Date Tested**	16/10/2023

Sample Type	
Undisturbed	
Swell Test	
Swell on Saturation(E_{SW})	0.3
Moisture Content Before Test (%)	23.3
Moisture Content After Test (%)	28.9
Shrink Test	
Shrinkage on Drying (E_{SH}%)	2.7
Estimated Inert Material Present (%)	0.0
Extent of Crumbling During Shrinkage	Mild
Extent of Cracking During Shrinkage	Mild
Moisture Content (%)	22.4
Shrink-Swell Index	
I_{ss} (percentage vertical strain per pF change in total suction)	**1.6**

Notes

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Shrink-Swell Index Report

Client	Tetra tech Coffey	**Source**	BH6_1-1.45 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No**	S90271-SS
Job No	S23445-1	**Lab No**	S90271

Test Procedure	AS 1289.7.1.1 Soil reactivity tests - Determination of the shrinkage index of a soil - Shrink-swell index		
Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	Unknown
Preparation	Prepared in accordance with the test method	**Date Tested**	14/10/2023

Sample Type	
Undisturbed	
Swell Test	
Swell on Saturation(E_{SW})	0.5
Moisture Content Before Test (%)	26.6
Moisture Content After Test (%)	26.1
Shrink Test	
Shrinkage on Drying (E_{SH}%)	1.0
Estimated Inert Material Present (%)	0.0
Extent of Crumbling During Shrinkage	Strong
Extent of Cracking During Shrinkage	Strong
Moisture Content (%)	24.3
Shrink-Swell Index	
I_{ss} (percentage vertical strain per pF change in total suction)	**0.7**

Notes

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Authorised Signatory: Date:

16/10/2023

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14 Carter St
Lidcombe NSW 2141

Document Set ID: 12363439
Version: 1, Version Date: 23/01/2025

SOIL CLASSIFICATION REPORT

Client	Tetra tech Coffey	**Source**	BH5_1-1.45 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No.**	S90272-PI
Job No.	S23445-1	**Lab No.**	S90272

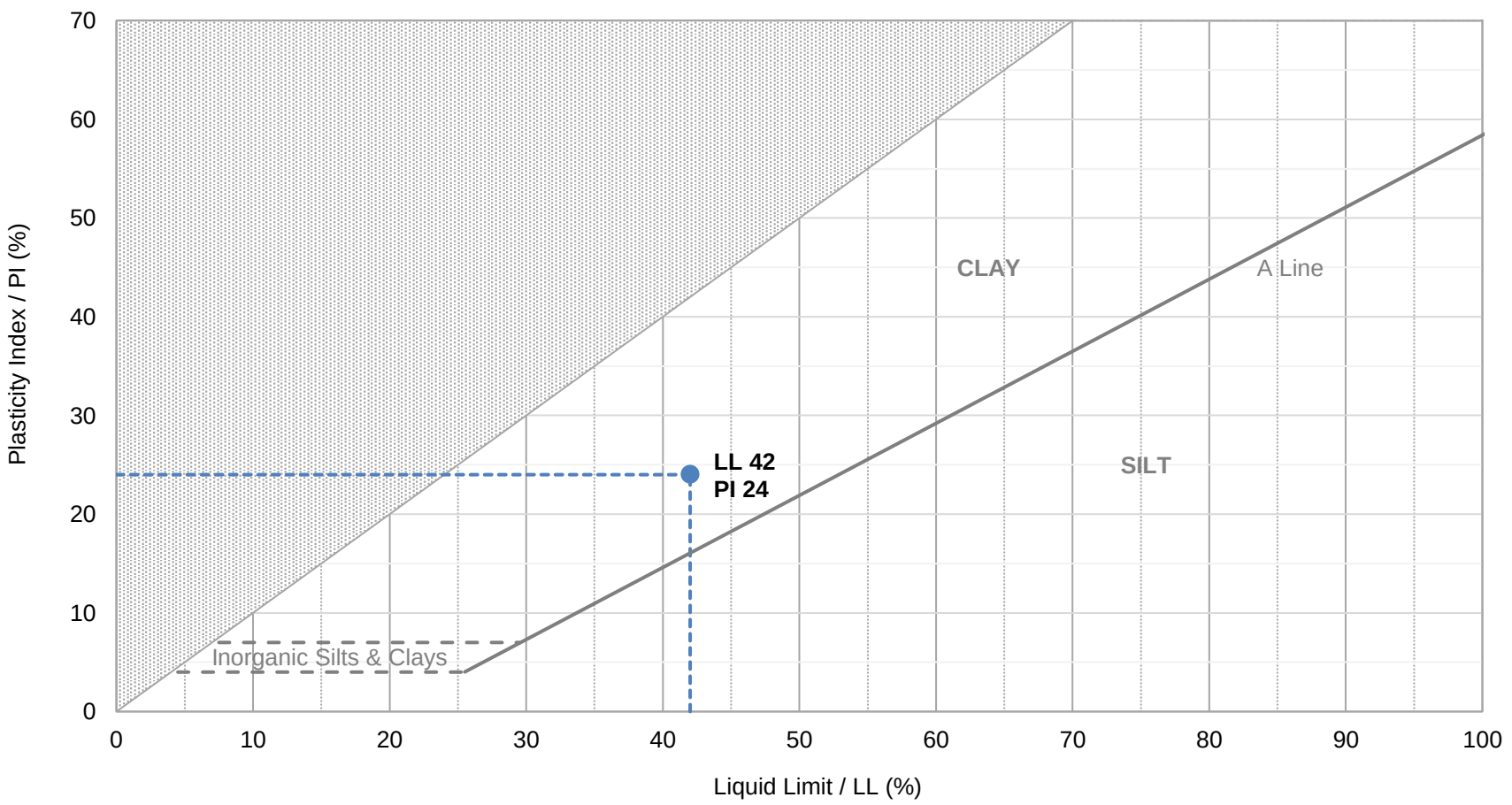
Test Procedure

☑	AS1289 3.1.1	Liquid Limit - Four point Casagrande method
☐	AS1289 3.1.2	Liquid Limit - One point Casagrande method
☑	AS1289 3.2.1	Plastic Limit - Standard method
☑	AS1289 3.3.1	Calculation of the Plasticity Index
☑	AS1289 3.4.1	Linear Shrinkage - Standard method

Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	Unknown
Preparation	Prepared in accordance with the test method	**Date Tested**	19/10/2023

Plasticity Chart for Classification of Fine-Grained Soils

AS 1726:2017 Clause 6.1.6 (Figure 5)



Preparation		**Results**	
Method of Preparation	**Dry Sieved**	Liquid Limit / LL (%)	**42**
History of the Sample	**Oven Dried**	Plastic Limit (%)	**18**
		Plasticity Index / PI (%)	**24**
		Linear Shrinkage (%)	**8.0**
		Condition upon Drying	**Linear**

Notes

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Authorised Signatory:

Chris Lloyd

23/10/2023

Date:

Macquarie Geotechnical
14 Carter St
Lidcombe NSW 2141

SOIL CLASSIFICATION REPORT

Client	Tetra tech Coffey	**Source**	BH4_1-1.05 m
Address	Level 19, Tower B, Citadel Tower, 799 Pacific Highway Chatswood	**Sample Description**	Silty CLAY
Project	754-SYDGE330330 - Shellharbour	**Report No.**	S90273-PI
Job No.	S23445-1	**Lab No.**	S90273

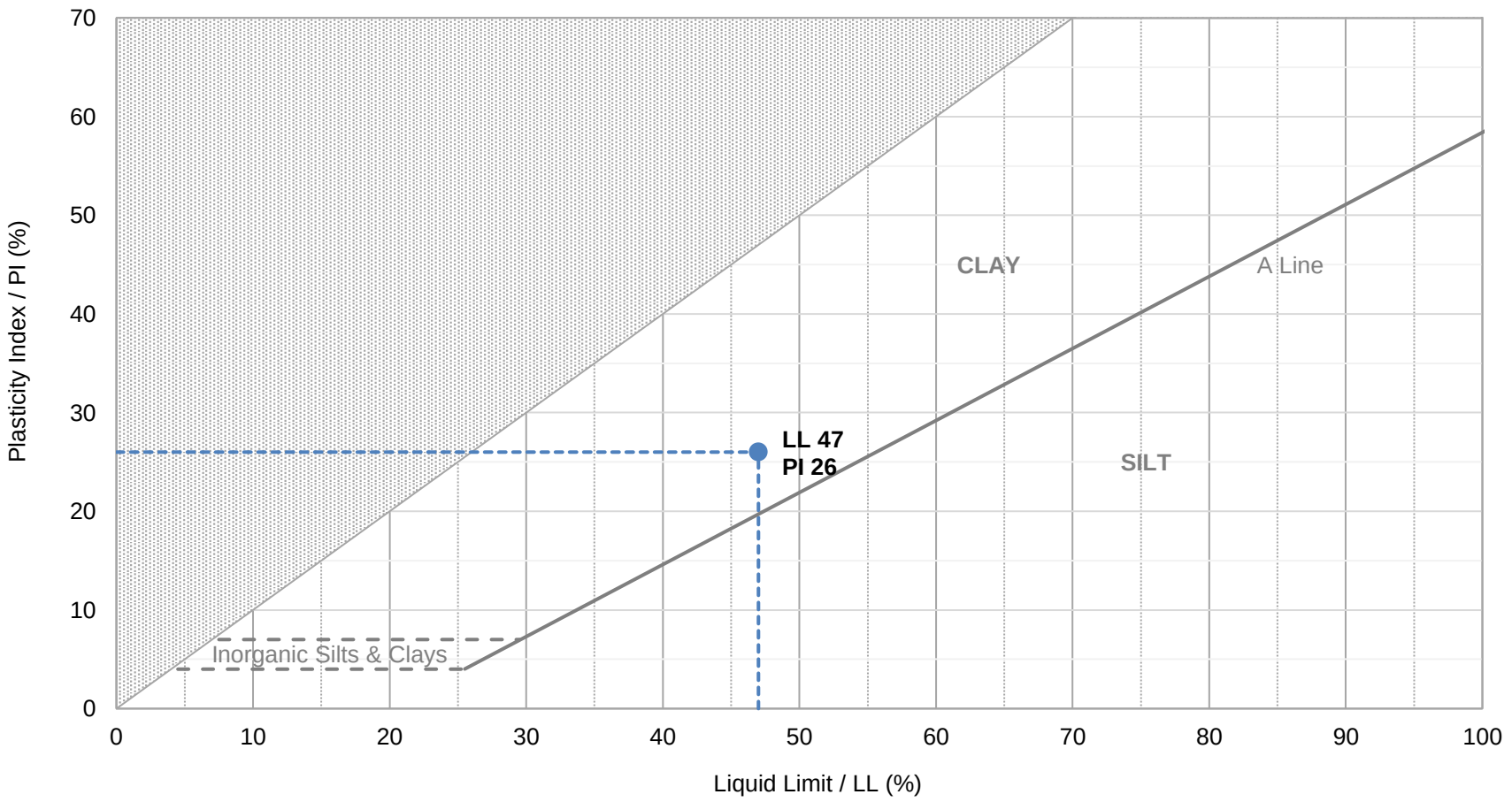
Test Procedure

- ☑ AS1289 3.1.1 Liquid Limit - Four point Casagrande method
- ☐ AS1289 3.1.2 Liquid Limit - One point Casagrande method
- ☑ AS1289 3.2.1 Plastic Limit - Standard method
- ☑ AS1289 3.3.1 Calculation of the Plasticity Index
- ☐ AS1289 3.4.1 Linear Shrinkage - Standard method

Sampling	Sampled by Client - results apply to the sample as received	**Date Sampled**	Unknown
Preparation	Prepared in accordance with the test method	**Date Tested**	19/10/2023

Plasticity Chart for Classification of Fine-Grained Soils

AS 1726:2017 Clause 6.1.6 (Figure 5)



Preparation

Method of Preparation	**Dry Sieved**
History of the Sample	**Oven Dried**

Results

Liquid Limit / LL (%)	**47**
Plastic Limit (%)	**21**
Plasticity Index / PI (%)	**26**

Notes

Sample was insufficient for 4 PT Atterberg Limits and Linear Shrinkage. 1 PT Atterberg was performed

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. This document shall not be reproduced, except in full. Results relate only to the samples tested.

NATA Accredited Laboratory Number: 14874

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Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	Trip Spike	Trip Blank	BH1/0-0.2	BH1/0.8-1.0	BH1/1.5-1.7
			Sampling date / time	25-Sep-2023 00:00	25-Sep-2023 00:00	05-Oct-2023 00:00	05-Oct-2023 00:00	05-Oct-2023 00:00
Compound	CAS Number	LOR	Unit	ES2334707-001	ES2334707-002	ES2334707-003	ES2334707-004	ES2334707-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	----	----	7.8	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	65	----
EA055: Moisture Content								
Moisture Content	----	1.0	%	----	----	31.1	----	8.3
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	----	----	16.7	----
EA200: AS 4964 - 2004 Identification of Asbestos in Soils								
Asbestos Detected	1332-21-4	0.1	g/kg	----	----	No	----	----
Asbestos (Trace)	1332-21-4	-	-	----	----	No	----	----
Asbestos Type	1332-21-4	-	--	----	----	-	----	----
Synthetic Mineral Fibre	----	-	--	----	----	No	----	----
Organic Fibre	----	-	--	----	----	No	----	----
Sample weight (dry)	----	0.01	g	----	----	47.0	----	----
APPROVED IDENTIFIER:	----	-	--	----	----	A. SMYLIE	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	----	3.3	----
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	----	7.0	----
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	----	<0.2	----
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	----	2.0	----
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	----	12.3	----
ø Exchangeable Sodium Percent	----	0.2	%	----	----	----	15.9	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	----	20	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	----	----	<50	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	----	----	<5	----	<5
Cadmium	7440-43-9	1	mg/kg	----	----	<1	----	<1
Chromium	7440-47-3	2	mg/kg	----	----	22	----	22
Copper	7440-50-8	5	mg/kg	----	----	32	----	48
Lead	7439-92-1	5	mg/kg	----	----	19	----	7
Nickel	7440-02-0	2	mg/kg	----	----	10	----	14

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH2/0-0.2	BH2/0.9-1.0	BH3/0.5-0.8	BH4/0.8-1.0	BH5/0.8-1.0
			Sampling date / time	06-Oct-2023 00:00	06-Oct-2023 00:00	06-Oct-2023 00:00	04-Oct-2023 00:00	05-Oct-2023 00:00
Compound	CAS Number	LOR	Unit	ES2334707-006	ES2334707-007	ES2334707-009	ES2334707-011	ES2334707-013
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	7.8	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	265	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	22.5	17.6	24.8	20.7	25.5
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	60	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	390	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	----	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	----	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	----	28	32	18	18
Copper	7440-50-8	5	mg/kg	----	58	38	49	30
Lead	7439-92-1	5	mg/kg	----	10	13	10	8
Nickel	7440-02-0	2	mg/kg	----	20	13	9	6
Zinc	7440-66-6	5	mg/kg	----	75	45	65	28
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	<0.1	<0.1	<0.1	<0.1
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	319-85-7	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC	58-89-9	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	319-86-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	76-44-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	309-00-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	1024-57-3	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
^ Total Chlordane (sum)	----	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
trans-Chlordane	5103-74-2	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05
alpha-Endosulfan	959-98-8	0.05	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	TP2/0-0.2	DUP-2	TP2/1.8-2.0	TP3/0-0.2	TP3/1.0-1.2
			Sampling date / time	05-Oct-2023 00:00	05-Oct-2023 00:00	05-Oct-2023 00:00	05-Oct-2023 00:00	05-Oct-2023 00:00
Compound	CAS Number	LOR	Unit	ES2334707-021	ES2334707-022	ES2334707-023	ES2334707-024	ES2334707-025
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	----	5.3	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	364	----	----
EA055: Moisture Content								
Moisture Content	----	1.0	%	25.2	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	28.9	22.5	19.3	22.4
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	1.4	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	9.7	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	0.1	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	1.9	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	13.1	----	----
Exchangeable Sodium Percent	----	0.1	%	----	----	14.4	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	190	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	----	280	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	----	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	----	<1
Chromium	7440-47-3	2	mg/kg	26	25	25	----	26
Copper	7440-50-8	5	mg/kg	43	31	23	----	20
Lead	7439-92-1	5	mg/kg	17	16	13	----	10
Nickel	7440-02-0	2	mg/kg	8	8	6	----	6
Zinc	7440-66-6	5	mg/kg	55	44	29	----	20
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	----	<0.1
EP066: Polychlorinated Biphenyls (PCB)								
Total Polychlorinated biphenyls	----	0.1	mg/kg	----	----	<0.1	<0.1	<0.1
EP068A: Organochlorine Pesticides (OC)								
alpha-BHC	319-84-6	0.05	mg/kg	----	----	<0.05	<0.05	<0.05
Hexachlorobenzene (HCB)	118-74-1	0.05	mg/kg	----	----	<0.05	<0.05	<0.05