Geotechnical Investigation Report

GEOTECHNICAL AND ACID SULFATE SOILS REPORT FOR

85-91 THOMAS STREET, PARRAMATTA NSW

Prepared for:

[redacted]

Reference: P2079_ 03

2 July 2025

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1 PROJECT BACKGROUND

Morrow Geotechnics Pty Ltd has undertaken a Geotechnical Investigation to provide geotechnical advice and recommendations for the proposed development at 85-91 Thomas Street, Parramatta NSW (the site).

1.1 Proposed Development

Architectural Drawings for the site have been prepared by PTI Architecture for project P541. From the drawings provided, Morrow Geotechnics understands that the proposed development involves demolition of existing structures at the site and construction of two residential structures over up to three level of basement parking. Excavation is expected to extend to a depth of approximately 6.05 m below existing ground level (mBGL).

1.2 Investigation Intent

The purpose of the investigation is to provide geotechnical advice and recommendations specific to the ground conditions observed at site for the proposed development. These recommendations include:

- Foundation advice along with relevant geotechnical design parameters;
- Excavation and shoring advice along with relevant geotechnical design parameters;
- Approaches to minimise the impact of the proposed development through vibration, ground movement or groundwater drawdown;
- Other relevant geotechnical issues which may impact construction; and
- Recommendations for further geotechnical input.

1.3 Published Geological Mapping

Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9130 (DMR 1983), indicates that the site overlies Ashfield Shale, which typically comprises black to dark grey shale and laminite.

1.4 Published Soil Landscapes

The Soil Conservation Service of NSW Sydney 1:100,000 Soil Landscapes Series Sheet 9130 (1st Edition) indicates that the residual landscape at the site likely comprises the Blacktown Landscape. This landscape type typically includes gently undulating rises on Wianamatta Group shales. It generally comprises shallow to moderately deep (< 1.0 m) red and brown podzolic soils on crests and upper slopes. These soils are noted to present poor soil drainage and moderately reactive, highly plastic subsoil.

2 OBSERVATIONS

2.1 Investigation Methods

Fieldwork was undertaken by Morrow Geotechnics on 20 and 23 November 2020. Work carried out as part of this investigation includes:

- Review of publicly available information from previous reports in the project area, published geological and soil mapping and government agency websites;
- Site walkover inspection by an experienced geotechnical engineer to assess topographical features, condition of surrounding structures and site conditions;
- Dial Before You Dig (DBYD) services search of proposed borehole locations;
- Drilling of three boreholes (BH1 to BH3) by a track mounted drill rig using solid flight augers equipped with a tungsten-carbide bit (TC bit). The boreholes were extended beyond TC bit refusal by NMLC coring techniques to depths of 10.17, 9.85 and 10.27 m below ground level (mBGL) respectively. Rock core was boxed and photographed and point load tests were undertaken on selected core sample to assess rock strength. Due to restricted access to the rear of one of the lots, one DCP (DCP4) was carried out to assess soil density/consistency and infer top of rock. Borehole and DCP locations are shown on **Figure 1** and borehole logs are presented in **Appendix A**;
- Groundwater observations within boreholes during drilling.

2.2 Subsurface Conditions

The stratigraphy at the site is characterised by residual soil overlying shale bedrock. Observations taken during the investigation have been used to produce a stratigraphic model of the site. The observed stratigraphy has been divided into six geotechnical units.

A summary of the subsurface conditions across the site, interpreted from the investigation results, is presented in **Table 1**. More detailed descriptions of subsurface conditions at the test locations are available in the borehole logs presented in **Appendix A**. The details of the method of soil and rock classification, explanatory notes and abbreviations adopted in the borehole logs are also presented in **Appendix A**.

TABLE 1 SUMMARY OF INFERRED SUBSURFACE CONDITIONS

Unit	Material	Approx. Depth Range of Unit [1] mBGL [RL mAHD]				Comments
		BH1	BH2	BH3	DCP4 [2]	
1	Fill	-	-	0.0 to 0.2	0.0 to 1.5	Concrete slab over residual soil.
2	Residual Soil	0.0 to 1.4	0.0 to 1.75	0.2 to 1.0		Generally medium to high plasticity silty clay with some ironstone gravel present. Stiff to very stiff consistency.
3	Class V Shale	1.4 to 3.0	1.75 to 2.8	1.0 to 2.0	1.5 +	Ashfield Shale comprising laminated Siltstone and Sandstone, grading from extremely weathered to fresh, grading from extremely low strength to high strength with depth. Rock classifications are in accordance with the Pells Rock Mass Classification System.
4	Class IV Shale	3.0 to 4.2	-	2.0 to 2.8	-	
5	Class III Shale	4.2 to 5.3	2.8 to 4.0	2.8 to 4.5	-	
6	Class II Shale	5.3 to 10.17	4.0 to 9.85	4.5 to 10.27	-	Ashfield Shale comprising laminated Siltstone and Sandstone, grading from extremely weathered to fresh, grading from extremely low strength to high strength with depth. Rock classifications are in accordance with the Pells Rock Mass Classification System.

Notes:

1 Depths shown are based on material observed within test locations and will vary across the site.

2 Depth range of shale at DCP4 is inferred from DCP refusal only and must me confirmed by a qualified geotechnical engineer during construction inspections.

2.3 Groundwater Observations

A standpipe piezometer was installed within BH2 and bailed dry of drilling fluids on 23 November 2020. Groundwater was not observed within the boreholes during the investigation. A regional groundwater table is not present at the site within the proposed depth of excavation. Minor seepage should be expected from the soil/rock interface and from within open joints in the rock mass during excavation as a response to surface water infiltration.

3 RECOMMENDATIONS

3.1 Excavation Retention

Temporary batters may be considered for retention during basement excavation only where adequate room for full batter construction is available. Temporary batter slopes of 1V:1H will be possible for all units above the water table provided that surface water is diverted away from the batter faces and batter heights are kept to less than 4m. Where batters extend beyond 4 m height benching may be required and further advice should be sought from a qualified geotechnical engineer. Permanent batters of 2H:1V may be employed for excavation design above the water table. Permanent batters will require surface protection or revegetation to prevent erosion and slaking.

For design of flexible shoring systems a triangular pressure distribution may be employed using the parameters provided in **Table 2**. For design of rigid anchored or braced walls, a trapezoidal earth pressure distribution should be used with a maximum pressure of $0.65.K_a.\gamma.H$ (kPa), where 'H' is the effective vertical height of the wall in metres.

Morrow Geotechnics understands that the finite element software package Wallap will be used for design of shoring. Drained cohesion and friction angles for input to Wallap have been provided in **Table 2** below.

TABLE 2 EARTH PRESSURE PARAMETERS

Material		Unit 1 Fill	Unit 2 Residual Soil	Unit 3 Class V Shale	Unit 4 Class IV Shale	Unit 5 Class III Shale	Unit 6 Class II Shale
Bulk Unit Weight (kN/m^3)		17	18	22	23	24	24
Saturated Unit Weight (kN/m^3)		18.5	19.5	23	23.5	24	24
Earth Pressure Coefficients	At rest, K_o	0.58	0.58	0.53	0.48	0.44	0.33
	Passive, K_p	2.46	2.46	2.77	3.12	3.54	5.04
	Active, K_a	0.41	0.41	0.36	0.32	0.28	0.20
Drained Cohesion, c' (kPa)		3	6	10	30	70	200
Drained Friction Angle, ϕ' (°)		25	25	28	31	34	42
Elastic Modulus (MPa)		5	20	75	100	200	400
Poisson's Ratio		0.30	0.30	0.30	0.25	0.22	0.20
Wall interface angle reduction (Active)		0.66	0.66	0.66	0.66	0.66	0.66
Wall interface angle reduction (Passive)		0.5	0.5	0.5	0.5	0.5	0.5

1 Unit Weight is based on visual assessment only, order of accuracy is approximately ±10%.
2 Earth pressures are provided on the assumption that the ground behind the retaining wall is flat and drained.

In addition, design of retaining walls should consider the following:

- Appropriate surcharge loading from construction equipment, vehicular traffic and neighbouring structures at finished surface level should be taken into account in the retention design. Surcharge loads on retention structures may be calculated using a rectangular stress block with an earth pressure coefficient of 0.5 applied to surcharge loads at ground surface level.
- Anchor design should ignore the contribution of any bonded length within a wedge which extends upwards at 45^{o} from the base of the excavation to account for a failure wedge forming behind the shoring system.

3.1.1 Design for Rock Wedge Failure

Several joints were noted within the investigation which are indicative of movement within the rock mass. Most notably, the following features indicate ongoing movement:

- BH1 – 6.6 to 6.8 mBGL, shear zone comprising orthogonal jointing and crushed rock.
- BH1 – 9.68 mBGL, 45° joint with slickensided, polished, surface.
- BH3 – 4.15to 4.4 mBGL, shear zone comprising orthogonal jointing and crushed rock with slickensided surfaces on joints indicative of movement.

The inferred mechanism of movement is the release of insitu stresses by erosion of the Parramatta River channel.

Given the presence of features indicating wedge failures are occurring at the site it is important that wedge failures are assumed in the design of shoring. It is not recommended that unsupported batters or vertical cut within high strength shale are adopted below 4 m depth. Any shoring design must incorporate a horizontal loading caused by an assumed rock wedge which is up to 4 m high and up to 8 m wide. A rear release plane may be assumed at 45° inclination above the horizontal with an interface friction angle of 25°. Based on these assumptions, the shoring wall must accommodate a wedge loading of 70 kN per m run of wall applied at mid-height in excess of earth pressures calculated through the methodology provided in Section 3.1 above.

3.2 Soil and Rock Excavatability

The expected ability of equipment to excavate the soil and rock encountered at the site is summarised in **Table 3**. This assessment is based on available site investigation data and guidance on the assessment of excavatability of rock by Pettifer and Fookes (1994). The presence of medium to high strength bands in lower strength rock and the discontinuity spacing may influence the excavatability of the rock mass.

TABLE 3 SOIL AND ROCK EXCAVATABILITY

Unit	Material	Excavatability
1	Fill	Easy digging by 20t Excavator
2	Residual Soil	Easy digging by 20t Excavator
3	Class V Shale	Moderate to hard ripping by 20t Excavator
4	Class IV Shale	Hard ripping by 20t Excavator with hydraulic hammering required where medium strength shale is encountered within Unit 4
5	Class III Shale	Hydraulic hammering will be required in medium to high strength shale within Unit 5.
6	Class II Shale	Hydraulic hammering will be required in medium to high strength shale within Unit 6.

The excavation methodology may also be affected by the following factors:

- Scale and geometry of the excavation;
- Availability of suitable construction equipment;
- Potential reuse of material on site; and
- Acceptable excavation methods, noise, ground vibration and other environmental criteria.

3.3 Excavation Vibration Considerations

As a guide, safe working distances for typical items of vibration intensive plant are listed in **Table 4**. The safe working distances are quoted for both "cosmetic" damage (refer British Standard BS 7385:1993) and human comfort (refer NSW Environmental Protection Agency Vibration Guideline).The safe working distances should be complied with at all times, unless otherwise mitigated to the satisfaction of the relevant stakeholders.

TABLE 4 RECOMMENDED SAFE WORKING DISTANCES FOR VIBRATION INTENSIVE PLANT

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385:1993) [1]	Human Response (EPA Vibration Guideline)
Vibratory Roller	< 50 kN (typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (typically 2-4 tonnes)	6 m	20 m
	< 200 kN (typically 4-6 tonnes)	12 m	40 m
	< 300 kN (typically 7-13 tonnes)	15 m	100 m
	< 300 kN (typically 13-18 tonnes)	20 m	100 m
	< 300 kN (typically >18 tonnes)	25 m	100 m
Small Hydraulic Hammer	300 kg – 5 to 12 t excavator	2 m	7 m
Medium Hydraulic Hammer	900 kg – 12 to 18 t excavator	7 m	23 m
Large Hydraulic Hammer	1600 kg – 18 to 34 t excavator	22 m	73 m
Vibratory Pile Driver	Sheet Piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Notes:

1 More stringent conditions may apply to heritage buildings or other sensitive structures.

In relation to human comfort (response), the safe working distances in **Table 4** relate to continuous vibration and apply to residential receivers. For most construction activities, vibration emissions are intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods are permitted, as discussed in British Standard BS 6472-1:2008.

The safe working distances provided in **Table 4** are given for guidance only. Monitoring of vibration levels may be required to ensure vibrations levels remain below threshold values during the construction period.

3.4 Foundation Design

The parameters given in **Table 5** may be used for the design of pad footings and bored piles. Morrow Geotechnics recommends that a Preliminary Geotechnical Strength Reduction Factor (GSRF) of 0.4 is used for the design of piles in accordance with AS 2159:2009 if no allowance is made for pile testing during construction. Should pile testing be nominated, the GSRF may be reviewed and a value of 0.55 to 0.65 may be expected.

Ultimate geotechnical strengths are provided for use in limit state design. Allowable bearing pressures are provide for serviceability checks. These values have been determined to limit settlements to an acceptable level for conventional building structures, typically less than 1% of the minimum footing dimension.

TABLE 5 PAD FOOTING AND PILE DESIGN PARAMETERS

Material		Unit 1 Fill	Unit 2 Residual Soil	Unit 3 Class V Shale	Unit 4 Class IV Shale	Unit 5 Class III Shale	Unit 6 Class II Shale
Allowable Bearing Pressure (kPa)		N/A	200	700	1000	2000	3500
Ultimate Vertical End Bearing Pressure (kPa)		N/A	600	2100	3000	6000	10500
Elastic Modulus (MPa)		5	20	75	100	200	400
Allowable Shaft Adhesion (kPa)	In Compression	0	20	70	100	200	350
	In Tension	0	10	35	50	100	175
Susceptibility to Liquefaction during an Earthquake		Medium	Low	Low	Low	Low	Low

Notes:

1 Side adhesion values given assume there is intimate contact between the pile and foundation material. Design engineer to check both 'piston' pull-out and 'cone' pull-out mechanics in accordance with AS4678-2002 Earth Retaining Structures.

2 Susceptibility to liquefaction during an earthquake is based on the following definition:
- Low - Medium to very dense sands, stiff to hard clays, and rock
- Medium - Loose to medium dense sands, soft to firm clays, or uncontrolled fill below the water table
- High - Very loose sands or very soft clays below the water table

3 Allowable Bearing Pressure provided for Unit 6 Class II Shale will require on site verification of rock quality by spoon testing of a minimum of 50% of the pad footings to 2 times the minimum pad footing width.

To adopt these parameters we have assumed that the bases of all pile excavations are cleaned of loose debris and water and inspected by a suitably qualified Geotechnical Engineer prior to pile construction to verify that ground conditions meet design assumptions. Where groundwater ingress is encountered during pile excavation, concrete is to be placed as soon as possible upon completion of pile excavation. Pile excavations should be pumped dry of water prior to pouring concrete, or alternatively a tremmie system could be used.

Selection of footing types and founding depth will need to consider the risk of adverse differential ground movements within the foundation footprint and between high level and deeper footings. Unless an allowance for such movement is included in the design of the proposed development we recommend that all new structures found on natural materials with comparable end bearing capacities and elastic moduli.

3.5 AS1170 Earthquake Site Risk Classification

Assessment of the material encountered during the investigation in accordance with the guidelines provided in AS1170.4-2007 indicates an earthquake subsoil class of Class B_e – Rock for the site.

3.6 Excavation Seepage Management

Seepage water would usually be encountered at the soil/rock interface and in joints and bedding partings within the bedrock. Seepage in sandstone bedrock may be assumed as typically flowing downwards toward local drainage lines or regional water table, along horizontal bedding planes and sub-vertical joints. The rock mass permeability will be governed by the joints, faults and bedding planes.

Due to the observed relatively intact bedrock with tight defects across the site it is anticipated that the permeability of the sandstone will be relatively low and that seepage inflows will be controlled by sump and pump methods.

No water table was observed at the site to below the proposed depth of excavation therefore the works do not require licensing with DPI Office of Water in accordance with the Water Management Act 2000 or the NSW Aquifer Interference Policy 2012.

4 Acid Sulfate Soils Assessment

4.1 Desktop Study

The Acid Sulfate Soil Risk Map of Parramatta Local Environmental Plan 2011 indicates that the site overlies the boundary between mapped Class 5 and Class 2 Acid Sulfate Soil areas, shown in **Figure 1** below.

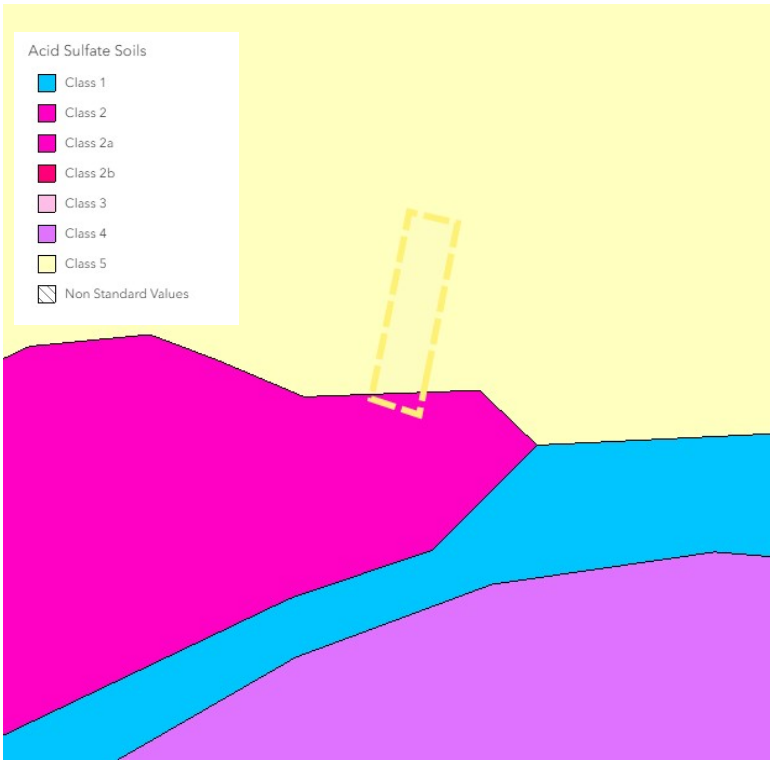

Figure 1: Screenshot from www.planningportal.nsw.gov.au showing Class 5 & 2 ASS at the site location.

- The Acid Sulfate Soil Risk Map of Parramatta Council area indicates that the site is in a Class 2 Acid Sulfate Soil area. In accordance with Section 6.1 of the Parramatta Local Environmental Plan 2011, development consent for Class 2 sites is required for:
    - Works below the natural ground surface.

- Works by which the watertable is likely to be lowered.
- The groundwater level encountered in the investigation is below the base of proposed excavation. It is likely that proposed development works will not lower the groundwater level.

4.2 Field Screening

The above assessments based on review of available information indicate acid sulfate or potentially acid sulfate soils may be encountered at the proposed development site and that an Acid Sulfate Soil assessment will be required for the development. Ten total representative soil samples from BH1 were collected and screened for Acid Sulfate Soil indicators. Field screening involved measurement of field pH along with measuring the result of rapid oxidization of the soil using hydrogen peroxide. Results of the field screening tests are shown in **Table 5**.

TABLE 5 ACID SULFATE FIELD SCREENING RESULTS

Sample	Field pH	Peroxide pH	Reaction to H_2O_2		
			Odour	Reaction	Colour Change
BH1 – 0.1 mBGL	4.8	4.8	Nil	Nil	Nil
BH1 – 0.5 mBGL	4.5	4.3	Nil	Slight	Nil
BH1 – 0.9 mBGL	4.8	4.7	Nil	Nil	Nil
BH1 – 1.5 mBGL	4.7	4.6	Nil	Slight	Nil
BH2 – 0.5 mBGL	4.2	4.1	Nil	Nil	Nil
BH2 – 1.0 mBGL	4.5	4.6	Nil	Nil	Nil
BH2 – 1.5 mBGL	4.4	3.4	Nil	Nil	Nil
BH2 – 2.0 mBGL	4.6	3.8	Nil	Nil	Nil
BH3 – 0.5 mBGL	4.4	4.3	Nil	Nil	Nil
BH3 – 1.5 mBGL	5.1	3.8	Nil	Nil	Nil
BH3 – 2.0 mBGL	5.3	4.1	Nil	Nil	Nil

The laboratory test results summarised in **Table 5** indicate the following:

- The field pH values are in range of 5.3 to 4.2. Field pH readings in this range are not indicative of the possible presence of actual acid sulfate soils.
- The peroxide pH values are in range of 4.7 to 3.4. Where peroxide pH values are lower than the field pH values the drop in pH is up to 1.3 pH units. The highest drop of pH occurred within shale in BH3 and is **not** indicative of the possible presence of potential acid sulfate soils due to the geology of the site.

4.3 Acid Sulfate Screening Results

Screening of soil samples from the investigation does **not** indicate the possible presence of actual acid sulfate and potential acid sulfate soils. An Acid Sulfate Soil Management Plan is **not** required for development at the site.

5 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL SERVICES

Further geotechnical inspections should be carried out during construction to confirm the geotechnical and hydrogeological model. These should include:

- All excavated material transported off site should be classified in accordance with NSW EPA 2014 - Waste Classification Guideline Part 1; Classifying Waste.
- A suitably qualified geotechnical engineer is to assess the condition of exposed material at foundation or subgrade level to assess the ability of the prepared surface to act as a foundation or as a subgrade.
- Regular inspections of battered and unsupported excavations, where proposed, to confirm geotechnical conditions and to assess the suitability of design assumptions and to provide further advice with regards to excavation retention/ support and proposed construction methodologies, if required.

6 STATEMENT OF LIMITATIONS

The adopted investigation scope was limited by site access restrictions due to presence of structures and services at the site at the time of our investigation and by the investigation intent. Further geotechnical inspections should be carried out during construction to confirm both the geotechnical model and the design parameters provided in this report.

Your attention is drawn to the document "Important Information", which is included in **Appendix B** of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Morrow Geotechnics, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

7 REFERENCES

AS1726:1993, *Geotechnical Site Investigations*, Standards Australia.

AS2159:2009, *Piling – Design and Installation*, Standards Australia.

AS2870:2011, *Residential Slabs and Footings*, Standards Australia.

AS3798:2007, *Guidelines on Earthworks for Commercial and Residential Developments*, Standards Australia.

Chapman, G.A. and Murphy, C.L. (1989), Soil Landscapes of the Sydney 1:100000 sheet. Soil Conservation Services of NSW, Sydney.

NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

NSW Department of Mineral Resources (1985) Sydney 1:100,000 Geological Series Sheet 9129 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

Pells (2004) Substance and Mass Properties for the Design of Engineering Structures in the Hawkesbury Sandstone, Australian Geomechanics Journal, Vol 39 No 3

8 CLOSURE

Please do not hesitate to contact Morrow Geotechnics if you have any questions about the contents of this report.

For and on behalf of Morrow Geotechnics Pty Ltd,

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Drawn	JB
Approved	AM
Date	30/11/2020
Scale	NTS

Century 888 Pty Ltd
85-91 Thomas Street, Parramatta NSW
Geotechnical Investigation
Borehole Location Plan

Figure:
1

Project: P2079

Appendix A

BOREHOLE LOGS AND EXPLANATORY NOTES

Project No:	P2079	Contractor:	Tracess	morrow	
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin		
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB	BH1	
Sheet 1 of 3		Date:	20/11/2020		

Drilling Method	Resistance	Water	Sampling	USCS	Depth	Stratigraphy	Consistency/ Density	Moisture	Additional Observations
SFA	L	GWNE	DS1-1 0.1-0.3 m SPT1-2 0.5-0.95 m 4, 4, 9 N=13 DS1-3 0.9-1.0 m	CI-CH	0.5 1.0	Silty CLAY, medium to high plasticity, red-brown - becoming orange-brown from 0.7 m	VSt	D	RESIDUAL SOIL
	L-M		SPT1-4 1.5-1.95 m 6, 8, 9 N=17	-	1.5 2.0 2.5 3.0 3.5	SHALE, pale grey / orange-brown, extremely weathered, inferred extremely low strength SHALE, brown, ironstone bands, distinctly weathered, inferred very low strength	-	-	WEATHERED ROCK
					4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0	Start Coring at 3.9 m			

Project No:	P2079	Contractor:	Traccess	morrow	
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin		
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB	BH1	
Sheet 2 of 3		Date:	20/11/2020		

Drilling Method	Water	TCR	RQD (SCR)	Rock Strength (EL VL L M H VH EH; 0.03 0.3 3; 0 0.1 1 10)	Weathering	Depth	Stratigraphy	Defect Spacing (10 100 1000; 30 300)	Defect Description
						0.5			
						1.0			
						1.5			
						2.0			
						2.5			
						3.0			
						3.5	Start Coring at 3.9 m		
NMLC	GWNO	100%	0% (55%)		MW	4.0	LAMINITE, laminated SILTSTONE (80%), brown / dark grey, and SANDSTONE (20%), fine grained, orange-brown, 0-5° laminations at 1-3 mm spacing		3.93-3.95, Sm, clay, 20mm thk 3.97, B, 0°, Pl, Ro, Ct clay, Sn fe 4.00, HB 4.03, B, 0°, Pl, Ro, Sn fe 4.07, DB 4.09-4.14, J, 45°, Irr, Ro, Sn fe 4.15-4.21, Bx3, 0°, Pl, Ro, Sn fe, 30mm sp 4.22-4.28, B, 0°, Pl, Sm, Ct clay 4.35-4.44, Sm, clay, 90mm thk 4.45, DB 4.50, B, 5°, Pl, Ro, Sn fe 4.56, DB 4.59-4.60, Sm, clay, 10mm thk 4.63-4.74, J, 90°, Pl, Ro, Sn fe 4.69-4.74, DB, core recovered as fragmented rock
						4.5			
						5.0			
		100%	75% (80%)		SW	5.5	- becoming dark grey with pale grey sandstone laminations from 5.25 m		4.80, DB 4.86-4.92, B, 5°, Pl, Ro, Sn fe 4.89-5.02, HBx4, 45mm sp 5.08, B, 5°, Pl, Ro, Sn fe 5.17, HB 5.20-5.28, Bx3, 0°, Pl, Ro, Sn fe, 40mm sp 5.20-5.23, DB, core recovered as fragmented rock 5.34-5.52, HBx3, 90mm sp 5.58, B, 5°, Pl, Ro, Sn fe 5.74-5.91, DB
						6.0			
						6.5			5.85-5.98, Bx2, 5°, Pl, Ro, Sn fe, 130mm sp 6.00, HB 6.06, B, 5°, Pl, Ro, Sn fe 6.06-6.10, J, 45°, Pl, Ro, Sn fe 6.15-6.19, DBx2, 40mm sp
		100%	100% (100%)		FR	7.0			6.26, B, 0°, Pl, Ro, Sn fe 6.37, DB 6.50, B, 0°, Pl, Ro, Sn fe 6.62-6.65, DB, core recovered as fragmented rock 6.70-6.85, J, 90°, Pl, Ro, Cn 6.80-6.85, DB, core recovered as fragmented rock 6.85-6.93, DBx5, 20mm sp 7.00, HB 7.20-7.90, DBx7, 115mm sp
						7.5			
						8.0			

Project No:	P2079	Contractor:	Traccess
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
Sheet 3 of 3		Date:	20/11/2020

morrow

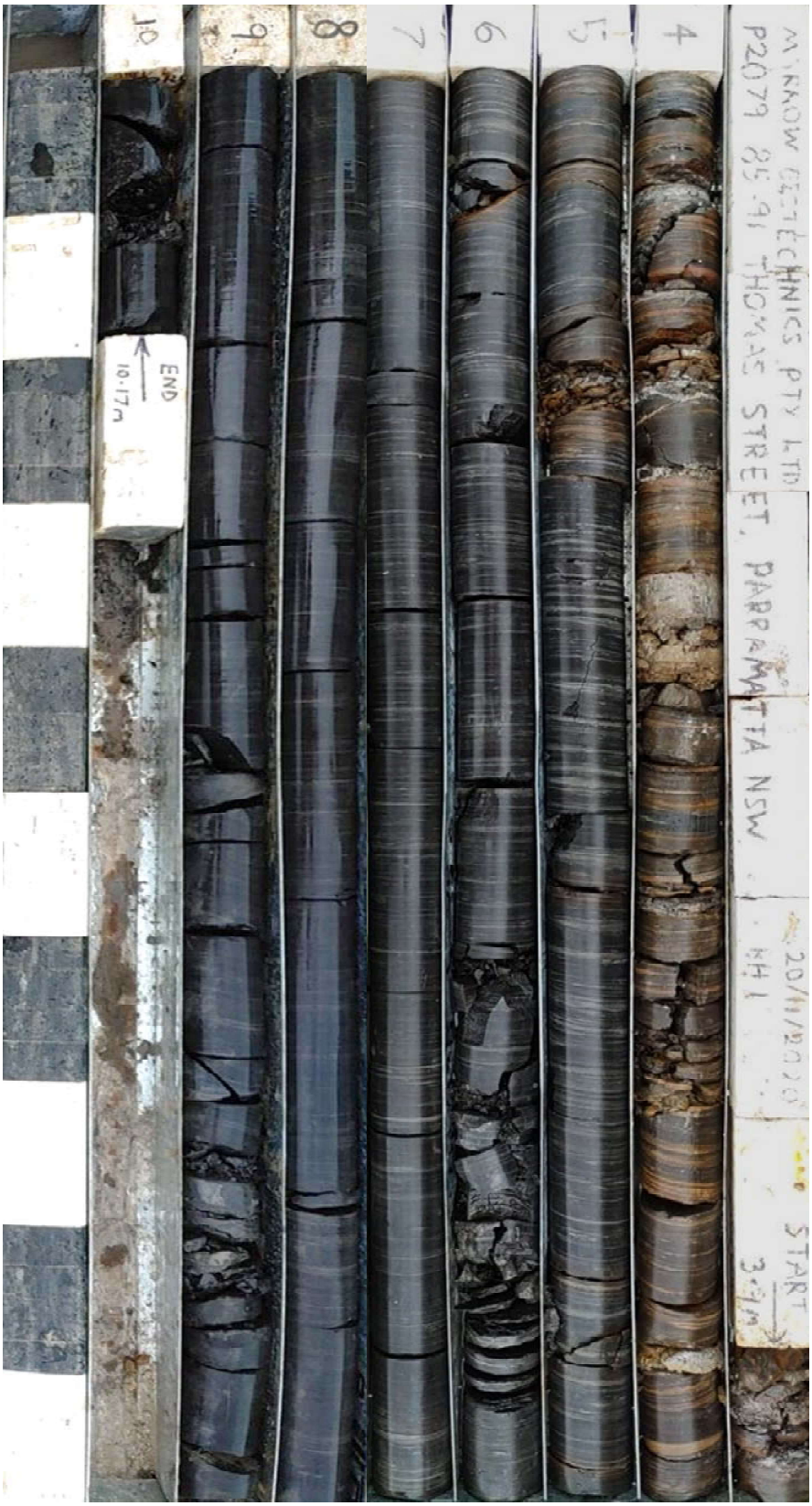
BH1

Drilling Method	Water	TCR	RQD (SCR)	Rock Strength (EL VL L M H VH EH; 0.03 0.1 0.3 1 3 10)	Weathering	Depth	Stratigraphy	Defect Spacing (10 30 100 300 1000)	Defect Description
NMLC	GWNO	AS ABOVE	AS ABOVE		FR	8.5	AS ABOVE, LAMINITE, SILTSTONE (80%), dark grey, and SANDSTONE (20%), fine grained, pale grey, 0-5° laminatios at 1-3 mm spacing		8.00, HB 8.15-8.87, DBx8, 105mm sp
						9.0			9.00, HB 9.05-9.26, DBx3, 105mm sp
		100%	50% (75%)			9.5			9.32-9.34, Bx2, 20°, Pl, Ro, Cn, 20mm sp 9.37, DB 9.45-9.50, J, 45°, Pl, Ro, Cn 9.50, DB 9.53, J, 5°, Pl, Ro, Cn 9.62, DB 9.68-9.72, J, 45°, Pl, Sl, Cn 9.68-9.72, DBx2, 40mm sp 9.72-9.85, Jx5, 5°, Pl, Ro, Cn, 30mm sp 9.86-9.96, DBx3, 50mm sp 10.00, HB 10.02-10.10, Jx2, 50°, Cv, Ro, Cn, 80mm sp 10.10-10.12, Sm, clay, 20mm thk
						10.0	End BH1 at 10.17 m Target Depth Reached		
						10.5			
						11.0			
						11.5			
						12.0			
						12.5			
						13.0			
						13.5			
						14.0			
						14.5			
						15.0			
						15.5			
						16.0			

Project No:	P2079	Contractor:	Traccess
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
		Date:	20/11/2020

morrow

BH1



Project No:	P2079	Contractor:	Tracess	morrow	
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin		
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB		
Sheet 1 of 3		Date:	20/11/2020	**BH2**	

Drilling Method	Resistance	Water	Sampling	USCS	Depth	Stratigraphy	Consistency/ Density	Moisture	Additional Observations
SFA	L	GWNE	SPT2-1 0.5-0.95 m 5, 7, 11 N=19 DS2-2 1.0-1.3 m SPT2-3 1.5-1.75 m 15, 15/100 mm HB	CI-CH	0.5 1.0 1.5	Silty CLAY, medium to high plasticity, red-brown	Vst	D	RESIDUAL SOIL
	L-M			-	2.0	SHALE, pale grey / orange-brown, extremely weathered, inferred extremely low strength - becoming brown / orange-brown from 2.0 m	-	-	WEATHERED SOIL
	L				2.5	- clay seams from 2.5 m			
					3.0	Start Coring from 2.8 m			
					3.5				
					4.0				
					4.5				
					5.0				
					5.5				
					6.0				
					6.5				
					7.0				
					7.5				
					8.0				

Project No:	P2079	Contractor:	Traccess
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
Sheet 2 of 3		Date:	20/11/2020

morrow

BH2

Drilling Method	Water	TCR	RQD (SCR)	Rock Strength (EL VL L M H VH EH; 0.03 0.3 3; 0 0.1 1 10)	Weathering	Depth	Stratigraphy	Defect Spacing (10 100 1000; 30 300)	Defect Description
						0.5			
						1.0			
						1.5			
						2.0			
						2.5	Start Coring at 2.8 m		
NMLC	GWNO	100%	20% (20%)		HW	3.0	LAMINITE, laminated SILTSTONE (80%), dark grey / brown, and SANDSTONE (20%), fine grained, orange-brown, 5-10° laminations at 1-5 mm spacing		2.80-3.00, Bx5, core recovered as fragmented rock, 50mm 3.00-3.02, Sm, clay, 20mm thk 3.06-3.19, DBx3, 65mm sp 3.16-3.18, J, 30°, Pl, Ro, Sn fe 3.22, B, 10°, Pl, Ro, Sn fe 3.23-3.28, Jx2, 50°, Pl, Ro, Sn fe, 50mm sp 3.28, B, 10°, Pl, Sm, Ct clay 3.30-3.45, Jx2, 60°, Cv, Ro, Sn fe, 150mm sp 3.45-3.56, Bx5, core recovered as fragmented rock, 25mm sp 3.57-3.69, DBx6, 25mm sp 3.69-3.74, J, 45°, Pl, Ro, Sn fe 3.74-3.83, DBx4, 30mm sp 3.83-3.89, Bx2, 5°, Pl, Ro, Sn fe, 60mm sp 3.91, BD 3.93-3.96, Bx2, 5°, Pl, Ro, Sn fe, 30mm sp 4.00, HB 4.15-4.61, DBx4, 155mm sp 4.70, B, 0°, Pl, Ro, Cn 4.82-4.95, DBx2, 130mm sp 5.00-5.02, HBx2, 20mm sp 5.12-5.15, DBx2, 30mm sp 5.35, B, 10°, Pl, Ro, Cn 5.56-6.00, DBx4, 145mm sp
						3.5			
					MW	4.0	- becoming dark grey with grey laminations, sub-horizontal laminations at 0° from 3.7 m		
						4.5			
		100%	90% (95%)			5.0			
						5.5	- laminations at 10° from 5.15 to 5.45 m		
					FR	6.0			
						6.5			6.33, DB 6.40-6.45, J, 50°, Pl, Ro, Cn 6.50, B, 0°, Pl, Ro, Cn 6.70, DB
		100%	95% (95%)			7.0			7.00, HB 7.02, B, 0°, Pl, Ro, Cn 7.06, DB 7.10-7.14, J, 45°, Pl, Ro, Cn 7.14-7.98, DBx6, 170mm sp
						7.5			
						8.0			

Project No:	P2079	Contractor:	Traccess
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
Sheet 3 of 3		Date:	20/11/2020

BH2

Drilling Method	Water	TCR	RQD (SCR)	Rock Strength (EL VL L M H VH EH; 0.03 0.3 3; 0 0.1 1 10)	Weathering	Depth	Stratigraphy	Defect Spacing (10 100 1000; 30 300)	Defect Description
NMLC	GWNO	100%	100% (95%)		FR	8.5 9.0 9.5	AS ABOVE, LAMINITE, laminated SILTSTONE (80%), dark grey, and SANDSTONE (20%), fine grained, grey, sub-horizontal laminations at 1-5 mm spacing		8.00, HB 8.13-8.23, Jx2, 30°, Pl, Ro, Cn, 100mm sp 8.33, J, 10°, Pl, Ro, Cn 8.45-8.80, DBx3, 175mm sp 9.00, HB 9.02, DB 9.13, B, 0°, Pl, Sm, Ct clay 9.31-9.85, DBx4, 180mm sp
						10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0	End BH3 at 9.85 m Target Depth Reached		

Project No:	P2079	Contractor:	Traccess
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
		Date:	20/11/2020

morrow

BH2

Project No:	P2079	Contractor:	Tracess
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
Sheet 1 of 3		Date:	23/11/2020

BH3

Drilling Method	Resistance	Water	Sampling	USCS	Depth	Stratigraphy	Consistency/ Density	Moisture	Additional Observations
DTC	H	-		-		CONCRETE, 2 slabs, 110 & 90 mm thick	-	-	PAVEMENT
SFA	L	GWNE	SPT3-1 0.5-0.95 m 3, 3, 4 N=7	CI-CH	0.5	Silty CLAY, medium to high plasticity, orange-brown mottled grey	St	M< PL	RESIDUAL SOIL
	L-M		SPT3-2 1.5-1.95 m 23 R	-	1.0 1.5	SHALE, orange-brown / brown, trace thin clay seams, ironstone bands, extremely weathered, extremely low strength	-	-	WEATHERED ROCK
	M		DS3-3 2.0-2.2 m		2.0 2.5	SHALE, orange-brown / brown, ironstone bands, distinctly weathered, inferred low strength			
						Start Coring at 2.7 m			
					3.0				
					3.5				
					4.0				
					4.5				
					5.0				
					5.5				
					6.0				
					6.5				
					7.0				
					7.5				
					8.0				

Project No:	P2079	Contractor:	Traccess
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
Sheet 2 of 3		Date:	23/11/2020

BH3

Drilling Method	Water	TCR	RQD (SCR)	Rock Strength (EL VL L M H VH EH; 0.03 0.3 3; 0 0.1 1 10)	Weathering	Depth	Stratigraphy	Defect Spacing (10 100 1000; 30 300)	Defect Description
						0.5			
						1.0			
						1.5			
						2.0			
						2.5			
							Start Coring at 2.7 m		
NMLC	GWNO	100%	50% (70%)		MW	3.0	LAMINITE, laminated SILTSTONE (70%), dark brown, and SANDSTONE (30%), fine grained, orange-brown, sub-horizontal laminations at 1-5 mm spacing		2.70, B, 0°, Pl, Ro, Sn fe 2.77-2.78, Sm, clay, 10mm thk 2.81, B, 0°, Pl, Ro, Sn fe 2.82-2.85, DBx3, 15mm sp 2.86-2.88, Bx2, 0°, Pl, Ro, Sn fe, 20mm sp 2.89, DBx3 2.90, B, 0°, Pl, Ro, Sn fe 2.91-2.92, DBx2, 10mm sp 2.97, B, 0°, Pl, Sm, Ct clay 2.97-3.01, J, 45°, Pl, Ro, Sn fe 3.00, HB 3.04-3.07, DBx2, 30mm sp 3.10, B, 0°, Pl, Sm , Ct clay 3.15-3.25, J, 90°, Pl, Ro, Sn fe 3.15-3.25, DBx5, 25mm sp 3.31-3.34, J, 30°, Pl, Ro, Sn fe 3.37-3.90, DBx11, 55mm sp 4.00-HB 4.02, J, 10°, Pl, Ro, Sn fe 4.12, DB 4.14-4.22, J, 60°, Pl, Ro, Sn fe 4.23, J, 0°, Irr, Sl, Cn 4.24-4.28, Cz, 40mm thk 4.30-4.47, J, 90°, Pl, Ro, Sn fe 4.32-4.42, DBx6, 20mm sp 4.61-4.68, Bx2, 5°, Pl, Ro, Sn fe, 70mm sp 4.69-4.71, J, 30°, Pl, Ro, Sn fe 4.86, DB HBx2-5.01, HB 5.04, B, 5°, Pl, Ro, Sn fe 5.23-5.78, DBx5, 135mm sp 5.98-6.00, HBx2, 20mm sp 6.27-6.94, DBx6, 135mm sp 7.00, HB 7.11-7.43, DBx3, 160mm sp 7.45, J, 30°, Pl, Ro, Cn 7.64-7.95, DBx5, 80mm sp
						3.5			
						4.0	- laminations at 30° from 4.15 m		
					SW	4.5	- laminations at 5°, 1-2 mm spacing from 4.4 m		
						5.0			
		100%	95% (100%)			5.5			
						6.0			
					FR	6.5			
						7.0			
						7.5			
						8.0			

Project No:	P2079	Contractor:	Traccess	morrow	
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin		
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB		
Sheet 3 of 3		Date:	23/11/2020	BH3	

Drilling Method	Water	TCR	RQD (SCR)	Rock Strength (EL VL L M H VH EH; 0.03 0.1 0.3 1 3 10)	Weathering	Depth	Stratigraphy	Defect Spacing (10 30 100 300 1000)	Defect Description
NMLC	GWNO	100%	100% (100%)		FR	8.5	AS ABOVE, LAMINITE, laminated SILTSTONE (70%), dark brown, and SANDSTONE (30%), fine grained, orange-brown, 5° laminations at 1-2 mm spacing		8.00, HB 8.08-8.15, DBx3, 35mm sp 8.39, DB 8.49-8.57, J, 60°, Pl, Ro, Cn 8.58-8.93, DBx2, 350mm sp
						9.0			9.00, HB 9.03, J, 10°, Pl, Ro, Cn 9.28, J, 10°, Pl, Ro, Cn
						9.5			9.44-9.74, DBx2, 300mm sp
						10.0			10.00, HB 10.19-10.27, DBx2, 80mm sp
						10.27	End BH3 at 10.27 m Target Depth Reached		
						10.5			
						11.0			
						11.5			
						12.0			
						12.5			
						13.0			
						13.5			
						14.0			
						14.5			
						15.0			
						15.5			
						16.0			

Project No:	P2079	Contractor:	Traccess
Client:	Century 888 Pty Ltd	Drill Rig:	Hanjin
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
		Date:	23/11/2020

BH3

Project No:	P2079	Contractor:	MG
Client:	Century 888 Pty Ltd	Drill Rig:	DCP
Project:	Residential Development 85-91 Thomas Street Parramatta NSW	Logged:	JB
Sheet 1 of 1		Date:	23/11/2020

DCP4

Drilling Method	Resistance	Water	Sampling	USCS	Depth	Stratigraphy (Additional Observations)	Consistency/ Density	Moisture	DCP (blows per 100 mm)
DCP					0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0				5, 10, 15, 20

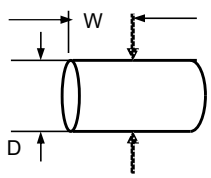
POINT LOAD STRENGTH INDEX

Project No.	P2079		
Client:	Century 888 Pty Ltd	Date:	20-23/11/2020
Project:	Geotechnical Investigation	Tested by:	JB
Location:	85-91 Thomas Street, Parramatta NSW	Data checked:	JB

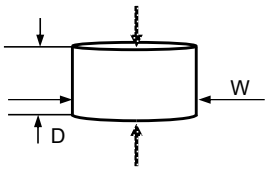
Test Machine:	GSA	Test Locality:	JB	Core Size:	52 mm

Bore/TP	Depth (m)	Rock Type	Moisture Condition	Test Type	W (mm)	D (mm)	Load kN (P)	Failure Type	Point Load Strength Index $I_{S(50)}$ (MPa)	Strength Classification
BH1	4.05	SW LAMINITE	F	A	52	45	3.06	4	1.07	
BH1	5.50	SW LAMINITE	F	A	52	42	6.00	1	2.21	H
BH1	6.31	FR LAMINITE	F	D	52	49	2.64	2	1.09	H
BH1	6.31	FR LAMINITE	F	A	52	45	5.58	4	1.95	
BH1	6.41	FR LAMINITE	F	A	52	40	4.94	1	1.89	H
BH1	7.42	FR LAMINITE	F	D	52	49	3.78	2	1.56	H
BH1	7.42	FR LAMINITE	F	A	52	44	7.62	1	2.71	H
BH1	8.36	FR LAMINITE	F	D	52	50	2.03	2	0.81	M
BH1	8.36	FR LAMINITE	F	A	52	49	5.68	4	1.86	
BH1	8.36	FR LAMINITE	F	A	52	48	4.50	1	1.49	H
BH1	9.10	FR LAMINITE	F	D	52	50	2.78	2	1.11	H
BH1	9.10	FR LAMINITE	F	A	52	47	3.79	1	1.28	H
BH1	9.15	FR LAMINITE	F	D	52	50	1.58	2	0.63	M
BH1	9.15	FR LAMINITE	F	A	52	45	3.02	4	1.05	
BH1	9.35	FR LAMINITE	F	A	52	44	4.36	4	1.55	
BH1	9.90	FR LAMINITE	F	A	52	48	1.89	1	0.63	M
BH2	3.85	FR LAMINITE	F	A	52	52	1.77	4	0.55	
BH2	4.05	FR LAMINITE	F	D	52	50	2.79	2	1.12	H
BH2	4.05	FR LAMINITE	F	A	52	49	3.83	4	1.25	
BH2	4.05	FR LAMINITE	F	A	52	45	4.30	1	1.50	H
BH2	5.11	FR LAMINITE	F	D	52	50	2.69	2	1.08	H
BH2	5.11	FR LAMINITE	F	A	52	45	4.72	4	1.65	
BH2	5.11	FR LAMINITE	F	A	52	42	3.59	1	1.32	H
BH2	5.95	FR LAMINITE	F	D	52	50	2.50	2	1.00	M
BH2	5.95	FR LAMINITE	F	A	52	50	2.70	4	0.87	
BH2	5.95	FR LAMINITE	F	A	52	47	3.25	1	1.10	H
BH2	6.80	FR LAMINITE	F	D	52	50	1.77	2	0.71	M
BH2	6.80	FR LAMINITE	F	A	52	48	3.71	1	1.23	H
BH2	7.86	FR LAMINITE	F	D	52	49	1.44	2	0.59	M
BH2	7.86	FR LAMINITE	F	A	52	40	1.54	4	0.59	
BH2	7.86	FR LAMINITE	F	A	52	45	2.01	1	0.70	M
BH2	8.85	FR LAMINITE	F	D	52	50	0.80	2	0.32	M
BH2	8.85	FR LAMINITE	F	A	52	50	3.12	1	1.00	H
BH2	9.80	FR LAMINITE	F	D	52	50	1.56	2	0.62	M
BH2	9.80	FR LAMINITE	F	A	52	48	2.65	4	0.88	
BH2	9.80	FR LAMINITE	F	A	52	45	2.49	1	0.87	M
BH3	3.52	MW LAMINITE	F	D	52	48	0.88	2	0.37	M
BH3	3.52	MW LAMINITE	F	A	52	49	1.38	4	0.45	
BH3	3.52	MW LAMINITE	F	A	52	48	1.54	4	0.51	
BH3	3.95	MW LAMINITE	F	A	52	47	1.87	4	0.63	
BH3	4.58	SW LAMINITE	F	D	52	49	2.92	2	1.21	H

TEST TYPE :



W/D > 0.5
DIAMETRAL (D)



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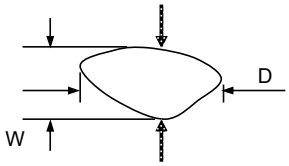
AXIAL (A)



D/W = 0.3 - 1.0
IRREGULAR LUMP (I)

MOISTURE CONDITION :
Field (F), Saturated (S), Dry (D)

FAILURE TYPE :
1. Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.
2. Fracture along bedding.
3. Fracture influenced by pre-existing joint plane (J), microfracture (M), vein (V), chemical alteration (C).
4. Chip or partial fracture.

NOTES For specimens tested parallel to plane of weakness $D_e^2 = D^2$
For specimens tested perpendicular to plane of weakness $D_e^2 = 4WD/\pi$

POINT LOAD STRENGTH INDEX

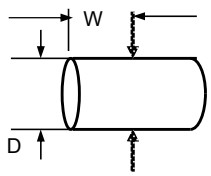
Project No.	P2079

Client:	Century 888 Pty Ltd	Date:	23-Nov-20
Project:	Geotechnical Investigation	Tested by:	JB
Location:	85-91 Thomas Street, Parramatta NSW	Data checked:	JB

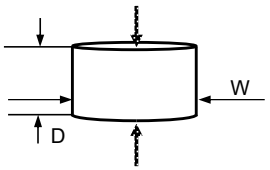
Test Machine:	GSA	Test Locality:	JB	Core Size:	52 mm

Bore/TP	Depth (m)	Rock Type	Moisture Condition	Test Type	W (mm)	D (mm)	Load kN (P)	Failure Type	Point Load Strength Index $I_{S(50)}$ (MPa)	Strength Classification
BH3	4.58	SW LAMINITE	F	A	52	43	4.13	1	1.49	H
BH3	5.28	FR LAMINITE	F	D	52	50	2.63	2	1.05	H
BH3	5.28	FR LAMINITE	F	A	52	47	4.78	1	1.61	H
BH3	6.22	FR LAMINITE	F	D	52	49	3.65	2	1.51	H
BH3	6.22	FR LAMINITE	F	A	52	48	3.24	4	1.08	
BH3	6.22	FR LAMINITE	F	A	52	47	4.11	1	1.39	H
BH3	7.29	FR LAMINITE	F	D	52	48	2.37	2	1.01	H
BH3	7.29	FR LAMINITE	F	A	52	52	4.20	4	1.31	
BH3	7.29	FR LAMINITE	F	A	52	40	3.85	1	1.47	H
BH3	8.32	FR LAMINITE	F	D	52	48	2.33	2	0.99	M
BH3	8.32	FR LAMINITE	F	A	52	51	2.29	4	0.73	
BH3	8.32	FR LAMINITE	F	A	52	40	2.20	1	0.84	M
BH3	9.21	FR LAMINITE	F	D	52	50	1.63	2	0.65	M
BH3	9.21	FR LAMINITE	F	A	52	50	2.53	1	0.81	M
BH3	10.15	FR LAMINITE	F	D	52	50	2.03	2	0.81	M
BH3	10.15	FR LAMINITE	F	A	52	43	2.10	4	0.76	
BH3	10.15	FR LAMINITE	F	A	52	42	3.21	1	1.18	H

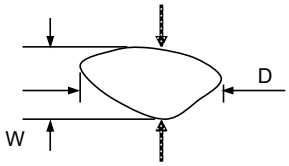
TEST TYPE :



W/D > 0.5
DIAMETRAL (D)



D/W = 0.3 - 1.0
AXIAL (A)



D/W = 0.3 - 1.0
IRREGULAR LUMP (I)

MOISTURE CONDITION :
Field (F), Saturated (S), Dry (D)

FAILURE TYPE :
1. Fracture through fabric of specimen oblique to bedding, not influenced by weak planes.
2. Fracture along bedding.
3. Fracture influenced by pre-existing joint plane (J), microfracture (M), vein (V), chemical alteration (C).
4. Chip or partial fracture.

NOTES For specimens tested parallel to plane of weakness $D_e^2 = D^2$
For specimens tested perpendicular to plane of weakness $D_e^2 = 4WD/\pi$

Soil and Rock Logging Explanatory Notes

GENERAL

Information obtained from site investigations is recorded on log sheets. The "Cored Drill Hole Log" presents data from an operation where a core barrel has been used to recover material - commonly rock. The "Non-Core Drill Hole - Geological Log" presents data from an operation where coring has not been used and information is based on a combination of regular sampling and insitu testing. The material penetrated in non-core drilling is commonly soil but may include rock. The "Excavation - Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits, trenches, etc.

The heading of the log sheets contains information on Project Identification, Hole or Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material substance description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The common depth scale is 8m per drill log sheet and about 3-5m for excavation logs sheets.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is inevitable in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures. Material description and classifications are based on SAA Site Investigation Code AS 1726 - 1993 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

DRILLING

Drilling & Casing

ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
WB	Wash-bore drilling
RR	Rock Roller
NMLC	NMLC core barrel
NQ	NQ core barrel
HMLC	HMLC core barrel
HQ	HQ core barrel

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage.

Drilling Penetration/Drill Depth

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

VE	Very Easy
E	Easy
M	Medium
H	High
VH	Very High

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

D	Disturbed
B	Bulk
U	Undisturbed
SPT	Standard Penetration Test
N	Result of SPT (sample taken)
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test

EXCAVATION LOGS

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added.

MATERIAL DESCRIPTION - SOIL

Classification Symbol - In accordance with the Unified Classification System (AS 1726-1993, Appendix A, Table A1)

Material Description - In accordance with AS 1726-1993, Appendix A2.3

Moisture Condition

D	Dry, looks and feels dry
M	Moist, No free water on remoulding
W	Wet, free water on remoulding

Consistency - In accordance with AS 1726-1993, Appendix A2.5

VS	Very Soft	< 12.5 kPa
S	Soft	12.5 – 25 kPa
F	Firm	25 – 50 kPa
St	Stiff	50 – 100 kPa
VSt	Very Stiff	100 – 200 kPa
H	Hard	> 200 kPa

Strength figures quoted are the approximate range of undrained shear strength for each class.

Density Index. (%) is estimated or is based on SPT results.

VL	Very Loose	< 15 %
L	Loose	15 – 35 %
MD	Medium Dense	35 – 65 %
D	Dense	65 – 85 %
VD	Very Dense	> 85 %

MATERIAL DESCRIPTION -ROCK

Material Description

Identification of rock type, composition and texture based on visual features in accordance with AS 1726-1993, Appendix A3.1-A3.3 and Tables A6a, A6b and A7.

Core Loss

Is shown at the bottom of the run unless otherwise indicated.

Bedding

Thinly Laminated	< 6 mm
Laminated	6 - 20
Very Thinly Bedded	20 - 60
Thinly Bedded	60 - 200
Medium Bedded	200 – 600
Thickly Bedded	600 – 2000
Very Thickly Bedded	> 2000

Weathering - No distinction is made between weathering and alteration. Weathering classification assists in identification but does not imply engineering properties.

Fresh (F)	Rock substance unaffected by weathering
Slightly Weathered (SW)	Rock substance partly stained or discoloured. Colour and texture of fresh rock recognisable.
Moderately Weathered (MW)	Staining or discolouration extends throughout rock substance. Fresh rock colour not recognisable.
Highly Weathered (HW)	Stained or discoloured throughout. Signs of chemical or physical alteration. Rock texture retained.
Extremely Weathered (EW)	Rock texture evident but material has soil properties and can be remoulded.

Strength - The following terms are used to described rock strength:

Rock Strength Class	Abbreviation	Point Load Strength Index, Is(50) (MPa)
Extremely Low	EL	< 0.03
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	≥ 10

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical estimated strength by using:

° Diametral Point Load Test

Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown.

MATERIALS STRUCTURE/FRACTURES

ROCK

Natural Fracture Spacing - A plot of average fracture spacing excluding defects known or suspected to be due to drilling, core boxing or testing. Closed or cemented joints, drilling breaks and handling breaks are not included in the Natural Fracture Spacing.

Visual Log - A diagrammatic plot of defects showing type, spacing and orientation in relation to core axis.

Defects	———	Defects open in-situ or clay sealed
	– – – – –	Defects closed in-situ
	.....	Breaks through rock substance

Additional Data - Description of individual defects by type, orientation, in-filling, shape and roughness in accordance with AS 1726-1993, Appendix A Table A10, notes and Figure A2.

Orientation - angle relative to the plane normal to the core axis.

Type	BP	Bedding Parting
	JT	Joint
	SM	Seam
	FZ	Fracture Zone
	SZ	Shear Zone
	VN	Vein
	FL	Foliation
	CL	Cleavage
	DL	Drill Lift
	HB	Handling Break
	DB	Drilling Break
Infilling	CN	Clean
	X	Carbonaceous
	Clay	Clay
	KT	Chlorite
	CA	Calcite
	Fe	Iron Oxide
	Qz	Quartz
	MS	Secondary Mineral
	MU	Unidentified Mineral
Shape	PR	Planar
	CU	Curved
	UN	Undulose
	ST	Stepped
	IR	Irregular
	DIS	Discontinuous
Rougness	POL	Polished
	SL	Slickensided
	S	Smooth
	RF	Rough
	VR	Very Rough

SOIL

Structures - Fissuring and other defects are described in accordance with AS 1726-1993, Appendix A2.6, using the terminology for rock defects.

Origin - Where practicable an assessment is provided of the probable origin of the soil, eg fill, topsoil, alluvium, colluvium, residual soil.

Appendix B

LABORATORY TEST CERTIFICATES

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Alan Morrow	Manager	Huong Crawford
Client	MORROW GEOTECHNICS PTY LTD	Laboratory	SGS Alexandria Environmental
Address	PO BOX 4069 CARLTON NSW 2218	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
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Facsimile	(Not specified)	Facsimile	+61 2 8594 0499
Email	alan@morrowgeo.com.au	Email	au.environmental.sydney@sgs.com
Project	**P2079 Parramatta**	SGS Reference	**SE213954 R0**
Order Number	**P2079**	Date Received	23 Nov 2020
Samples	11	Date Reported	27 Nov 2020

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Shane MCDERMOTT
Inorganic/Metals Chemist

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name SE213954.001 Soil 20 Nov 2020 DS1-1	SE213954.002 Soil 20 Nov 2020 SPT1-2	SE213954.003 Soil 20 Nov 2020 DS1-3	SE213954.004 Soil 20 Nov 2020 SPT1-4
Field pH for Acid Sulphate Soil Method: AN104 Tested: 26/11/2020						
pHf	pH Units	-	**4.8**	**4.5**	**4.8**	**4.7**
pHfox	pH Units	-	**4.8**	**4.3**	**4.7**	**4.6**
Reaction Rate*	No unit	-	X X	X	X X	X
pH Difference*	pH Units	-10	**0.0**	**0.2**	**0.2**	**0.1**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name SE213954.005 Soil 20 Nov 2020 SPT2-1	SE213954.006 Soil 20 Nov 2020 DS2-2	SE213954.007 Soil 20 Nov 2020 SPT2-3	SE213954.008 Soil 20 Nov 2020 DS2-4
Field pH for Acid Sulphate Soil Method: AN104 Tested: 26/11/2020						
pHf	pH Units	-	**4.2**	**4.5**	**4.4**	**4.6**
pHfox	pH Units	-	**4.1**	**4.6**	**3.4**	**3.8**
Reaction Rate*	No unit	-	X	X	X	X
pH Difference*	pH Units	-10	**0.1**	**-0.1**	**1.0**	**0.7**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name SE213954.009 Soil 23 Nov 2020 SPT3-1	SE213954.010 Soil 23 Nov 2020 SPT3-2	SE213954.011 Soil 23 Nov 2020 DS3-3
Field pH for Acid Sulphate Soil Method: AN104 Tested: 26/11/2020					
pHf	pH Units	-	**4.4**	**5.1**	**5.3**
pHfox	pH Units	-	**4.3**	**3.8**	**4.1**
Reaction Rate*	No unit	-	X	X	X
pH Difference*	pH Units	-10	**0.1**	**1.3**	**1.2**

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Field pH for Acid Sulphate Soil **Method: ME-(AU)-[ENV]AN104**

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pHf	LB214334	pH Units	-	0%	NA
pHfox	LB214334	pH Units	-	0 - 2%	NA

METHOD	METHODOLOGY SUMMARY
AN104	pHF is determined on an extract of approximately 2g of as received sample in approximately 10 mL of deionised water with pH determined after standing 30 minutes.
AN104	pHFox is determined on an extract of approximately 2g of as received sample with a few mLs of 30% hydrogen peroxide (adjusted to pH 4.5 to 5.5) with the extract reaction being rated from slight to extreme, with pH determined after reaction is complete and extract has cooled. Referenced to ASS Laboratory Methods Guidelines, method 23Af-Bf, 2004. 1 Slight Reaction 2 Moderate Reaction 3 Strong/High Reaction 4 Extreme/Vigorous Reaction (gas evolution and heat generation)

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
***	Indicates that both * and ** apply.	NVL	Not Validated

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

Appendix C

IMPORTANT INFORMATION

morrow

Important Information

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