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Geotechnical Investigation Report

GEOTECHNICAL REPORT & ACID SULFATE SOIL ASSESSMENT

RESIDENTIAL DEVELOPMENT

28 SOUTH STREET, STRATHFIELD NSW

Prepared for:

MAZIN MEHAJER

Reference: P2352_01

22 September 2021

Morrow Geotechnics Pty Ltd | ABN 42 605 892 126
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1 INTRODUCTION

Morrow Geotechnics Pty Ltd has undertaken a Geotechnical Investigation to provide geotechnical advice and recommendations for the proposed development at 28 South Street, Strathfield NSW (the site).

1.1 Proposed Development

Architectural drawings for the proposed development have not been provided at the time of preparation of this report. From discussions with the client, Morrow Geotechnics understands that the proposed development involves construction of a new single storey dwelling over a single level basement. Excavation is expected to extend to a depth of up to 3 m below ground level (mBGL).

1.2 Purpose of the Investigation

The purpose of the investigation is to provide geotechnical advice and recommendations addressing:

- Expected subsurface conditions;
- Allowable bearing pressure for slab and foundation design;
- Site classification for slab and foundation design; and
- Geotechnical construction considerations;

1.3 Investigation Methods

Fieldwork was undertaken on 15 September 2021. 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 two boreholes (BH1 and BH2) using hand augers to depths of 0.9 and 2.1 mBGL respectively. Borehole locations are shown on **Figure 1** and the borehole logs are attached to this report;
- Dynamic Cone Penetrometer tests were undertaken adjacent to the borehole locations. DCP test results were used to assess soil consistency/density and to infer top of rock;
- Groundwater observations within boreholes during drilling.

2 DESKTOP REVIEW OF SITE CONDITIONS

2.1 Published Geological Mapping

The Department of Mineral Resources Geological Map Sydney 1:100,000 Geological Series Sheet 9130 (DMR 1991) indicates the site overlies Bringelly Shale of the Wianamatta Group, which comprises Shale, carbonaceous claystone, claystone, laminite, fine to medium grained lithic sandstone, rare coal and tuff.

2.2 Published Soil Landscapes

The Soil Conservation Service of NSW Sydney 1:100,000 Soil Landscapes Series Sheet 9130 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 with slopes of > 5 %. Soils are typically shallow to moderately deep (> 1.0 m) hardsetting red and brown podzolic soils on crests grading to yellow podzolic soils on lower slopes and drainage lines. These soils are noted to present localised seasonal waterlogging, localised water erosion hazard, moderately reactive, highly plastic subsoil, and localised surface movement potential.

3 OBSERVATIONS

3.1 Subsurface Conditions

The stratigraphy at the site is characterised by fill and natural soil overlying shale bedrock. For the development of a site-specific geotechnical model, the observed stratigraphy has been divided into four 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**.

TABLE 1 SUMMARY OF INFERRED SUBSURFACE CONDITIONS

Unit	Material	Approx. Depth Range of Unit [1] mBGL		Comments
		BH1	BH2	
1	**Fill / Topsoil**	0.0 to 0.15	0.0 to 0.4	Generally low plasticity silt. Fill within Unit is inferred to be uncontrolled and poorly compacted.
2	**Soft Clay**	-	0.4 to 1.0	Generally medium to high plasticity silty clay with ironstone gravel. Ranging from soft to stiff consistency.
3	**Stiff Clay**	0.15 to 0.9	1.0 to 2.1	
4	**Weathered Shale**	0.9 +	2.1 +	Inferred from regional geology, borehole results and surrounding projects to be distinctly weathered, very low strength shale. Rock strength will increase with excavation depth.

Notes:

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

3.2 Groundwater Observations

Seepage flow was not noted within the open boreholes during the investigation. Minor seepage may occur, however, at the soil/rock boundary in response to surface water infiltration following rainfall events.

4 GEOTECHNICAL RECOMMENDATIONS FOR DESIGN

4.1 Foundation Design

It is not recommended that shallow footings or slabs found within Unit 1 or 2 material due to the potential for differential settlement caused by footings bridging between materials of varying stiffness. Shallow footings and slabs should be designed in accordance with AS2870:2011 based on a Site Classification of 'H1.' The site classification has been provided on the basis that the performance expectations set out in Appendix B of AS2870–2011 are acceptable and that future site maintenance will be undertaken in accordance with CSIRO BTF 18.

The parameters given in **Table 2** 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.

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.

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 2 PAD FOOTING AND PILE DESIGN PARAMETERS

Material		Unit 1 Fill / Topsoil	Unit 2 Soft Clay	Unit 3 Stiff Clay	Unit 4 Weathered Shale
Allowable Bearing Pressure (kPa)		NA	NA	200	600
Ultimate Vertical End Bearing Pressure (kPa)		NA	NA	600	1800
Elastic Modulus (MPa)		5	10	15	70
Allowable Shaft Adhesion (kPa)	In Compression	0	20	25	50
	In Tension	0	10	12.5	25
Susceptibility to Liquefaction during an Earthquake		High	Medium	Low	Low

Notes:

1 Shaft 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

To adopt these parameters we have assumed that the bases of all footing 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.

4.2 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.

4.3 Excavations

Excavations up to a depth of approximately 2.5 m will be required for the development. Temporary batter slopes of 1H:1V will be possible for all soil units provided that surface water is diverted away from the batter faces and batter heights are kept to less than 3 m. Permanent batters of 2H:1V may be employed for all soil units. Permanent batters will require surface protection or revegetation to prevent erosion and slaking.

Where excavations extend beneath the zone of influence of nearby structures, services or pavements, or where site constraints such as site boundaries do not allow the construction of temporary batters, excavation retention will be required. For design of cantilevered shoring systems a triangular pressure distribution may be employed using the parameters presented in **Table 3**. For design of rigid anchored or braced walls such as top-down construction, a trapezoidal earth pressure distribution should be used with a maximum pressure of 0.65.Ka.γ.H (kPa), where 'H' is the effective vertical height of the wall in metres.

TABLE 3 EARTH PRESSURE PARAMETERS

Material		Unit 1 Fill / Topsoil	Unit 2 Soft Clay	Unit 3 Stiff Clay	Unit 4 Weathered Shale
Bulk Unit Weight (kN/m^3)		16	17	18	23
Earth Pressure Coefficients	At rest, K_o	0.55	0.50	0.44	0.25
	Passive, K_p	2.66	3.00	3.54	4.00
	Active, K_a	0.38	0.33	0.28	0.15

Notes:

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.

4.4 Soil and Rock Excavatability

The expected ability of equipment to excavate the soil and rock encountered at the site is summarised in **Table 4**. 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 4 SOIL AND ROCK EXCAVATABILITY

Unit	Material	Excavatability
1	**Fill / Topsoil**	Easy digging by 20t Excavator
2	**Soft Clay**	Easy digging by 20t Excavator
3	**Stiff Clay**	Easy digging by 20t Excavator
4	**Weathered Shale**	Hard ripping by 20t excavator. Hydraulic hammering may be required if medium strength shale is encountered within the excavation profile.

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.

4.5 Excavation Vibration Considerations

As a guide, safe working distances for typical items of vibration intensive plant are listed in **Table 5**. 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 5 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 5** 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.

Where rock excavation will take place closer than the recommended safe working distances provided above vibration mitigation measures should be employed. Morrow Geotechnics recommends the following mitigation measures for excavation at the site:

- Saw cutting of the perimeter of the excavation;
- Saw cutting parallel to the perimeter of the excavation at 0.5 to 1.0 m offsets to the perimeter;
- A maximum hydraulic hammer size of 900 kg used at 50% of full operational capacity;
- The orientation of rock breaking equipment in a direction away from property boundaries towards existing excavation; and
- Monitoring of vibration at the nearest residential receptor.

The safe working distances provided in **Table 5** are given for guidance only. Monitoring of vibration levels is recommended at the nearest receptor. This is required to ensure vibrations levels remain below threshold values during the construction period. Morrow Geotechnics recommends an upper limit for ppv of 3 mm/sec is adopted for sensitive structures such as Heritage Structures and Telstra, Ausgrid and Sydney Water mains (or as recommended by utility owner), 10 mm/sec is adopted for residential buildings and 20 mm/sec is adopted for commercial and industrial buildings or reinforced concrete structures. Should vibrations exceed set limits, we recommend the following:

- Cease excavation works and notify the Geotechnical Engineer immediately; and
- Develop an alternative excavation plan in conjunction with the Geotechnical Engineer.

5 Acid Sulfate Soils Assessment

Acid sulfate soil is naturally occurring sediments and soils containing iron sulfides (principally iron sulfide, iron disulfide or their precursors). Oxidation of these soils through exposure to the atmosphere or through lowering of groundwater levels results in the generation of sulfuric acid.

Most acid sulfate soil are of Holocene age (<10,000 years) and their formation requires the presence of iron-rich sediments, sulfate (usually from sea water), removal of reaction products such as bicarbonate, the presence of sulfate-reducing bacteria and an abundant supply of organic matter. These conditions generally exist in mangroves, salt marshes, inter-tidal areas and on the beds of coastal rivers and lakes.

Acid sulfate soil is further sub-divided into Actual Acid Sulfate Soils (AASS) and Potential Acid Sulfate Soil (PASS). AASS and PASS are generally found in the same soil profile with AASS overlying PASS.

AASS are soils that contain highly acidic soil horizons or layers resulting from the oxidation of iron sulfides. The oxidation produces hydrogen ions in excess of the buffering or neutralising capacity of the soil, resulting in pH of 4 or less when measured in dry-season conditions (1:5 soil:water).

PASS are soils containing iron sulfides or sulfidic material (usually ferrous iron disulfide or pyrite) which are waterlogged soils, rich in pyrite, that have not been exposed to air and oxidised. Any disturbance that admits oxygen (such as excavation works, or dewatering) will lead to the development of actual acid sulfate soil layers, which may pose an environmental risk.

Common characteristics of AASS and PASS (as defined in the reference 1), include:

AASS

- The presence of shells, and
- Any jarositic horizons or substantial iron oxide mottling in auger holes, in surface encrustations or in any material dredged or excavated and left exposed. Jarosite is a characteristic pale yellow mineral deposits which can be precipitate as pore fillings and coatings on fissures. In the situation of a fluctuating watertable, jarosite may be found along cracks and root channels in the soil. However, jarosite is not always found in actual acid sulfate soils.

PASS

- The presence of shells, and
- Waterlogged soils including unripe muds (soft, buttery, blue grey or dark greenish grey) or estuarine silty sands or sands (mid to dark grey) or bottom sediments of estuaries or tidal lakes (dark grey to black).

5.1 Desktop Study

The Acid Sulfate Soil Risk Map of Strathfield Local Environmental Plan 2012 indicates that part of the site is in a Class 5 Acid Sulfate Soil area, shown in **Figure 1** below.

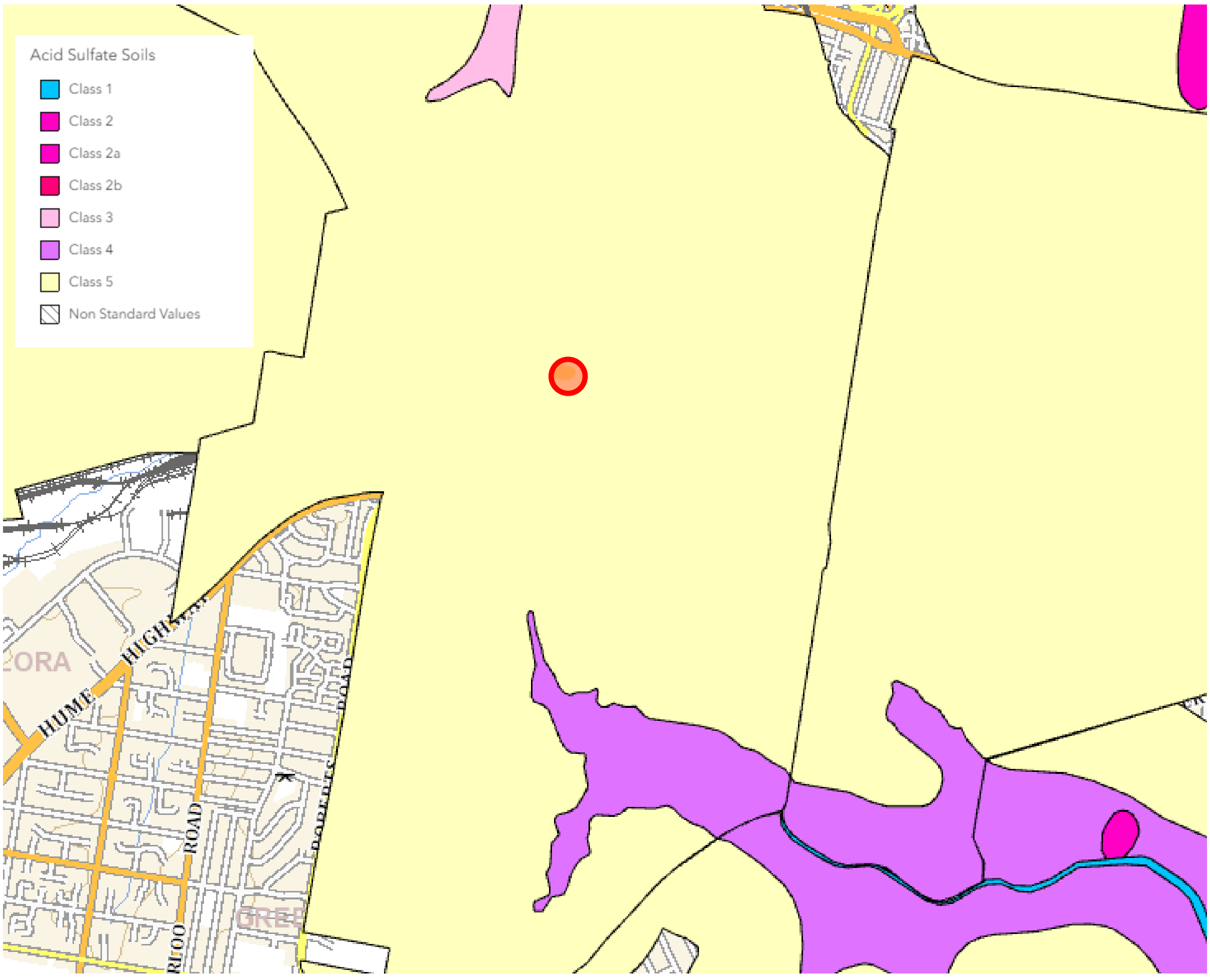


Figure 1: Screenshot from www.planningportal.nsw.gov.au showing Class 5 ASS at the site location (indicated with a red dot).

In accordance with Section 6.1 of the Strathfield LEP 2012, development consent addressing Acid Sulfate Soils for Class 5 sites is required for works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the watertable is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land.

Groundwater was not observed at the site to below the level of the proposed works.

5.2 Field Assessment

The geological profile at the site comprises residual soil over shale bedrock. The soils encountered are derived from weathering of the shale bedrock. No recent alluvial soils were encountered during the investigation. As discussed above, Acid Sulfate Soils are generally linked with alluvial and marine sediments of the Holocene era (<10,000 years ago). The soils encountered on site comprise Bringelly Shale of the Wianamatta Group which ages to the Middle Triassic era (between 247.2 and 237 million years ago). The soils encountered at the site are not consistent in age or origin to produce Acid Sulfate Soils.

Groundwater was not encountered during the geotechnical investigation for the proposed development to below the depth of the proposed excavation. Within the Bringelly Shale formation, where trapped surface water is encountered, seepage generally occurs at the soil/rock interface and in joints and bedding partings within the bedrock. Seepage in shale 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 and is generally less than $1x10^{-7}$ m/sec. Permeability of shale is such that excavation works associated with the proposed development will not lead to a drawdown of the groundwater or surface.

Field assessment of soil conditions at the site indicate that the ground conditions comprise shale derived clays which do not have the potential to form Actual or Potential Acid Sulfate Soils. Further, the permeability of the soils is sufficiently low that water drawdown effects would be confined to within 25 m of the site and do not have the potential to affect adjacent Class 1, 2, 3 or 4 land.

As such the site is not impacted by Acid Sulfate Soils and an Acid Sulfate Soil Management Plan is not required for development at the site.

6 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.

7 STATEMENT OF LIMITATIONS

The adopted investigation was limited by the agreed scope of the investigation. 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.

8 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 (1983) Sydney 1:100,000 Geological Series Sheet 9130 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

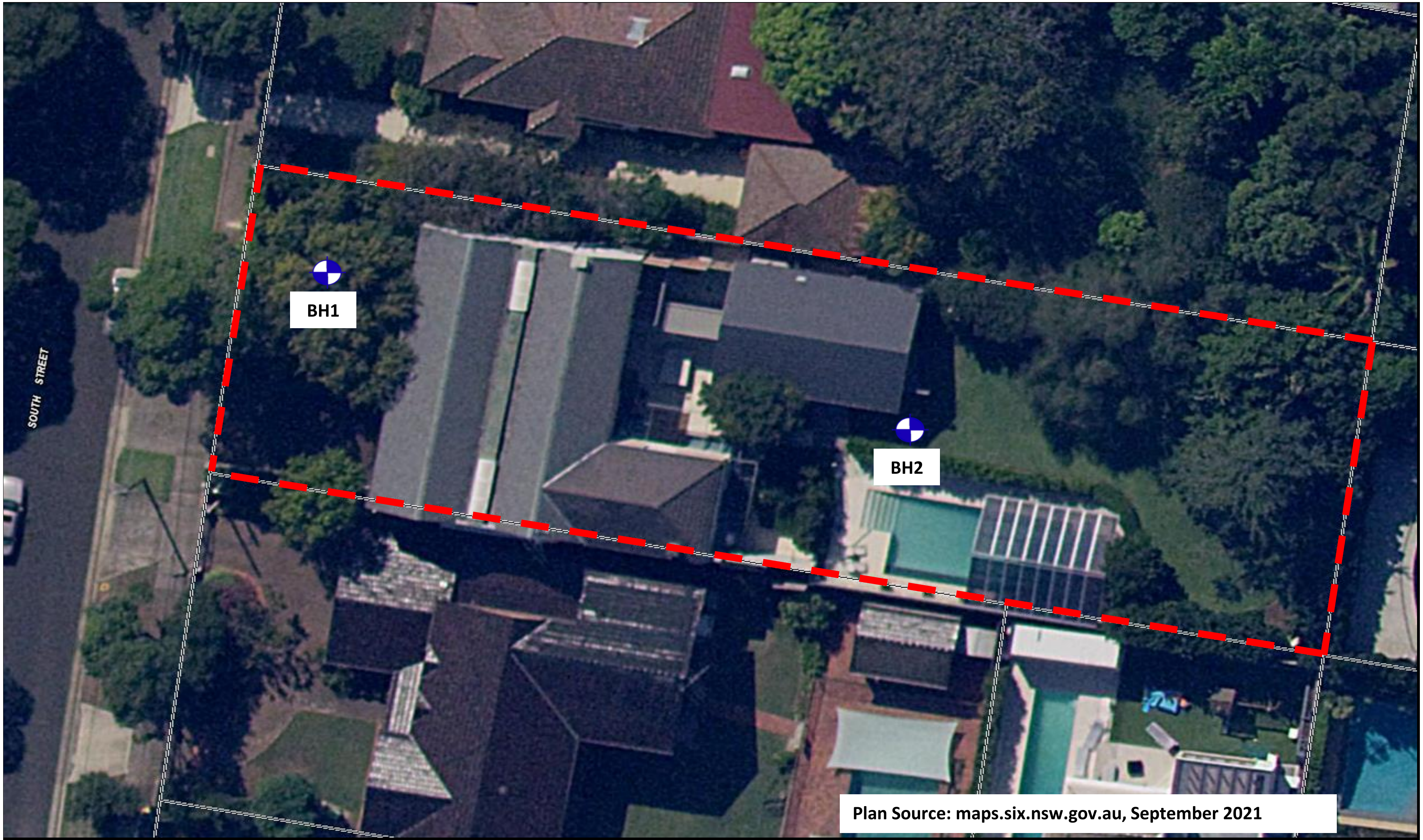
Pells (2004) Substance and Mass Properties for the Design of Engineering Structures in the Hawkesbury Sandstone, Australian Geomechanics Journal, Vol 39 No 3

9 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,

Alan Morrow
Principal Geotechnical Engineer



Plan Source: maps.six.nsw.gov.au, September 2021

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Drawn	JB
Approved	JB
Date	17/09/2021
Scale	NTS

Mazin Mehajer
28 South Street, Strathfield NSW
Geotechnical Investigation
Borehole Location Plan

Figure:
1

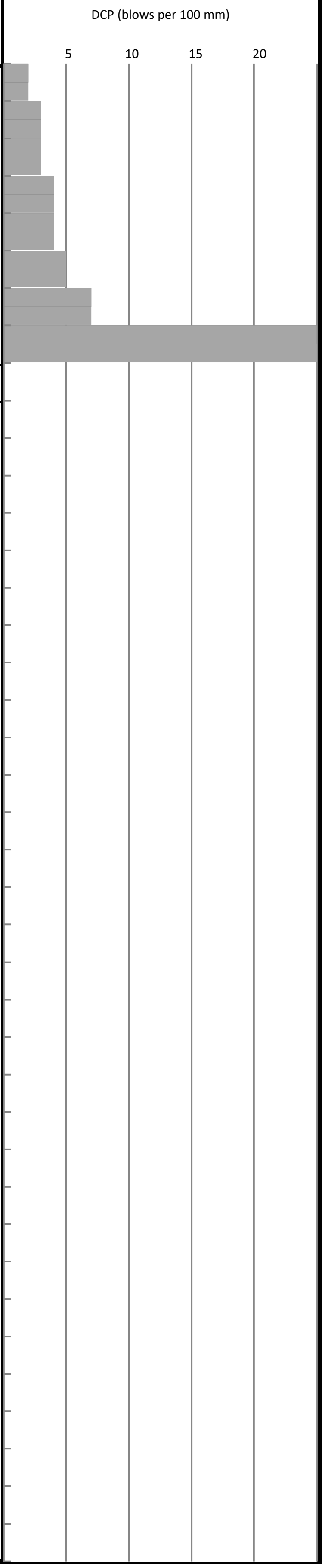
Project: P2352

BOREHOLE LOGS AND EXPLANATORY NOTES

Project No:	P2352	Contractor:	MG
Client:	Mazin Mehajer	Drill Rig:	Hand Auger
Project:	Residential Development 28 South Street Strathfield NSW	Logged:	JB
		Approved:	AM
Sheet:	1 of 1	Date:	15/09/2021

BH1

Drilling Method	Resistance	Water	Sampling	USCS	Depth	Stratigraphy (Additional Observations)	Consistency/ Density	Moisture
HA	L	GWNE		ML-MI		FILL - SILT, low to medium plasticity, dark brown, roots	St	M< PL
	H			CI-CH	0.25 0.50 0.75	Silty CLAY, medium to high plasticity, red-brown, rootlets, (RESIDUAL SOIL) - orange-brown mottled pale grey from 0.5 m - bands of ironstone form 0.65 m		
	R			-		Sandy SILTSTONE, fine to medium grained sand, pale orange, extremely weathered, inferred extremely low strength	-	-
					1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00 3.25 3.50 3.75 4.00	End of BH1 at 0.9 m Practical Auger Refusal on Weathered Rock		



Project No: P2352
Client: Mazin Mehajer
Project: Residential Development
28 South Street
Strathfield NSW
Sheet: 1 of 1

Contractor: MG
Drill Rig: Hand Auger
Logged: JB
Approved: AM
Date: 15/09/2021

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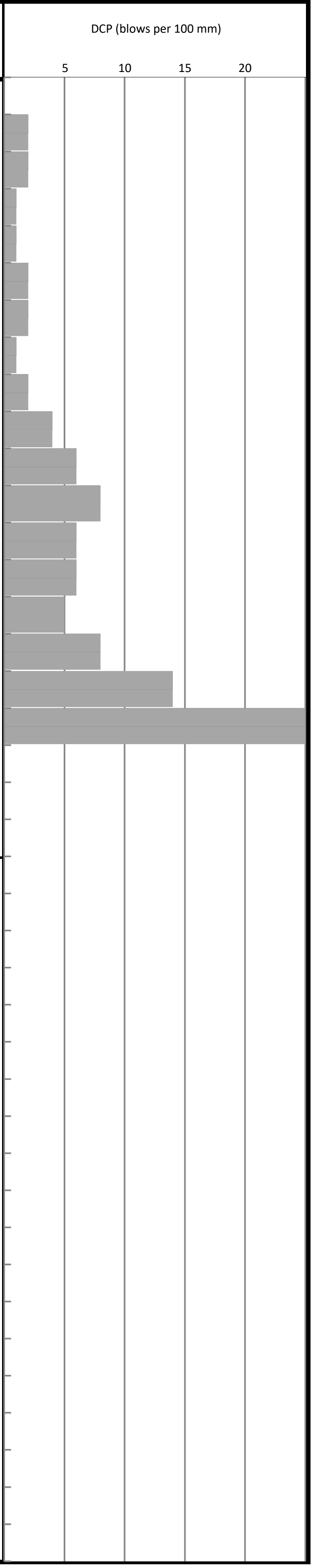
BH2

Drilling Method	Resistance	Water	Sampling	USCS	Depth	Stratigraphy (Additional Observations)	Consistency/ Density	Moisture
HA	L	GWNE		ML-MI		FILL - SILT, low to medium plasticity, dark brown, roots	S	M< PL
					0.25			
	M			CI-CH	0.50	Silty CLAY, medium to high plasticity, red-brown mottled grey, (RESIDUAL SOIL)		
					0.75			
					1.00	- trace fine to medium angular to sub-angular (ironstone) from 1.0 m	St	
					1.25			
					1.50	- becoming pale grey from 1.45 m	VSt-H	
	H			CI	1.75	- with fine to medium angular gravel (shale fragments) from 1.7 m		
					2.00			
					2.25	End BH2 at 2.1 m Practical Auger Refusal on Weathered Siltstone		
					2.50			
					2.75			
					3.00			
					3.25			
					3.50			
					3.75			
					4.00			



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.

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