Geotechnical Investigation Report

Project

Proposed Residential Development
10-14 Lethbridge Street, Penrith NSW 2750

Prepared for

Fobupu Pty Ltd
C/O PBD Architects Pty Ltd

Date

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1 INTRODUCTION

This report presents the findings of a geotechnical investigation undertaken by Alliance Geotechnical Pty Ltd (Alliance) for Fobupu Pty Ltd (the client) for the proposed residential development at 10-14 Lethbridge Street, Penrith NSW 2750 (the site). The investigation was carried out in accordance with the scope of works outlined in Alliance proposal, estimate no. 04867, dated 29 April 2021.

The proposed development involves the constructions of multi-storey residential apartments which includes two levels of basements and five levels above ground.

The geotechnical investigation is required to support a Development Application (DA) submission and provide geotechnical design parameters required for structural designs and during construction stages.

The purpose of Alliance's geotechnical investigation was to assess the surface of subsurface conditions and provide comments recommendation relating to:

- Existing geotechnical and groundwater conditions;
- Geotechnical design parameters
- Excavation conditions and vibration management;
- Excavation support;
- Suitable foundation materials and footing types with geotechnical footings design parameters; and
- Soil aggressivity regarding steel and concrete.

In order to achieve the project objectives, the following scope of works was carried out:

- Review of geological maps;
- Walkover observations and inspection of the site conditions by a geotechnical engineer;
- Drill two boreholes across the site to a maximum depth of 10.2m below the ground level (BGL) with Standard Penetration Tests (SPTs) at 1.5m intervals;
- Perform two Dynamic Cone Penetrometer (DCP) tests adjacent to the boreholes;
- Install monitoring well to monitor the groundwater level; and
- Collect soil samples for soil aggressivity testing.

This report provides the findings of the geotechnical investigation along with the comments and recommendations regarding the proposed development including the geotechnical monitoring program.

2 PROPOSED DEVELOPMENT

To assist with the geotechnical investigation, Alliance has been provided with the following documents:

- A set of architecture drawings, prepared by PBD Architects, ref.: 2026, dated July and September 2020; and
- The site survey plan, prepared by RHCO, ref.: 16498, dated 27/09/2016.

Based on the supplied documents, it is understood that the proposed development includes the demolition of the existing structures and the construction of seven-storey building which includes two carpark basements.

The second basement finish floor elevation is RL 39.5m. Assuming excavation level would be 150mm below the finishing basement floor, the bulk excavation elevation is estimated to be RL 39.35m. As such, the maximum excavation depth would be 8.9m.

It is considered that the excavation setbacks are:

- 6m to the northern and southern boundary approximately;
- 1.5m to the western boundary approximately; and
- 1.3m to the eastern boundary approximately.

There is a very minimal setback between the site boundary and the garage from No 9 Lethbridge Street.

Referring to Dial Before You Dig (DBYD) plans there is a sewer main (150 VC) crossing the site boundary at the southwest corner.

3 SITE DESCRIPTION & REGIONAL GEOLOGY

The site covers a rectangular block of land, known as Lot 456 of DP 1114361, which comprises and area of 1800m^2 approximately. It is located within residential area of Penrith within the City of Penrith Local Government Area. At the time of the investigation, the site was vacant with some vegetation present at the northwest corner.

The site is bounded by residential lots to the west, south, and east and by Lethbridge Street to the North. Figure 1 shows the site with surrounding features.

Refer to the provided survey plan, the site is situated on a slight slope of <5° with gradient falling towards the northwest corner. The reduced levels in relation to Australian Height Datum (AHD) of the northwest and southeast corners are recorded as RL 46.6m and RL 48.2m, respectively.

The 1:100,000 Penrith Geological Map (Geological Survey of NSW, Department of Minerals and Energy, Sheet 9030, Edition 1, 1991) indicates that the site is underlain by Middle Triassic aged Bringelly shale of the Wianamatta group, describes as '*Shale, carbonaceous claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff*.'

Figure 1 - General Site Location

4 GEOTECHNICAL INVESTIGATION

4.1 Methods

The geotechnical investigation was carried out on 4 June 2021. Selected site photographs taken during the fieldwork are presented in Appendix A and borehole locations are shown in Drawing 12970-GR-1-A (Appendix B).

After the site walkover and inspections, two proposed locations were cleared of underground services by an accredited contractor.

The investigation comprised drilling two boreholes, BH01 and BH02, using a track-mounted drilling rig operated by a subcontractor. The soil profile was advanced using solid flight augers fitted with a tungsten carbide bit (TC-bit) upon encountering shale bedrock where NMLC coring was initiated to the target depth of 10m BGL.

SPTs were undertaken at 1.5m intervals in the drilled boreholes. Two DCP tests were performed adjacent to the borehole locations to assess the near surface consistency.

The ground condition along with the in-situ test results was documented by an Alliance geotechnical engineer in accordance with AS1726:2016 – Geotechnical Site Investigations. Selected soil and cored samples were transported to Alliance's NATA accredited materials testing laboratory for further testing and storage.

A standpipe piezometer was constructed and installed inside borehole BH01 to a depth of 9.1m BGL to monitor groundwater level.

At the completion of the investigation, BH2 was backfilled with excavated materials and uncontrolled spoils to make flush with the surrounding ground surface.

4.2 Subsurface Conditions

The full details of the subsurface profile encountered and the DCP test results are presented in Appendix C. The borehole logs should be read in conjunction with the attached Explanatory Notes which explain the terms, abbreviations, and symbols used, the interpretation and the limitation of the logging procedure.

A summary of the encountered subsurface conditions is presented in Table 1. The site comprised a 0.1m thickness of topsoil underlain by residual clay of stiff to very stiff consistency. Shale bedrock was encountered at depth 1.6m – 2.7m BGL.

The encountered bedrock was predominantly shale of varying strength and weathering degree. Bedrock defects and seams are listed in the borehole logs presented in Appendix C. Clayey seams were observed within bedrock layers in both boreholes with maximum thickness of 110mm in borehole BH01.

Table 1- Subsurface Condition

Soil Profile	Depth (m)	
	BH01	BH02
Topsoil – Silty sandy clay	0.0 – 0.1	0.0 – 0.1
Residual – Clay, stiff	0.3 – 0.6	0.1 - 1.1
Residual – Clay, very stiff	0.0 – 0.3 and 0.6 – 1.3	1.1 – 1.8
Bedrock – Shale, very low strength, extremely weathered	1.3 – 1.7	1.8 – 3.2
Bedrock – Shale, low strength, highly weathered	1.7 – 5.2	3.2 – 4.0
Bedrock – Shale, medium to high, slightly weathered	5.2 – 10.2	4.0 – 10.2
Termination Depth (m)	10.2	10.2

4.3 Groundwater Conditions

Groundwater was not encountered during drilling. An additional site visit was carried out on 22 June 2021 to check the groundwater level inside the well installed at BH01. The groundwater level at this date was recorded at a depth of 4.5m below ground level (RL 43.3m).

5 LABORATORY TESTING

5.1 Point Load Strength Index (I_{S50})

The point load strength index tests were undertaken on rock core samples from borehole BH01 and BH02 at Alliance's NATA accredited laboratory. The results are included on the borehole logs provided in Appendix C.

5.2 Soil Aggressivity

An aggressivity test was performed to aid in the design of durable, buried concrete and steel materials in contact with the site soils on a selected soil sample collected from BH02.

The laboratory test certificates are provided in Appendix D. Table 2 presents the results of aggressivity test of a sample obtained from a depth of 0.8 -1.3m. The results were assessed in conjunction with AS 2159 – 2009 to classify the aggressivity of the soils for concrete and steel piles.

Table 2- Soil Aggressivity Test Results

Test	Unit	BH02
Chloride	$mg.kg^{-1}$	82
Conductivity(1)	$uS.cm^{-1}$	48
pH(1)	-	6.7
Resistivity	Ohm.cm	21,000
Sulfate (SO_4)	$mg.kg^{-1}$ (ppm)	32
Moisture	%	17
Results(2)	*In regard to steel*	*Non-Aggressive*
	In regard to concrete	*Non-Aggressive*

(1): Tests were done on a 1:5 aqueous extract at 25°C as recorded.

(2): Assessed in accordance with AS 2159 – 2008, Table 6.4.2 (C) and Table 6.5.2 (C)

6 RECOMMENDATIONS

6.1 Geotechnical Design Parameters

Based on the drilling investigation, the following geotechnical parameters are provided in Table 3.

Table 3 – Geotechnical Design Parameters

Ground Layer		Consistency/ Density/ Strength	Depth	γ	C_u	C'	∅′	K_a	K_o	K_p	E	ν
Origin	Type		m	KN/m^3	kPa	kPa	Degrees	-	-	-	-	-
Topsoil: silty sandy CLAY		-	Refer to borehole logs	-	-	-	-	-	-	-	-	-
Residual	CLAY	Stiff		18	50	5	26	0.39	0.56	2.56	15	0.3
Residual	CLAY	Very Stiff		19	100	7	28	0.36	0.53	2.77	30	0.3
Bedrock	Shale	Very low strength		22	500	50	28	0.36	0.53	2.77	150	0.3
Bedrock	Shale	Low strength		23	-	100	33	0.29	0.46	3.39	450	0.3
Bedrock	Shale	Medium to high strength		23	-	200	40	0.22	0.36	4.60	1400	0.25

Legend:
γ : Unit Weight
C_u: Undrained cohesion
c': Effective Cohesion
∅′ : Effective Friction Angle
K_a: Active earth pressure
K_o: Earth pressure at rest
K_p: Passive earth pressure
E: Elasticity Modulus
ν: Poisson's Ratio

6.2 Groundwater control

Based on the findings of this investigation, groundwater is expected to be encountered during the proposed excavation works. There is also a potential for groundwater inflow into the excavation through open bedding planes or joints and at the clay/rock interface, particularly during and following inclement weather. It is anticipated that inflows during bulk excavation can be managed by sump- pumping method. However, in the long term, drainage behind perimeter retaining walls (including any shotcrete) and underfloor drainage (with discharge via a permanent pump system) will be required as part of the final design.

If a permanent pump-out system following completion of construction is not preferred by the Client or Water NSW does not allow permanent pumping due to the effect on the groundwater table, it may be necessary to construct watertight retaining walls by tanking the basement.

Based on the current limited groundwater monitoring, a design groundwater level at RL 43.8m AHD is recommended. However, further groundwater monitoring should be considered to measure the maximum standing groundwater level (for the purpose of permanent retaining wall and base slab design) and to assess the anticipated short term and long-term inflow rates.

Since the site is underlain by residual clayey soils and bedrock, managing the site groundwater seepage by sump pumping is not anticipated to impact the adjoining properties. However, it should be assessed based on the anticipated inflow rate and the short-term and long-term groundwater management methods.

The base of the excavation is anticipated to be founded within medium strength shale. This material is prone to breaking down and deteriorating over the time when it gets wet. Therefore, to provide an appropriate working platform at the base of the excavation, it is recommended to place a layer of compacted single-size gravel with a minimum compacted thickness of 100mm.

If bored piles are adopted for this project, groundwater inflow may occur during pile drilling. Consequently, pumps may be required to remove water from the bored pile holes prior to inspection and the placement of

steel reinforcement and concrete. Alternatively, tremie concrete placement method could be adopted for the concrete placement if the pile has been approved for concrete placement prior to recent entry of water.

6.3 Excavations and Vibration

Based on the subsurface conditions encountered and summarised in Table 1, bulk excavations are expected to encounter stiff to very stiff clays to a depth of 1.3m to -1.8m overlying shale bedrock of very low strength to high strength.

Based on the supplied preliminary architectural drawings, finished floor level (FFL) of basement 2 is at RL 39.5m, i.e. up to 8.9m excavation at the eastern site boundary. Considering borehole logs, the excavations will have to be undertaken through medium to high strength bedrock.

Excavations through the overlying soils, very low strength and low strength shale are expected to be readily achievable using conventional earthworks equipment such as a tracked excavator with a tiger-toothed bucket. Excavations within medium to high strength shale will require larger excavators (i.e. 30 tonnes) and the use of ripping or rock impact breakers for bulk excavations.

Low vibration equipment may be necessary near site boundaries where vibrations could impact on adjacent building footings and structures. Alternatively, to limit the transmission of vibrations, the perimeter of the excavation may be saw-cut prior to any ripping or excavation of the rock mass.

To manage the potential for damage to nearby properties, it is recommended that ground vibration peak particle velocity be limited to 5mm/s at the property boundaries during any demolition, excavation and construction works.

A dilapidation survey on nearby structures and infrastructures is recommended to be undertaken prior to the commencement of any site excavations. The report should include precise measurements of the existing defects and cracks presented with the relevant photos.

6.4 Excavation Support

Based on site survey and preliminary architectural plans, up to 8.9m excavation is expected to be undertaken at the site eastern boundary. Considering 5.9m setbacks of the basement footprints to the site boundaries, temporary batter slopes may be feasible to some depth at north and south basement walls only.

Batter slopes in soil should not be extended below the ‘zone of influence’ of any adjacent structures, road and infrastructures (i.e. a 45° line drawn from the foundation level of any adjacent structure in soil profile). The recommended maximum temporary batter slopes are presented in Table 4.

Table 4 - Maximum Excavation Batter Slopes

Material	Maximum Dry Batter Slope (H: V)	
	Permanent	Temporary
Residual stiff to very stiff clay	N/A	1: 1

Wherever temporary unsupported battered slopes are not feasible (e.g. eastern and western boundaries), the proposed excavation should be supported by a properly designed shoring system along the site boundaries.

The temporary shoring system and permanent earth retaining structures should be designed in accordance with AS 4678-2002 incorporating geotechnical design parameters presented in Table 3, to withstand the applied lateral pressures of the subsurface soil layers and the existing surcharge loads within the zone of influence of the structure. Contiguous piles with reinforced shotcrete infill panels and drainage provided behind the shotcrete panels are recommended for this project. The piles to support the excavation could be designed as a cantilever pile, anchored piles, or internally braced.

For the design of flexible temporary retaining structures, where some lateral movement is acceptable, an 'active' lateral earth pressure coefficient is recommended (k_a). If it is critical to limit the horizontal deformation of a retaining structure (e.g. permanent retaining walls) an earth pressure coefficient 'at rest' should be considered (k_o).

The specific requirements for excavation support are to be assessed by an experienced geotechnical engineer as the excavation proceeds. It is recommended that the excavation be inspected by an experienced geotechnical engineer upon completion of the excavation to assess the shoring system adequacy.

6.5 Foundations

The proposed building can be founded on shallow pad footings at the basement level or, alternatively, deep piled footings.

Based on the geotechnical investigation results, the recommended geotechnical design parameters for deep footings are provided in Table 5. A minimum factor of safety of 3.0 is recommended for design purposes. Where pad footing allowable bearing pressures of more than 3,500kPa are adopted, spoon tests are recommended to be undertaken to confirm the assumed bearing pressure.

End bearing pressures recommended in this table can be used for design of shallow pad footings using appropriate factors of safety (minimum of 3 is recommended).

Table 5 –Design Parameters for Foundation

Description	Depth * (m)	Ultimate End Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)
Very low strength shale	Refer to Table 1 and attached borehole logs	3,000	150
Low strength shale		6,000	350
Medium to high strength shale		10,000	600

The bedrock allowable bearing pressures are assessed in accordance with the classification presented by Pells et al (1998) for Sydney shale foundations.

It is recommended that the pile foundations be designed in accordance with AS 2159-2009 Piling – Design and Installation.

Before pouring concrete, the pad footings, bored pile excavation/pier hole should be inspected by an experienced Geotechnical Engineer to confirm the allowable bearing pressure, socket depth, and that the bases of the pads/piles are clean and free of soft, loose, wet or disturbed soils. Tremie pipe is recommended to be used to pour pile concrete where groundwater table or considerable seepage is encountered during foundation works.

7 Limitations

Alliance Geotechnical Pty Ltd (Alliance) has prepared this report for the site located at 10-14 Lethbridge Street, Penrith NSW 2750 in accordance with Alliance's fee proposal and Terms of Engagement. This geotechnical report has been prepared for Fobupu Pty Ltd c/o PBD Architects Pty Ltd for this project and for the purposes outlined in this report.

This report cannot be relied upon for other projects, other parties on this site or any other site. The comments and recommendations provided in this report are based on the assumption that the geotechnical recommendations contained in this report will be fully complied with during the design and construction of the proposed site development.

The borehole investigation and laboratory testing results provided in this report are indicative of the subsurface conditions at the site only at the specific sampling and testing locations, and to the depths drilled at the time of the investigation. Subsurface conditions can change significantly due to geological and human processes. Where variations in conditions are encountered further geotechnical advice should be sought from Alliance.

APPENDIX A – Site Photograph

Photo 1 – DCP Test at BH02 Location Looking Southeast at BH01 Location

APPENDIX B – Investigation Location Plan

0 5 10 15 20 25 50m

LEGENDS:

Indicative borehole and DCP test locations

Geotechnical Investigation Plan

Client Name:	Fobupu Pty Ltd	Drawing Number:	12970-GR-1-A
Project Name:	Proposed Residential Development	Drawing Date:	18 June 2021
Project Location:	10-14 Lethbridge Street, Penrith NSW 2750	Report Number:	12970

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APPENDIX C – Explanatory Notes, Borehole Logs & and DCP Test Report

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Explanatory Notes
Drill & Excavation Logs

General

Information obtained from site investigations is recorded on log sheets. Soils and very low strength rock are commonly drilled using a combination of solid-flight augers with a Tungsten-Carbide (TC) bit. Descriptions of these materials presented on the "Borehole Log" are based on a combination of regular sampling and in-situ testing. Rock coring techniques commences once material is encountered that cannot be penetrated using a combination of solid-flight augers and Tungsten-carbide bit. The "Cored Borehole Log" presents data from drilling where a core barrel has been used to recover material - commonly rock.

The "Excavation - Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits or trenches.

The heading of the log sheets contains information on Project Identification, Hole or Test Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material 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 scale is presented in the depth column as metres below ground level.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is included 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, and geological unit. Material description and classifications are based on Australian Standard Geotechnical Site Investigations: AS 1726 - 2017 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 and Excavating

Drilling methods deployed are abbreviated as follows

AS	Auger Screwing
ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
BH	Backhoe
E	Excavator
HA	Hand Auger
HQ	HQ core barrel (~63.5 mm diameter core) *
HMLC	HMLC core barrel (~63.5 mm diameter core) *
NMLC	NMLC core barrel (~51.9 mm diameter core) *
NQ	NQ core barrel (~47.6 mm diameter core) *
RR	Rock Roller
WB	Wash-bore drilling

* Core diameters are approximate and vary due to the strength of material being drilled.

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage. It is introduced to assist with the drill process, in particular, when core drilling. The introduction of drill fluid/water does not allow for accurate identification of water seepages.

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
F	Firm
H	Hard
VH	Very Hard

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

Groundwater inflow water level

Samples/Tests

Samples collected and testing undertaken are abbreviated as follows

ES	Environmental Sample
DS	Disturbed Sample
BS	Bulk Sample
U50	Undisturbed (50 mm diameter)
C	Core Sample
SPT	Standard Penetration Test
N	Result of SPT (*sample taken)
VS	Vane Shear Test
IMP	Borehole Impression Device
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test
HB	Hammer Bouncing

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

Material Description - In accordance with AS 1726-2017

Classification Symbol - In accordance with the Unified Classification System (AS 1726-2017).

Abbreviation	Typical Names
GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well graded sands, gravelly sands, little or no fines.
SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
SM	Silty sand, sand-silt mixtures.
SC	Clayey sands, sand-clay mixtures.
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL	Organic silts and organic silty clays of low plasticity. *
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, clastic silts.
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity, organic silts. *
Pt	Peat and other highly organic soils. *

* Additional details may be provided in accordance with the Von Post classification system (1922).

Organic Soils - Identification using laboratory testing:

Material	Organic Content - % of dry mass
Inorganic	<2
Organic Soil	<2 ≤ 25
Peat	> 25

Organic Soils - Descriptive terms for the degree of decomposition of peat:

Term	Decomposition	Remains	Squeeze
Fibrous	Little or none	Clearly recognizable	Only water No solid
Pseudo-fibrous	Moderate	Mixture of fibrous and amorphous	Turbid water < 50% solids
Amorphous	Full	Not recognizable	Paste > 50% solids

Particle Characteristics– Definitions are as follows:

Fraction	Component (& subdivision)		Size (mm)
Oversize	Boulders		> 200
	Cobbles		> 63 ≤ 200
Coarse grained soils	Gravel	Coarse	> 19 ≤ 63
		Medium	> 6.7 ≤ 19
		Fine	> 2.36 ≤ 6.7
	Sand	Coarse	> 0.6 ≤ 2.36
		Medium	> 0.2 ≤ 0.6
		Fine	> 0.075 ≤ 0.21
Fine grained soils	Silt		0.002 ≤ 0.075
	Clay		< 0.002

Secondary and minor soil components

In coarse grained soils – The proportions of secondary and minor components are generally estimated from a visual and tactile assessment of the soils. Descriptions for secondary and minor soil components in coarse grained soils are as follows.

Designation of components	Percentage fines	Terminology (as applicable)	Percentage accessory coarse fraction	Terminology (as applicable)
Minor	≤ 5	Trace clay / silt	≤ 5	Trace sand / gravel
	> 5 ≤12	With clay / silt	> 5 ≤12	With sand / gravel
Secondary	> 12	Silty or clayey	> 30	Sandy or gravelly

Descriptions for secondary and minor soil components in fine grained soils are as follows.

Designation of components	Percentage coarse grained soils	Terminology (as applicable)
Minor	≤ 5	Trace sand / gravel / silt / clay
	> 5 ≤12	With sand / gravel / silt / clay
Secondary	> 30	Sandy / gravelly / silty / clayey

Plasticity Terms – Definitions for fine grained soils are as follows:

Descriptive Term	Range of Liquid Limit for silt	Range of Liquid Limit for clay
Low Plasticity	≤ 50	≤ 35
Medium Plasticity	N/A	> 35 ≤50
High Plasticity	> 50%	> 50

Particle Characteristics

Particle shape and angularity are estimated from a visual assessment of coarse-grained soil particle characteristics. Terminology used includes the following:

Particle shape – spherical, platy, elongated,

Particle angularity –angular, sub-angular, sub-rounded, rounded.

Moisture Condition – Abbreviations are as follows:

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

Moisture content of fine-grained soils is based on judgement of the soils moisture content relative to the plastic and liquid limit as follows:

MC < PL	Moist, dry of plastic limit
MC ≈ PL	Moist, near plastic limit
MC > PL	Moist, wet of plastic limit
MC ≈ LL	Wet, near liquid limit
MC > LL	Wet of liquid limit

Consistency - of cohesive soils in accordance with AS 1726-2017, Table 11 are abbreviated as follows:

Consistency Term	Abbreviation	Indicative Undrained Shear Strength Range (kPa)
Very Soft	**VS**	< 12
Soft	**S**	12 ≤ 25
Firm	**F**	25 ≤ 50
Stiff	**St**	50 ≤ 100
Very Stiff	**VSt**	100 ≤ 200
Hard	**H**	≥ 200
Friable	**Fr**	-

Density Index (%) of granular soils is estimated or is based on SPT results. Abbreviations are as follows:

Description	Abbreviation	Relative Density	SPT N
Very Loose	VL	< 15%	0 - 4
Loose	L	15 - 35%	4 - 10
Medium Dense	MD	35 - 65%	10 - 30
Dense	D	65 - 85%	30 - 50
Very Dense	VD	> 85%	> 50

Structures - Fissuring and other defects are described in accordance with AS 1726-2017 using the terminology for rock defects

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

MATERIAL DESCRIPTION - ROCK

Material Description

Descriptions of rock for geotechnics and engineering geology in civil engineering

Identification of rock type, composition and texture based on visual features in accordance with AS 1726-2017.

Rock Naming – Where possible conventional geological names are used within the logs. Engineering properties cannot be inferred directly from the rock names in the table, but the use of a particular name provides an indicative range of characteristics to the reader. Lithological identification of rock is provided to appreciate the geology of an area, to correlate geological profiles seen in boreholes or to distinguish boulders from bedrock.

Grain Size – Grain size is done in accordance with AS1726-2017 as follows:

Coarse grained	Mainly 0.6 to 2 mm
Medium grained	0.2 – 0.6 mm
Fine grained	0.06 – 0.2 mm

Colour – Rock colour is described in the moist condition.

Texture and Fabric - Frequently used terms include:

Sedimentary Rock	Metamorphic Rock	Igneous
Bedded	Cleaved	Massive
Interbedded	Foliated	Flow banded
Laminated	Schistose	Folded
Folded	Banded	Lineated
Massive	Lineated	Porphyritic
Graded	Gneissose	Crystalline
Cross-bedded	Folded	Amorphous

Bedding and Laminated – AS 1726 – 2017 bedding and laminated rock descriptions are provided below with additional detail from BS EN ISO 14689-1 as guidance.

Description	Spacing (mm)
Very Thickly Bedded	> 2000
Thickly Bedded	> 600 ≤ 2000
Medium Bedded	> 200 ≤ 600
Thinly Bedded	> 60 ≤ 200
Very Thinly Bedded	> 20 ≤ 60
Thickly Laminated	> 6 ≤ 20
Thinly Laminated	< 6

Features, inclusions and minor components – Features, inclusions and minor components within the rock material shall be described where those features could be significant such as gas bubbles, mineral veins, carbonaceous material, salts, swelling minerals, mineral inclusions, ironstone or carbonate bands, cross-stratification or minerals the readily oxidise upon atmospheric exposure.

Moisture content – Where possible descriptions are made by the feel and appearance of the rock using one according to following terms:

Dry	Looks and feels dry.
Moist	Feels cool, darkened in colour, but no water is visible on the surface
Wet	Feels cool, darkened in colour, water film or droplets visible on the surface

The moisture content of rock cored with water may not be representative of its in-situ condition.

Durability – Descriptions of the materials durability such as tendency to develop cracks, break into smaller pieces or disintegrate upon exposure to air or in contact with water are provided where observed.

Rock Material Strength – The strength of the rock material is based on uniaxial compressive strength (UCS). The following terms are used:

Rock Strength Class	Abbreviation	UCS (MPa)	Point Load Strength Index, $I_{s(50)}$ (MPa)
Very Low	VL	> 0.6 ≤ 2	> 0.03 ≤ 0.1
Low	L	> 2 ≤ 6	> 0.1 ≤ 0.3
Medium	M	> 6 ≤ 20	> 0.3 ≤ 1
High	H	> 20 ≤ 60	> 1 ≤ 3
Very High	VH	> 60 ≤ 200	> 3 ≤ 10
Extremely High	EH	> 200	> 10

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

D	Diametral Point Load Test
A	Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown. Point Load Strength Index test results are presented as $I_{s(50)}$ values in MPa.

Weathering - Weathering classification assists in identification but does not imply engineering properties. Descriptions are as follows:

Term (Abbreviation)	Description
Fresh (FR)	No signs of mineral decomposition or colour change.
Slightly Weathered (SW)	partly stained or discoloured. Not or little change to strength from fresh rock.
Moderately Weathered (MW)	material is completely discoloured, little or no change of strength from fresh rock.
Highly Weathered (HW)	material is completely discoloured, significant decrease in strength from fresh rock.
Extremely Weathered (EW)	Material has soil properties. Mass structure, material texture and fabric of original rock are still visible.
Residual Soil (RS)	Material has soil properties. Mass structure and material texture and fabric of original rock not visible, but the soil has not been significantly transported.

Alteration – Physical and chemical changes of the rock material due to geological processes by fluids at depth at pressures and temperatures above atmospheric conditions. Unlike weathering, alteration shows no relationship to topography and may occur at any depth. When altered materials are recognized, the following terms are used:

Term		Abbreviation		Definition
Extremely Altered		XA		Material has soil properties. Structure, texture and fabric of original rock are still visible. The rock name is replaced with the name of the parent material, e.g. Extremely Altered basalt. Soil descriptive terms are used.
Highly Altered	Distinctly altered	HA	DA	The whole of the rock material is discoloured. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be higher or lower due to loss of minerals or precipitation of secondary minerals in pores.
Moderately Altered	Distinctly altered	MA	DA	The whole of the rock material is discoloured Little or no change of strength from fresh rock. The term 'Distinctly Altered' is used where it is not practicable to distinguish between 'Highly Altered' and 'Moderately Altered'. Distinctly Altered is defined as follows: The rock may be highly discoloured; Porosity may be higher due to mineral loss; or may be lower due to precipitation of secondary minerals in pores; and Some change of rock strength.
Slightly Altered		SA		Rock is slightly discoloured Little or no change of strength from fresh rock.

Alteration is only described in the context of the project where it has relevance to the civil and structural design.

Defect Descriptions

General and Detailed Descriptions – Defect descriptions are provided to suit project requirements. Generalized descriptions are used for some projects where it is unnecessary to describe each individual defect in a rock mass, or where multiple similar defects are present which are too numerous to log individually. The part of the rock mass to which this applies is delineated.

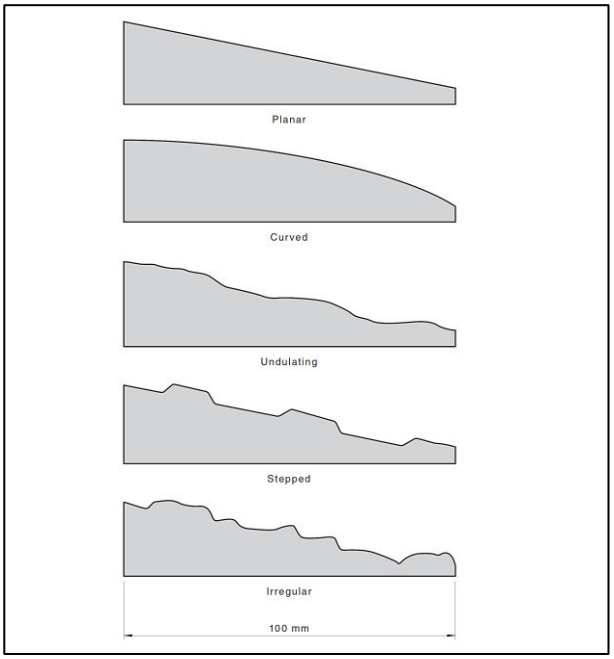
Detailed descriptions are given of defects judged to be particularly significant in the context of the project. For example, crushed seams in an apparently unstable slope. As a minimum, general descriptions outlining the number of defect sets within the rock mass and their broad characteristics are provided where it is possible to do so.

Defect Type – Defect abbreviations are as follows:

BP	Bedding Parting	FL	Foliation	SP	Shear Plane
CL	Cleavage	FZ	Fracture Zone	SZ	Shear Zone
CS	Crushed Seam	HB	Handling break	VN	Vein
DB	Drilling break	JT	Joint		
DL	Drill Lift	SM	Seam		

Defect Orientation – The dip and dip direction are recorded as a two-digit and three-digit number separated by a slash, e.g. 50/240 only when orientated core are collected and there is not core loss that could obscure core orientation. If alternative measurements are made, such as dip and strike or dip direction relative to magnetic north this shall be documented.

Surface Shape –At the medium scale of observation, description of the roughness of the surface shall be enhanced by description of the shape of the defect surface using the following terms, as illustrated below:



Defect Coatings and Seam Composition – Coatings are described using the following terms:

(a) *Clean* No visible coating.
(b) *Stained* No visible coating but surfaces are discoloured.
(c) *Veneer* A visible coating of soil or mineral, too thin to measure; may be patchy.
(d) *Coating* A visible coating up to 1 mm thick. Soil in-fill greater than 1 mm shall be described using defect terms (e.g. infilled seam). Defects greater than 1 mm aperture containing rock material great described as a vein.

Defect Spacing, Length, Openness and Thickness –described directly in millimetres and metres. In general descriptions, half order of magnitude categories are used, e.g. joint spacing typically 100 mm to 300 mm, sheared zones 1 m to 3 m thick.

Depending on project requirements and the scale of observation, spacing may be described as the mean spacing within a set of defects, or as the spacing between all defects within the rock mass. Where spacing is measured within a specific set of defects, measurements shall be made perpendicular to the defect set.

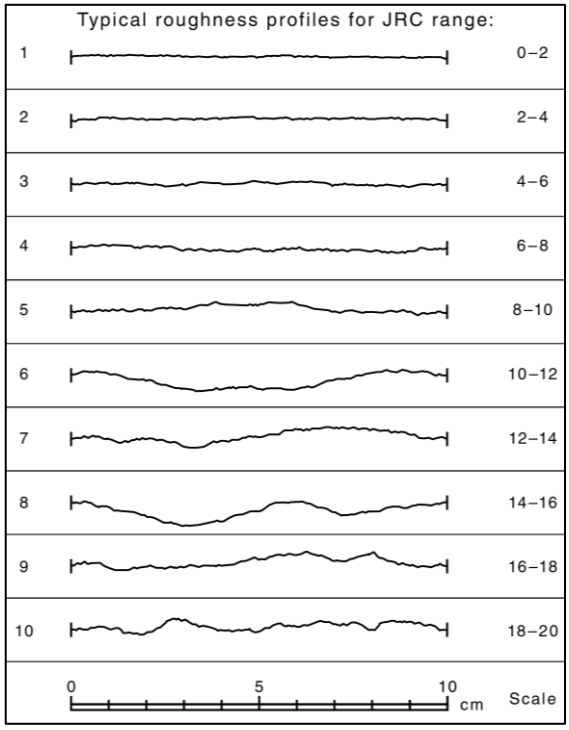
Defect spacing and length (sometimes called persistence), shall be described directly inmillimetres and metres.

Stratigraphic Unit - Geological maps related to the project are used for the designation of lithological formation name and, where possible geological unit name, e.g. Bringelly Shale, Potts Hill Sandstone Member.

Defect Roughness and Shape – Defect surface roughness is described as follows:

Very rough	Many large surface irregularities with amplitude generally more than 1 mm.
Rough	Many small surface irregularities with amplitude generally less than 1 mm.
Smooth	Smooth to touch. Few or no surface irregularities.
Polished	Shiny smooth surface
Slickensided	Grooved or striated surface, usually polished.

Where applicable Joint Roughness Range (JRC) is provided as follows:



Joint roughness profiles and corresponding JRC range based on Barton, N and Choubey, V. The Shear Strength of Rock Joints in Theory and Practice. *Rock Mechanics.* Vol. 10 (1977), pp. 1–54.

Where possible the mineralogy of the coating is identified.

Defect Infilling - abbreviated as follows:

CA	Calcite	KT	Chlorite
CN	Clean	MS	Secondary Mineral
Cy	Clay	MU	Unidentified Mineral
CS	Crushed Seam	Qz	Quartz
Fe	Iron Oxide	X	Carbonaceous

PARAMETERS RELATED TO CORE DRILLING

Total Core Recovery – T

Defect Spacing or Fracture Index – T

Rock Quality Designation – Y

Core Loss – Core loss occurs when material is lost during the drilling process It is shown at the bottom of the run unless otherwise indicated where core loss is known.

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Borehole Log

Client: Fobupu Pty Ltd
Project: Proposed Residential Development
Location: 10-14 Lethbridge Street, Penrith, NSW 2750

Started: 4/06/2021
Finished: 4/06/2021
Borehole Size 110 mm

Rig Type: Comacchio Geo300 **Hole Location:** Refer to Drawing 12970-GR-1-A **Driller:** DM **Logged:** KN
RL Surface: 47.8m **Contractor:** Stratacore **Bearing:** --- **Checked:** MS

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT	Not enountered during augering.	47.8	0.0		--	TOPSOIL: Silty Sandy CLAY, low plasticity, brown, trace fine to medium subangular black gravel.		MC ~ PL	--	TOPSOIL
		47.5	0.5		CI-CH	CLAY, medium to high plasticity, orange mottled pale grey.		MC >~ PL	St - VSt	RESIDUAL
		47.0	1.0			At 0.4m: Becoming pale grey mottled orange.		MC ~< PL		
		46.5	1.5		--	SHALE, extremely weathered, recovered as CLAY, medium plasticity, pale brown mottled orange.		--	--	EXTREMELY WEATHERED SHALE
					--	SHALE, very low strength, highly weathered, interbedded with siltstone, brown, with grey thinly lamination.	SPT 30/140mm	--	--	BEDROCK
		46.0	2.0			Borehole BH01 continued as cored hole				
		45.5	2.5							
		45.0	3.0							
		44.5	3.5							
		44.0	4.0							
		43.5	4.5							
		43.0	5.0							
		42.5	5.5							

2. NON CORED BOREHOLE (NO COORD/RL) 12970 - LOGS.GPJ GINT STD AUSTRALIA.GDT 23/06/21

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Cored Borehole Log

Client: Fobupu Pty Ltd
Project: Proposed Residential Development
Location: 10-14 Lethbridge Street, Penrith, NSW 2750
Started: 4/06/2021
Finished: 4/06/2021
Borehole Size 110 mm

Rig Type: Comacchio Geo300 **Hole Location:** Refer to Drawing 12970-GR-1-A **Driller:** DM **Logged:** KN
RL Surface: 47.8m **Contractor:** Stratacore **Bearing:** --- **Checked:** MS

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (●- Axial O- Diametral) EL -0.03 VL -0.1 L -0.3 M -1 H -3 VH -10 EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm 30 100 300 1000 3000	Additional Data
		47.5	0.5								
		47.0	1.0								
		46.5	1.5		Continued from non-cored borehole						
NMLC	Water introduced for coring.	46.0	2.0		SHALE, interbedded with silstone, with brown, grey and dark grey lamination.	HW		A 0.08			
		45.5	2.5		SHALE, interbedded with ironstone bands and clay layers.			A 0.12 A 0.09	70		2.25 - Clay Seam, 2mm. 2.42 - 2.52 - Clay Seam, 100mm.
		45.0	3.0								2.76 - 2.87 - Clay Seam, 110mm. 2.80 - 2.86 - FZ, Rough, Clean. 2.94 - Clay Seam, 2mm.
		44.5	3.5						85		3.16 - 3.20 - Clay Seam, 40mm. 3.26 - 3.30 - Clay Seam, 40mm.
		44.0	4.0		SHALE, grey and dark gray laminated, interbedded with siltstone.	MW		D A 0.23 0.08			3.80 - 3.86 - JT, Planar, Rough, Clean. 4.00 - 4.20 - JT, 70°, Irregular, Rough, Clean.
		43.5	4.5		4.3 - 4.4m: With iron staining.			D A 0.16 0.37			4.40 - JT, Planar, Rough, Clean. 4.50 - 4.55 - Clay Seam, 50mm. 4.55 - 4.70 - FZ.
		43.0	5.0					D A 0.19 0.28	71		4.81 - JT, Planar, Rough, Clean. 4.82 - 4.87 - JT, 80°, Planar, Rough, Clean. 4.96 - 5.05 - JT, 60°, Planar, Rough, Clean. 5.05 - 5.12 - JT, 45°, Planar, Rough, Clean.
		42.5	5.5		5.2 - 5.3m: With iron staining.			D A 0.52 0.65			5.20 - 5.30 - FZ, Rough, Clean. 5.47 - 5.54 - FZ, Rough, Clean.

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Cored Borehole Log

Client: Fobupu Pty Ltd
Project: Proposed Residential Development
Location: 10-14 Lethbridge Street, Penrith, NSW 2750
Started: 4/06/2021
Finished: 4/06/2021
Borehole Size 110 mm

Rig Type: Comacchio Geo300 **Hole Location:** Refer to Drawing 12970-GR-1-A **Driller:** DM **Logged:** KN
RL Surface: 47.8m **Contractor:** Stratacore **Bearing:** --- **Checked:** MS

Method	Water	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (●- Axial O- Diametral) EL -0.03 VL -0.1 L -0.3 M -1 H -3 VH -10 EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm (30 100 300 1000 3000)	Additional Data
NMLC		42.0	6.0		SHALE, grey and dark gray laminated, interbedded with siltstone. *(continued)*	MW		D 0.16 A 0.51			5.73 - JT, 45°, Planar, Rough, Clean.
		41.5	6.5					D 0.27 A 0.8	71		6.62 - 6.67 - Clay Seam, 50mm.
		41.0	7.0					D 0.12 A 0.36			6.78 - 6.68 - JT, Planar, Rough, Clean. 6.96 - JT, 45°, Planar, Rough, Clean.
		40.5	7.5		7.44 - 7.50m: With iron stains.			D 0.27 A 0.37			7.44 - JT, Planar, Rough, Clean. 7.54 - JT, Planar, Rough, Clean.
		40.0	8.0		SHALE, medium strength, moderately weathered, grey and dark grey thinly laminated.	SW		D 0.47 A 0.75			7.84 - BP, Stained.
		39.5	8.5					D 0.54 A 1.55	97		
		39.0	9.0								
		38.5	9.5					D 0.39 A 0.98			
		38.0	10.0					D 0.54 A 1.37			
		37.5	10.5		Target depth. BH01 terminated at 10.18m						End of core.
		37.0	11.0								

6. CORED BOREHOLE (NO COORD/RL) 12970 - LOGS.GPJ GINT STD AUSTRALIA.GDT 23/06/21

Core Box 1 - BH01

Client Name:	Fobupu Pty Ltd	Figure Number:	12970-GR-1-1-B-1
Project Name:	Proposed Residential Development	Figure Date:	18 June 2021
Project Location:	10-14 Lethbridge Street, Penrith NSW 2750	Report Number:	12970-GR-1-1

Core Box 2 - BH01

Client Name:	Fobupu Pty Ltd	Figure Number:	12970-GR-1-1-B-2
Project Name:	Proposed Residential Development	Figure Date:	18 June 2021
Project Location:	10-14 Lethbridge Street, Penrith NSW 2750	Report Number:	12970-GR-1-1

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BH No: BH02
PAGE 1 OF 3
Job No: 12970

Borehole Log

Client: Fobupu Pty Ltd
Project: Proposed Residential Development
Location: 10-14 Lethbridge Street, Penrith, NSW 2750

Started: 4/06/2021
Finished: 4/06/2021
Borehole Size 110 mm

Rig Type: Comacchio Geo300 **Hole Location:** Refer to Drawing 12970-GR-1-A **Driller:** DM **Logged:** KN
RL Surface: 47.0m **Contractor:** Stratacore **Bearing:** --- **Checked:** MS

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description	Samples Tests Remarks	Moisture Condition	Consistency/ Density Index	Additional Observations
ADT	Not encountered during augering.		47.0	0.0		--	TOPSOIL: Silty Sandy CLAY, low plasticity, brown, trace fine to medium subangular black gravel.		MC ~ PL	--	TOPSOIL
						CI-CH	CLAY, medium to high plasticity, orange mottled pale grey, trace fine subangular black gravel.			St	RESIDUAL
			46.5	0.5					MC > PL		
							At 0.8m: Becoming pale grey mottled yellow and orange.		MC ~ PL		
			46.0	1.0							
			45.5	1.5			At 1.4m: Becoming medium plasticity, pale grey mottled red, with ironstone fragments.	SPT 12, 30/145mm	MC ~ < PL		
						--	SHALE, brown and orange thinly laminated, with ironstone fragments.		--	--	BEDROCK
			45.0	2.0							
			44.5	2.5							
							Borehole BH02 continued as cored hole				
			44.0	3.0							
			43.5	3.5							
			43.0	4.0							
			42.5	4.5							
			42.0	5.0							
			41.5	5.5							

2. NON CORED BOREHOLE (NO COORD/RL) 12970 - LOGS.GPJ GINT STD AUSTRALIA.GDT 23/06/21

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Cored Borehole Log

BH No: BH02
PAGE 2 OF 3
Job No: 12970

Client: Fobupu Pty Ltd
Project: Proposed Residential Development
Location: 10-14 Lethbridge Street, Penrith, NSW 2750

Started: 4/06/2021
Finished: 4/06/2021
Borehole Size 110 mm

Rig Type: Comacchio Geo300 **Hole Location:** Refer to Drawing 12970-GR-1-A **Driller:** DM **Logged:** KN
RL Surface: 47.0m **Contractor:** Stratacore **Bearing:** --- **Checked:** MS

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (●- Axial ○- Diametral) EL -0.03 VL -0.1 L -0.3 M -1 H -3 VH -10 EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm 30 100 300 1000 3000	Additional Data
			46.5	0.5								
			46.0	1.0								
			45.5	1.5								
			45.0	2.0								
			44.5	2.5		Continued from non-cored borehole						
NMLC	Water introduced for coring.		44.0	3.0		SHALE,interbedded with siltstone and clay layers, brown and dark grey lamination,	HW		D A 0.23 0.11	<		2.79 - 3.80 - FZ, Rough, Clean.
			43.5	3.5		At 3.13 - 3.23m: With iron staining.			D A 0.08 0.1	<		2.96 - JT, Planar, Rough, Carbonaceous Veneer. 2.98 - JT, Planar, Rough, Carbonaceous Veneer. 3.12 - 3.21 - Clay Seam, 90mm.
			43.0	4.0					D A 0.19 0.26	<		3.48 - 3.64 - Clay Seam, 160mm.
			42.5	4.5			MW		D A 0.08 0.49	<		3.67 - 3.90 - JT, 90°, Planar, Rough.
			42.0	5.0					D A 0.19 0.47	84		4.20 - 4.30 - JT, Rough.
			41.5	5.5					D A 0.12 0.42	<		4.40 - 4.16 - JT, Rough. 5.12 - JT, 45°, Planar, Rough, Clean. 5.30 - JT, 45°, Planar, Rough, Clean. 5.33 - JT, 45°, Planar, Rough, Clean.

6. CORED BOREHOLE (NO COORD/RL) 12970 - LOGS.GPJ GINT STD AUSTRALIA.GDT 23/06/21

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Cored Borehole Log

Client: Fobupu Pty Ltd
Project: Proposed Residential Development
Location: 10-14 Lethbridge Street, Penrith, NSW 2750

Started: 4/06/2021
Finished: 4/06/2021
Borehole Size 110 mm

Rig Type: Comacchio Geo300 **Hole Location:** Refer to Drawing 12970-GR-1-A **Driller:** DM **Logged:** KN

RL Surface: 47.0m **Contractor:** Stratacore **Bearing:** --- **Checked:** MS

Method	Water	Well Details	RL (m)	Depth (m)	Graphic Log	Material Description	Weathering	Estimated Strength (●- Axial, O- Diametral) EL -0.03 VL -0.1 L -0.3 M -1 H -3 VH -10 EH	$Is_{(50)}$ MPa D- diametral A- axial	RQD %	Defect Spacing mm (30 100 300 1000 3000)	Additional Data
NMLC			41.0	6.0		SHALE,interbedded with siltstone and clay layers, brown and dark grey lamination, *(continued)*	MW			< 84		5.56 - 5.60 - Clay Seam, 40mm. 5.60 - 5.64 - FZ, Rough, Clean. 5.70 - 5.73 - Clay Seam, 30mm.
						SHALE, grey and dark grey thinly laminated.	MW		D A 0.27 0.23			5.86 - 8.90 - Clay Seam, 40mm.
			40.5	6.5		At 6.22 - 6.40m: Interbedded with silstones.			D A 0.16 0.74			
									D A 0.82 1.05			
			40.0	7.0								
									D A 0.39 0.6	98		7.28 - 7.30 - Clay Seam, 20mm.
			39.5	7.5								
			39.0	8.0					D A 0.43 2.07			
									D A 0.19 1.17			8.28 - JT, Planar, Rough, Clean. 8.30 - JT, Planar, Rough, Clean.
			38.5	8.5					D A 0.85 1.22			
			38.0	9.0								
									D A 0.23 0.91	99		
			37.5	9.5								9.68 - HB, Stained.
			37.0	10.0					D A 0.27 1.17 D A 0.31 0.95			
			36.5	10.5		Target depth. BH02 terminated at 10.16m						End of core.
			36.0	11.0								

6. CORED BOREHOLE (NO COORD/RL) 12970 - LOGS.GPJ GINT STD AUSTRALIA.GDT 23/06/21

Core Box 3 - BH02

Client Name:	Fobupu Pty Ltd	Figure Number:	12970-GR-1-1-B-3
Project Name:	Proposed Residential Development	Figure Date:	18 June 2021
Project Location:	10-14 Lethbridge Street, Penrith NSW 2750	Report Number:	12970-GR-1-1

Core Box 4 - BH02

alliance	Client Name:	Fobupu Pty Ltd	Figure Number:	12970-GR-1-1-B-4
	Project Name:	Proposed Residential Development	Figure Date:	18 June 2021
	Project Location:	10-14 Lethbridge Street, Penrith NSW 2750	Report Number:	12970-GR-1-1

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Website: www.allgeo.com.au

Dynamic Cone Penetrometer (DCP) Test Report

Client	Fobupu Pty Ltd	**Report Number**	12970-GR-1-1
Project Name	Proposed Residential Development	**Project Number**	12970
Project Location	10-14 Lethbridge St, Penrith NSW	**Date Tested**	4 June 2021
Test Method	AS 1289.6.3.2		

Test Number	**DCP-01**	**DCP-02**
Test Locations	Refer to Drawing No. 12970-GR-1-A	
Surface Material	Topsoil: Silty sandy CLAY	
Surface Conditions	MC ≈ PL	
Approximated RL (m AHD)	~47.8	~47.0
0.00 – 0.15	13	9
0.15 – 0.30	12	6
0.30 – 0.45	7	6
0.45 – 0.60	7	6
0.60 – 0.75	10	7
0.75 – 0.90	14	6
0.90 – 1.05	19	7
1.05 – 1.20	25	13
1.20 – 1.35	Refusal	19
1.35 – 1.50		25/100mm
1.50 – 1.65		Refusal
1.65 – 1.80		
1.80 – 1.95		
1.95 – 2.10		
2.10 – 2.25		
2.25 – 2.40		
2.40 – 2.55		
2.55 – 2.70		

Notes: This test report is intended to be read in conjunction with the geotechnical report by Alliance Geotechnical (ref: 12970-GR-1-1).

APPENDIX D – Laboratory Test Certificates

Alliance Geotechnical
10 Welder Road
Seven Hills
NSW 2147

NATA Accredited
Accreditation Number 1261
Site Number 18217

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

Attention: **Zubair Khan**

Report **801246-S**
Project name PROPOSED RESIDENTIAL DEVELOPMENT
Project ID 12970
Received Date Jun 07, 2021

Client Sample ID			**BH02:0.8-1.3M**
Sample Matrix			**Soil**
Eurofins Sample No.			**S21-Jn15107**
Date Sampled			**May 05, 2021**
Test/Reference	LOR	Unit	
Chloride	10	mg/kg	62
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	48
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	6.7
Resistivity*	0.5	ohm.m	210
Sulphate (as SO4)	10	mg/kg	32
% Moisture	1	%	17

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chloride	Sydney	Jun 09, 2021	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	Jun 09, 2021	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	Jun 09, 2021	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Sydney	Jun 09, 2021	28 Days
- Method: E045 Anions by Ion Chromatography			
% Moisture	Sydney	Jun 07, 2021	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

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IANZ # 1290

Company Name:	Alliance Geotechnical	**Order No.:**	**Received:** Jun 7, 2021 6:30 PM
Address:	10 Welder Road Seven Hills NSW 2147	**Report #:** 801246 **Phone:** 1800 288 188 **Fax:** 02 9675 1888	**Due:** Jun 15, 2021 **Priority:** 5 Day **Contact Name:** Zubair Khan
Project Name:	PROPOSED RESIDENTIAL DEVELOPMENT		
Project ID:	12970		

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217						X	X
Brisbane Laboratory - NATA Site # 20794							
Perth Laboratory - NATA Site # 23736							
Mayfield Laboratory - NATA Site # 25079							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH02:0.8-1.3M	May 05, 2021		Soil	S21-Jn15107	X	X
Test Counts						1	1

General Glossary - Mould

SPORE CLASSIFICATION

WATER INDICATOR: Most commonly associated with indoor mould growth in buildings with long-term water intrusion issues.

BACKGROUND DEBRIS: Background debris is the amount of non-fungal particulate present in the trace including dust, fibres, skin cells, dust mites, and insect parts. A debris rating is assigned each trace from 0 (lowest) to 5 (highest). A higher debris rating means samples are more difficult to analyse, and spores, especially smaller spores like Aspergillus/Penicillium, may be obscured. Counts with debris ratings of 4 or 5 should be regarded as minimal counts with actual counts assumed to be significantly higher. A further explanation of the debris rating is listed below:

1) None Detected. No debris observed.
2) Trace. Field of view obscured < 5%. Counts unaffected.
3) Light. Field of view obscured 5% to 25%. Counts slightly affected.
4) Moderate. Field of view obscured 25% to 75%. Actual counts may be higher than reported counts.
5) Heavy. Field of view obscured 75% to 90%. Actual counts may be significantly higher than reported counts.
6) Very Heavy. Field of view obscured > 90%. Actual counts may be significantly higher than reported counts.

TERMS

COC	Chain of Custody
fs	Fungal Structures. A collective term for a fragment; or groups of fragments from fungi, including but not limited to conidia, conidiophores, hyphae and spores.
Hyphal Structures	Hyphae, mycelia or fruiting bodies – fragmented or intact
Smut/myxo/peri.	Smuts / myxomycetes / periconia
-like	Spores lacking distinguishable characteristics from other similar spores
N/A	Not applicable
NS	Non-specified
Un-ID	Unidentified Fungal Particulate
Set	Set of 4 agar plates per sample
TNTC	Too Numerous to Count
LOR	Limit of Reporting

DEFINITION OF TERMS

Raw Counts	The number of spores counted by the analyst.
% Analysed	The amount of the trace that was analysed for each individual spore type. If large amounts of any spore type(s) exist, counts may be estimated.
LOR	LOR for Spore Trap is 13 fs/m^3 at 100% trace analysis.

UNITS:

fs/m^3	Fungal Structure per cubic metre
fs/cm^2	Fungal Structure per square centimetre
cfu	Colony Forming Units
L/min	Litres per minute
g	Gram
min	Minute
%	Percentage

INDOOR AND OUTDOOR COMPARISONS:

There are no current industrial standards regarding permissible levels of airborne fungi that may be present in buildings. It is common for fungal spores to be present in a normal indoor environment. A general guideline that is widely accepted in the industrial hygiene industry is that the types and numbers of mould spores present in the indoor environment should be similar to those present in the outdoor environment. If inside spore counts are significantly higher than outside counts, this may indicate a potential mould problem. The comparison of outdoor and indoor spore types and concentrations is a useful tool in assessing abnormal mould contamination; however, it should not be the sole determining factor in evaluating health risks and remediation strategies.

All samples received in acceptable condition. Information provided by customer includes customer sample ID, location, flow rate and volume. Analytical results are not corrected for field and laboratory blanks. Test results relate only to the items tested and cannot be extrapolated to anything larger than their original intent. This report may not be reproduced, except in full, without written approval by Eurofins Environment Testing Australia Pty Ltd. Eurofins bears no responsibility for client sampling methods and makes no warranty representation regarding the accuracy of client-supplied information in preparing and presenting analytical results. Eurofins maintains liability limited to the cost of analysis; except for Eurofins own wilful misconduct or gross negligence. Interpretation of the analytical results is the sole responsibility of the customer.

Other:

1. Samples were analysed on an “as received” basis.
2. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on results.
3. Spores of *Aspergillus, Penicillium,* and others are small with few distinguishing features and therefore can be difficult to differentiate.
4. If % analysed is <100%, spores per m^3 is based on extrapolation and not actual count.
5. This report replaces any interim results previously issued.

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1	Result 2	RPD	Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
Conductivity (1:5 aqueous extract at 25°C as rec.)			uS/cm	< 10			10	Pass	
LCS - % Recovery									
Chloride			%	101			70-130	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)			%	94			70-130	Pass	
Resistivity*			%	94			70-130	Pass	
Sulphate (as SO4)			%	99			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Chloride	S21-Jn14486	NCP	%	122			70-130	Pass	
Sulphate (as SO4)	S21-Jn14486	NCP	%	97			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S21-Jn14486	NCP	mg/kg	100	100	<1	30%	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	N21-Jn17969	NCP	uS/cm	81	78	3.0	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	N21-Jn17969	NCP	pH Units	7.9	7.9	<1	30%	Pass	
Sulphate (as SO4)	S21-Jn14486	NCP	mg/kg	10	< 10	2.0	30%	Pass	
% Moisture	S21-Jn14613	NCP	%	11	11	3.0	30%	Pass	

Comments

Sample Integrity

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

Authorised by:

Andrew Black	Analytical Services Manager
Charl Du Preez	Senior Analyst-Inorganic (NSW)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

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

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