GEOTECHNIQUE® PTY LTD

ABN 64 002 841 063

Job No: 14816/1
Our Ref: 14816/1-AA
25 January 2021

Inglow Investments Pty Ltd
c/-Morson Group Pty Ltd
PO Box 170
POTTS POINT NSW 1335
Email: ruben@morsongroup.com.au

Attention: Mr R Hernandez

Dear Sir

re **Proposed Residential Flat Development**
44-48 Rodley Avenue, Penrith
Fee Proposal - Geotechnical Investigation

This report details the results of a geotechnical investigation carried out for a proposed residential flat development at 44-48 Rodley Avenue, Penrith, hereafter referred to as the site.

We understand the following:

- The proposed development at the site includes demolition of existing structures and construction of a new residential building with five storeys above ground and two levels of basement car park. We also understand that the basement excavations will be up to about 6.0m deep. A site plan showing the footprint of the proposed building was provided for the preparation of this report.
- A geotechnical investigation is required to assess subsurface conditions across the site in order to provide geotechnical recommendations on the design of the basement excavation, retaining structures, floor slabs, and footings.

Scope of Works
The scope of works for the geotechnical investigation included the following:

- Reviewing available geological, soil landscape, and salinity potential maps relevant to the site.
- Carrying out a walk over survey to assess existing site conditions.
- Reviewing services plans obtained from “Dial Before You Dig” to determine locations of services across the site.
- Drilling boreholes to assess subsurface conditions across the site.
- Carrying out laboratory tests on representative soil samples to determine salinity of soils.
- Preparation of a report with assessment of subsurface conditions and recommendations on the design of the proposed residential flat building.

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Review of Available Information

Reference to the Geological Map of Penrith (scale 1:100,000) indicates that the bedrock at the site is Ashfield Shale, belonging to the Wianamatta Group of rocks and comprising dark grey to black shale and laminite. Bedrock is overlain by alluvial deposits.

Reference to the Soil Landscape Map of Penrith (scale 1:100,000) indicates that the landscape at the site belongs to the Richmond Group, which is Quaternary terrace of the Nepean and Georges Rivers, and is relatively flat (slopes less than 1%) with local relief to 3m for splays and levees. Soils in this landscape comprise clay, loam, and sand. The landscape is susceptible to high erosion on terrace edges, and minor localised flooding.

Reference to the Map showing Salinity Potential in Western Sydney, prepared by Department of Infrastructures, Planning and Natural Resources in 2002, indicates moderate salinity potential across the site.

Geotechnique Pty Ltd has completed geotechnical investigations for several developments in the vicinity of the site, which indicate that the subsurface profile at the proposed development site is likely to comprise a sequence of clayey sand/sandy clay, gravel and bedrock. The depths to gravel and bedrock are likely to vary from about 4m to 6m and 12m to 14m from existing ground surface, respectively.

Field Work

Field work for the geotechnical investigation was carried out on 18 January 2021, and included the following:

- Carrying out a walk over survey to assess existing site conditions and nominate borehole locations.
- Reviewing services plans obtained from “Dial Before You Dig” to determine locations of services across the site.
- Scanning proposed borehole locations for underground services to ensure that services were not damaged during field work. We engaged a specialist services locator for this purpose.
- Drilling two boreholes (BH1 and BH2) using a track mounted Sonic drilling rig fully equipped for geotechnical investigation. Boreholes were uniformly distributed in accessible portions of the site. Both boreholes were terminated in bedrock at depths of about 12m from the existing ground surface. The approximate borehole locations are indicated on the attached Drawing No 14816/1-AA1. Engineering borehole logs and photographs of rock cuttings recovered from boreholes are also attached.
- Conducting Standard Penetration Tests (SPT) in the boreholes to assess strength characteristics of sub-surface soils up to gravel.
- Recovering representative soil samples and crushed bedrock for visual assessment and laboratory tests.
- Measuring depths to groundwater level or seepage in the boreholes, where encountered.
- Backfilling the boreholes with soils recovered from boreholes after logging and sampling.

Field work was supervised by a Field Engineer from this company who was responsible for the walk over survey, nominating the borehole locations, supervision of SPT tests, sampling, and preparation of field logs.

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Site Description

The proposed development site is rectangular, measuring approximately 46.5m by 36.5m in plan area. The following observations were made during field work:

- The site is bound by Rodley Avenue to the north, Penrith Paceway to the south, and existing residential properties in two remaining sides.
- There are three existing residences with associated sheds/alfresco, one in each of the three lots. Vacant portions of the site are grass covered with some scattered mature trees.
- Natural ground surface across the site is almost levelled and flat.
- There is a drainage channel along the southern boundary.

Sub-surface profiles encountered in the boreholes are detailed in the attached logs, and summarised below in Table 1.

Table 1 – Sub-surface Profiles encountered in Boreholes

Borehole No	Termination Depth (m)	Depth Range for Topsoil (m)	Depth Range for Clayey Alluvium (m)	Depth Range for Sandy/Gravelly Alluvium (m)	Depth to Bedrock (m)
BH1	12.0	0.0-0.2	0.2-3.1	3.1-10.0	10.0
BH2	12.0	0.0-0.2	0.2-3.0	3.0-10.0	10.0

Table 1 indicates that the sub-surface profile across the site is similar and comprises a sequence of topsoil and alluvial deposits underlain by bedrock shale. Alluvial deposits include layers of clayey, sandy and gravelly soils. The subsurface materials may in general be described as follows.

Topsoil Silty CLAY, low plasticity, red, brown, dry, with roots.

Alluvium CLAY, Sandy CLAY, medium to high plasticity, red, brown, moisture content lower than plasticity, stiff to very stiff, with some gravel at depths exceeding 2.0m.

Gravelly SAND/Sandy GRAVEL, fine to medium grained, light grey, dry, loose to medium dense, with some cobbles.

SAND, fine to medium grained, grey, moist, medium dense

Bedrock SHALE, distinctly weathered, grey, low to medium strength

Both boreholes encountered minor groundwater seepage at depths of about 9m from the existing ground surface. No groundwater level was encountered up to borehole termination depths of about 12m. However, groundwater level might vary with rainfall or other factors not evident during field works for the geotechnical investigation. As the site is located close to Nepean River and the sub-surface profile within and in the vicinity of the site predominantly comprises sandy and gravelly materials with very high permeability, it is possible that the groundwater level within the site might rise to about existing ground surface level (about 1 in 100 years flood level) during high flooding in the Nepean River.

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Laboratory Testing

Representative soil samples recovered from boreholes were tested in the NATA accredited laboratory of SGS Environmental Services, in accordance with relevant Australian Standards, to determine chemical properties like Electrical Conductivity (EC), pH, chloride, sulphate, and resistivity. Detailed laboratory test results are attached, and a summary is presented below in Table 2.

Table 2 – Results of Chemical Properties Tests

Borehole No	Depth (m)	EC (µS/cm)	pH	Chloride (ppm)	Sulphate (ppm)	Resistivity (ohm-cm)
BH1	0.5-0.95	190	5.4	150	130	6800
BH1	2.0-2.45	480	5.1	650	<5	2300
BH1	9.0-9.3	46	7.7	36	18	25000
BH2	0.5-0.95	290	4.9	320	98	4500
BH2	2.0-2.45	260	6.0	370	<5	4300
BH2	3.5-3.8	110	7.8	120	8.2	9700

DISCUSSION AND RECOMMENDATIONS

Soil Salinity

Salinity refers to the presence of excess salt in the environment, either in soil or water. Soil salinity is generally assessed by measuring EC of a soil sample made up of 1:5 soil water suspension. Thus, determined EC is multiplied by a factor varying from 6 to 23, based on the texture of the soil sample, to obtain Equivalent Electrical Conductivity, designated as ECe (Reference 1). Alternatively, ECe may be directly measured in soil saturation extracts. Soils are classified as saline if ECe of the saturated extracts exceed 4.0dS/m. The criteria for assessment of soil salinity classes are shown in Table 3 (Reference 1).

Table 3 –Criteria for Soil Salinity Classification

Classification	EC_e (dS/m)	Comments
Non-saline	<2	Salinity effects mostly negligible
Slightly saline	2 – 4	Yields of very sensitive crops may be affected
Moderately saline	4 – 8	Yields of many crops affected
Very saline	8 – 16	Only tolerant crops yield satisfactorily
Highly saline	>16	Only a few tolerant crops yield satisfactorily

Soils likely to be disturbed and excavated during the proposed development works are anticipated to be predominantly clayey up to depths of about 3m, and sandy/gravelly at depths exceeding 3m. For clayey soils a multiplying factor of 8 to 10 is assessed to be appropriate, and for sandy soils a multiplying factor of 16 to 18 is assessed to be appropriate. Even if factors of 10 and 18 are assumed for clayey and sandy/gravelly oils respectively, estimates of ECe values for representative soil samples presented in Table 2 vary from about 0.8dS/m to 4.8dS/m. Only one sample shows ECe value of more than 4.8dS/m. Therefore, it is our assessment that the soils likely to be disturbed or excavated during the proposed development works are assessed to be non-saline. Earthworks involving excavation and disturbance of soils for the proposed development may be carried out without a Saline Soil management Plan (SSMP).

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Soil Aggressivity

Aqueous solution of chlorides causes corrosion of iron and steel, including steel reinforcements in concrete. Corrosion damage by chlorides is only relevant to iron and steel. The aggressivity classifications of soil and groundwater applicable to iron and steel, in accordance with Australian Standard AS2159 (Reference 2), are given below in Table 4.

Table 4 – Aggressivity Classification for Steel/Iron

Chloride		pH	Resistivity (ohm cm)	Soil Condition A*	Soil Condition B#
In Soil (ppm)	In Water (ppm)				
<5000	<1000	>5.0	>5000	Non-aggressive	Non-aggressive
5000-20000	1000-10000	4.0-5.0	2000-5000	Mild	Non-aggressive
20000-50000	10000-20000	3.0-4.0	1000-2000	Moderate	Mild
>50000	>20000	<3.0	<1000	Severe	Moderate

*Soil Condition A = high permeability soils (e.g. sands and gravels) which are below groundwater

#Soil Condition B = low permeability soils (e.g. silts and clays) and all soils above groundwater

The aggressivity classifications of soil and groundwater applicable to concrete, in accordance with Australian Standard AS2159 (Reference 2), are given below in Table 5.

Table 5 – Aggressivity Classification for Concrete

Sulphate expressed as SO_4		pH	Chloride in Water (ppm)	Soil Condition A	Soil Condition B
In Soil (ppm)	In Groundwater (ppm)				
<5000	<1000	>5.5	<6000	Mild	Non-aggressive
5000-10000	1000-3000	4.5-5.5	6000-12000	Moderate	Mild
10000-20000	3000-1000	4.0-4.5	12000-30000	Severe	Moderate
>20000	>10000	<4.0	>30000	Very Severe	Severe

Approximately 100ppm of SO_4 = 80ppm of SO_3

As discussed above, soils likely to be disturbed and excavated during the proposed development works are anticipated to be sandy. Therefore, the appropriate site condition for predominant soils at the site is assessed to be “Condition A”. Laboratory test results for aggressivity classifications provided in Table 4 and 5 indicate that the site conditions are non-aggressive to mildly aggressive to construction materials like steel/iron and concrete. Therefore, we recommend that construction materials appropriate for mildly aggressive sites are used for the proposed development works.

Geotechnical Model

Based on site observation and information obtained from boreholes drilled during the current investigation, a Geotechnical Model has been developed for the proposed development site. Anticipated Geotechnical Units constituting the Geotechnical Model for the site are provided in Table 6. Each Geotechnical Unit represents a specific nature of soil and/or bedrock encountered across the site.

Table 6 –Geotechnical Model

Geotechnical Unit	Material Description	Depth Range in BH1 (m)	Depth Range in BH2 (m)
Unit 1	Clayey Alluvium	0.0-3.1	0.0-3.0
Unit 2	Sandy/Gravelly Alluvium	3.1-10.0	3.0-10.
Unit 3	Bedrock Shale	>10.0	>10.0

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If any controlled fill is placed in accordance with recommendations provided below in this report, the controlled fill may also be included in Unit 1. Assessed strength parameters in terms of cohesion and internal friction angle as well as modulus for each Geotechnical Unit are presented below in Table 7.

Table 7 –Strength Parameters and Modulus

Geotechnical Units	Unit Weight (kN/m^3)	Cohesion (kPa)	Friction Angle (deg)	Modulus (MPa)	Poisson's Ratio
Unit 1	18.0	0.0	25.0	15.0	0.30
Unit 2	19.0	0.0	32.0	25.0	0.30
Unit 3	21.0	50.0	34.0	500.0	0.25

Excavation Conditions

The depth of the basement excavation is anticipated to be up to about 6m below the existing ground surface. Therefore, materials to be excavated are expected to comprise topsoil and alluvial deposits comprising clayey, sandy and gravelly soils. No rock excavation is anticipated.

It is our assessment that the excavation of topsoils and alluvial deposits can be achieved using conventional earthmoving equipment such as excavators and dozers.

Ground vibration during excavation works is generally represented by maximum peak particle velocity. Houses and high rise residential buildings can generally tolerate ground vibration of about 5.0mm/s to 10.0mm/s. We anticipate that the vibration up to depth of about 6m will result in ground vibrations that are likely to be within tolerable limits for stability of existing structures in the vicinity of the site.

Observations during borehole drilling indicate that the depth to groundwater is likely to be deeper than the base of proposed basement excavation. Therefore, we do not anticipate significant groundwater inflow during the proposed basement excavation if excavation is carried out during normal climatic conditions. Any minor groundwater inflow could be managed by a conventional sump and pump method.

However, during inclement weather conditions and during floods in Nepean River, the proposed excavation may encounter groundwater inflow. Therefore, we suggest a specialist dewatering contractor be contacted for advice if significant groundwater inflow is encountered during basement excavation.

Fill Placement

It is likely that some fill placement will be required as part of site preparation. We recommend the following procedures for placement of controlled fill, where required.

- Strip topsoil and stockpile separately for possible use in landscaping or disposal off site.
- Strip existing fill and stockpile separately for possible use in controlled fill or disposal off site.
- Undertake proof rolling (using an 8 to 10 tonnes roller) of the exposed alluvial deposits to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of about 300mm and replace with granular fill, compacted as described below.
- Undertake proof rolling of soft spots backfilled with granular fill, as described above. If the backfilled area shows further movement during proof rolling, this office should be contacted for further recommendations.

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- Place suitable fill materials on proof rolled surface of alluvial deposits. Controlled fill should preferably comprise non-reactive materials such as crushed sandstone with a maximum particle size not exceeding 75mm, or low plasticity clay. The alluvial deposits obtained from excavation within the site are assessed to be suitable for use in controlled fill after removal of deleterious materials. The fill should be placed in horizontal layers of 200mm to 250mm maximum loose thickness (depending on the size of equipment) and compacted to a Minimum Dry Density Ratio (MDDR) of 98% Standard, at moisture content within 2% of Optimum Moisture Content (OMC), for cohesive materials (clayey soils), and density index of 70% for cohesionless materials (sandy and gravelly soils).
- Fill placement should be supervised to ensure that material quality, layer thickness, testing frequency and compaction criteria conform to the specifications. We recommend "Level 2" or better supervision, in accordance with AS3798-2007 (Reference 3). It should be noted that a Geotechnical Inspection and Testing Authority will generally provide certification on the quality of compacted fill only if Level 1 supervision and testing is carried out.

Batter Slopes and Earth Pressures

As noted earlier, the proposed development is likely to involve both cut and fill operations. All cut and fill slopes created during proposed development works should be battered for stability or retained by engineered retaining structures. It is also noted that the depth to groundwater under normal climatic conditions is more than 6.0m from existing ground surface. For up to 6.0m deep cut slopes in alluvial deposits and fill slopes in controlled fill, the recommended batter slopes under normal climatic conditions are presented in Table 8

Table 8 – Recommended Batter Slopes

Material Type	Permanent Batter Slope	Temporary Batter Slope
Unit 1 - Clayey Alluvium	1.0 vertical to 3.0 horizontal	1.0 vertical to 2.0 horizontal
Unit 2 - Sandy/Gravelly Alluvium	1.0 vertical to 2.5 horizontal	1.0 vertical to 1.5 horizontal
Unit 3 - Bedrock Shale	Not Applicable	Not Applicable

Batter slopes recommended in Table 8 are not applicable during inclement weather conditions that cause groundwater level to be shallower than 6.0m.

It is unlikely that batter slopes recommended in Table 8 can be achieved as the proposed excavations are likely to extend to site boundaries. Therefore, cut and fill slopes should be retained by engineered retaining structures.

Appropriate retaining structures for the proposed development would comprise bored pier walls or secant walls. Use of secant walls will be a necessity if the groundwater level is likely to be higher than the base of the excavation at some time during the design life of the building. Alternatively, a dewatering system may be installed to lower groundwater level permanently below base of excavation. The earth pressure distribution on such walls is assumed to be triangular and estimated as follows:

$$p_h = \gamma k H$$

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If the retaining walls are anchored or strutted, the earth pressure distribution on such retaining structures is assumed to be rectangular and estimated as follows:

$$p_h = 0.65\gamma kH$$

Where,

p_h = Horizontal active pressure (kN/m^2)
γ = Total density of materials to be retained (kN/m^3)
k = Coefficient of earth pressure (k_a or k_o)
H = Retained height (m)

Distribution of passive pressure, if retaining walls are embedded below the base of excavation, may also be assumed triangular and estimated as follows:

$$p_p = \gamma_1 k_p h$$

Where,

p_p = Horizontal passive pressure (kN/m^2)
γ_1 = Wet density of materials below base of excavation (kN/m^3)
k_p = Coefficient of passive earth pressure
h = Wall embedment depth below base of excavation (m)

For design of flexible retaining structures, where some lateral movement is acceptable, an active earth pressure coefficient (k_a) is recommended. If it is critical to limit the horizontal deformation of a retaining structure, use of an earth pressure coefficient at rest (k_0) should be considered. Recommended earth pressure coefficients for design of retaining walls are presented in Table 9.

Table 9 – Recommended Earth Pressure Parameters

Material Types	Dry Unit Weight (kN/m^3)	Active Earth Pressure Coefficient (k_a)	Passive Earth Pressure Coefficient (k_p)	At Rest Earth Pressure Coefficient (k_o)
Unit 1 - Clayey Alluvium	18.0	0.40	2.5	0.60
Unit 2 - Sandy/Gravelly Alluvium	19.0	0.30	3.2	0.45
Unit 3 - Bedrock Shale	21.0	0.25	3.5	0.40

These coefficients are based on the assumption that ground level behind the retaining structure is horizontal and the retained material is effectively drained. If materials are subjected to groundwater pressure and other surcharge loads (structures and traffic in the vicinity of the site), additional earth pressures resulting from groundwater and surcharge loads should also be allowed for in the design of retaining structures.

We do not anticipate that the retaining structures will be subjected to groundwater pressure under normal climatic conditions. However, as indicated earlier, the groundwater level within the site might rise to about the existing ground surface level during high flooding in the Nepean River. To allow for extreme possible climatic conditions, the design of retaining structures should consider the following:

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- Design the basement structure (retaining walls and floor slabs) as a tank structure so that the retaining walls and floor slabs are watertight. If this option is preferred, retaining walls and floor slabs should be designed to withstand earth pressure as well as groundwater pressure. For 6.0m deep excavations, groundwater pressure on retaining wall is estimated to increase linearly from zero at ground surface to 60.0kPa at the base of excavation.
- Provide a basement dewatering system to ensure that the retained material is completely drained or groundwater level is permanently maintained below the base of the basement excavation. It is anticipated that the dewatering system will have to be used only occasionally during high flood periods. If this option is preferred, the retaining walls and the floor slabs may be designed without allowing for groundwater pressure.

The design of any retaining structure should also be checked for bearing capacity, overturning, sliding, and overall stability of the slope.

Floor Slabs and Footings

We anticipate that the foundation materials at the base of the 6.0m deep basement excavations will be sandy/gravelly alluvial deposits. Therefore, floor slabs for the proposed structure may be designed as ground bearing slabs or suspended slabs supported by footings. For design of floor slabs bearing on sandy/gravelly alluvial deposits, we recommend a Modulus of Subgrade Reaction Value of 30.0kPa/mm.

Exact loadings due to the proposed structure are not known at this stage. However, we consider that appropriate footings would comprise shallow footings founded in sandy/gravelly alluvial deposits or deep footings (bored piers) socketed into bedrock shale. Deep footings will be preferable if footings are required to withstand significant lateral and uplift loads. The recommended allowable bearing pressures for design of footings are presented in Table 10.

Table 10 – Recommended Earth Pressure Parameters

Founding Material	Founding Depth from Ground Surface* (m)	Allowable End Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Unit 1 - Clayey Alluvium	1.0-3.5	150.0	Ignore
Unit 2 - Sandy/Gravelly Alluvium	3.5-10.0	450.0	5.0
Unit 3 - Bedrock Shale	10.0	800.0	80.0

*Approximate only from existing ground surface. Depth to a material type varies across the site.

Design of footings should be based on allowable bearing pressures for the foundation materials and acceptable total and differential footing settlements. For footings founded in alluvial deposits (clayey, sandy and gravelly soils), the total settlement is estimated to be about 2.5% of minimum footing dimension or pier diameter. The differential settlements are anticipated to be about halves the total settlements.

If total or differential settlements of footings founded in alluvial deposits are not tolerable, footings might have to be founded in bedrock. Bedrock will have higher allowable bearing pressures and undergo significantly less settlement. For footings founded in bedrock shale, the total settlement is estimated to be about 1.0% of the minimum footing dimension or pier diameter. The differential settlements are anticipated to be about halves the total settlements.

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As depths to alluvial deposits and bedrock with recommended allowable bearing pressures could vary across the site and between boreholes, the founding depths of footing could also vary. Therefore, founding level at a specific location will have to be confirmed by an experienced Geotechnical Engineer, on the basis of assessment made during footing excavation or pier hole drilling. The engineer should ensure that the design strength of soil and rock are achieved.

General

Assessments and recommendations presented in this report are based on site observation and information from only two boreholes. Although we believe that the sub-surface profile presented in this report is indicative of the general profile across the site, it is possible that the sub-surface profile including depth to groundwater level could differ from that encountered in the boreholes. Therefore, we recommend that this company is contacted for further advice if soils or bedrock encountered during the construction stage differ from those presented in this report.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

[redacted]

INDRA JWORCHAN
Principal Geotechnical Engineer

Attached Drawing No 14816/1-AA1 Borehole Location Plan
Engineering Borehole Logs, Rock Cutting Photographs & Explanatory Notes
Laboratory Test Results

References

1. *Australian Standard, Geotechnical Site Investigation, AS1726-1993.*
2. *Lillicrap, A and McGhie, S., Site Investigation for Urban Salinity, Department of Land and Water Conservation, 2002.*
3. *Australian Standard AS2159-2009, Piling – Design and Installation, 2009.*
4. *Australian Standard AS3798-2007, Guidelines on Earthworks for Commercial and Residential Developments, 2007.*

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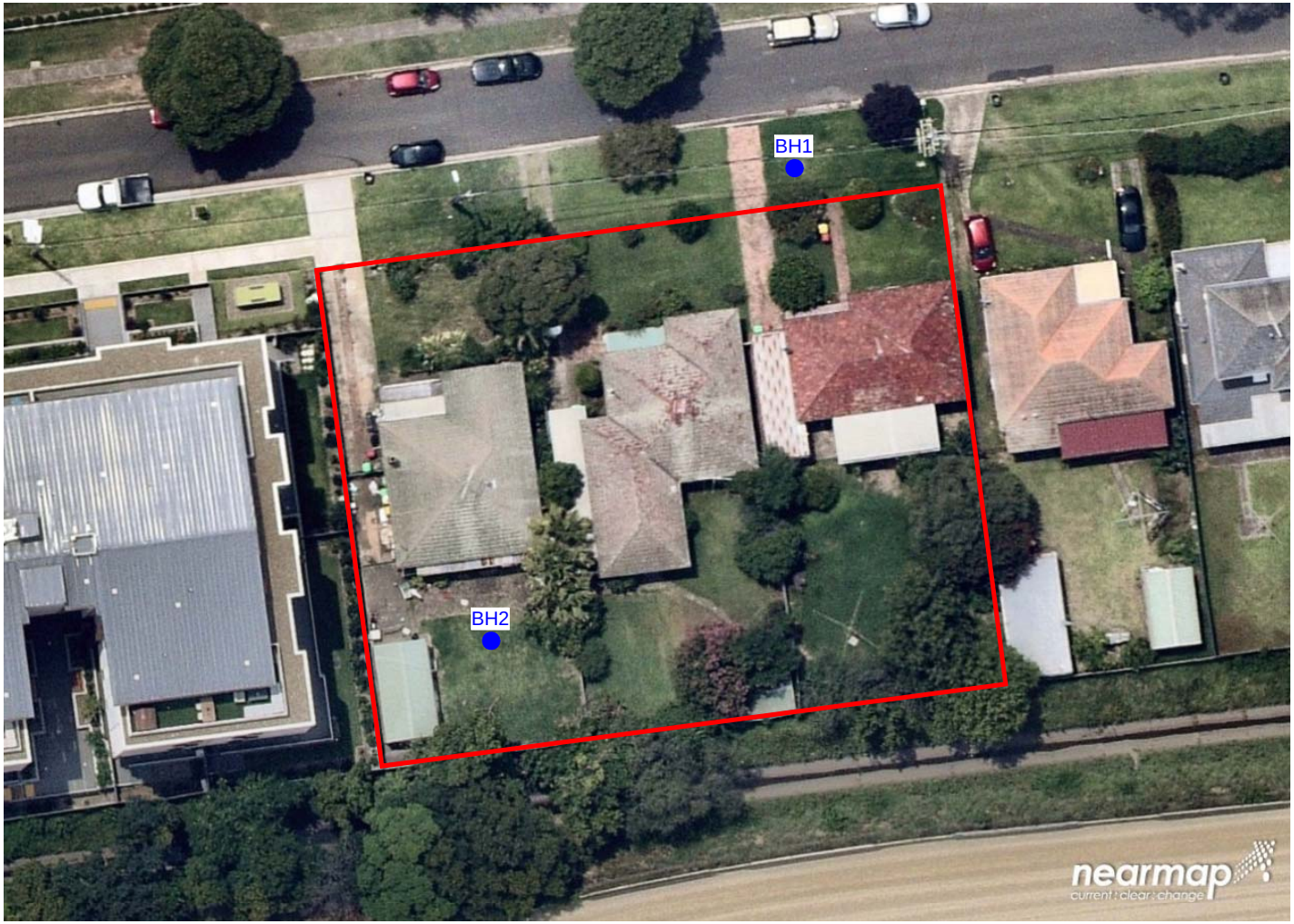

Imagery ©2020 NearMap.com

N

LEGEND

- Borehole

0 5 10 15 20 25m

Scale 1:500

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NOTES

1. Site features are indicative and are not to scale.
2. This drawing has been produced using a base plan provided by others to which additional information e.g test pits, borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing

Morson Group Pty Ltd
Proposed Residential Flat Development
44-48 Rodley Avenue
Penrith

Borehole Locations

Drawing No: 14816/1-AA1
Job No: 14816/1
Drawn By: MH
Date: 25 January 2021
Checked By: IJ

File No: 14816-1
Layers: 0, AA1

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engineering log - borehole

Client : Morson Group Pty Ltd
Project : Proposed Residential Flat Development
Location : 44-48 Rodley Avenue, Penrith

Job No. : 14816/1
Borehole No. : BH1
Date : 18/01/2021
Logged/Checked by: NK/IJ

drill model and mounting : Comacchio 450 Sonic **slope :** **deg.** **R.L. surface :**

hole diameter : 125 **mm** **bearing :** **deg.** **datum :**

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Sonic Drilling						0			TOPSOIL: Silty Clay, low to medium plasticity, brown, with grass roots				
								CI-CH	Silty CLAY, medium to high plasticity, brown	M<PL	F		Alluvial
					N=5 2,3,2	1		CH	Silty CLAY, high plasticity, grey mottled brown	M<PL	St-VSt		
					N=35 11,15,20	2		CI	Silty CLAY, medium plasticity, grey and brown, with gravel	M<PL	H		
						3		SP	Gravelly SAND/Sandy GRAVEL, fine to medium grained, grey, brown, with cobbles and boulders	D	MD		
						5			Gravelly SAND/Sandy GRAVEL, fine to medium grained, grey, brown, with cobbles, boulders, and clay bands	D	MD		
						9		SP	SAND, medium grained, brown, with cobbles and boulders	W	MD-D		Seepage at 9.0m

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GEOTECHNIQUE
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engineering log - borehole

Client : Morson Group Pty Ltd
Project : Proposed Residential Flat Development
Location : 44-48 Rodley Avenue, Penrith

Job No. : 14816/1
Borehole No. : BH1
Date : 18/01/2021
Logged/Checked by: NK/IJ

drill model and mounting : Comacchio 450 Sonic **slope :** **deg.** **R.L. surface :**

hole diameter : 125 **mm** **bearing :** **deg.** **datum :**

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						10			SHALE, grey, low strength, extremely weathered				Bedrock
						11			SHALE, grey, medium to high strength, distinctly to slightly weathered				
						12			Borehole BH1 terminated at 12.0m in shale bedrock				
						13							
						14							
						15							
						16							
						17							
						18							
						19							

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Rock Cutting from BH1 Depth 10.0-12.0m

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engineering log - borehole

Client : Morson Group Pty Ltd
Project : Proposed Residential Flat Development
Location : 44-48 Rodley Avenue, Penrith

Job No. : 14816/1
Borehole No. : BH2
Date : 18/01/2021
Logged/Checked by: NK/IJ

drill model and mounting : Comacchio 450 Sonic **slope :** **deg.** **R.L. surface :**

hole diameter : 125 **mm** **bearing :** **deg.** **datum :**

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Sonic Drilling						0			TOPSOIL: Silty Clay, low to medium plasticity, brown, with grass roots				
								CI-CH	Silty CLAY, medium to high plasticity, brown mottled grey	M<PL	F		Alluvial
					N=5 2,3,2	1		CH	Silty CLAY, high plasticity, grey mottled brown	M<PL	St-VSt		
					N=28 9,13,15	2		CI	Silty CLAY, medium plasticity, grey and orange brown, with gravel	M<PL	H		
						3		SP	Gravelly SAND/Sandy GRAVEL, fine to medium grained, grey, brown, with cobbles and boulders	D	MD		
						5		SP	Gravelly SAND/Sandy GRAVEL, fine to medium grained, grey, brown, with cobbles, boulders, and clay bands	D	MD		
						9		SP	SAND, medium grained, brown, with cobbles and boulders	W	MD-D		Seepage at 9.0m

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engineering log - borehole

Client : Morson Group Pty Ltd
Project : Proposed Residential Flat Development
Location : 44-48 Rodley Avenue, Penrith

Job No. : 14816/1
Borehole No. : BH2
Date : 18/01/2021
Logged/Checked by: NK/IJ

drill model and mounting : Comacchio 450 Sonic **slope :** **deg.** **R.L. surface :**

hole diameter : 125 **mm** **bearing :** **deg.** **datum :**

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						10			SHALE, grey, low strength, extremely weathered				Bedrock
						11			SHALE, grey, medium to high strength, distinctly to slightly weathered				
						12			Borehole BH2 terminated at 12.0m in shale bedrock				
						13							
						14							
						15							
						16							
						17							
						18							
						19							

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Rock Cutting from BH2 Depth 10.0-12.0m

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Log Symbols & Abbreviations (Non-cored Borehole Log)

Log Column	Symbol/Value	Description
Drilling Method	V-bit TC-bit RR DB BB	Hardened steel 'V' shaped bit attached to auger Tungsten Carbide bit attached to auger Tricone (Rock Roller) bit Drag bit Blade bit
Groundwater	Dry  	Groundwater not encountered to the drilled or auger refusal depth Groundwater level at depths shown on log Groundwater seepage at depths shown on log
Environment Sample	GP G P	Glass bottle and plastic bag sample over depths shown on log Glass bottle sample over depths shown on log Plastic bag sample over depths shown on log
PID Reading	100	PID reading in ppm
Geotechnical Sample	DS DB U_{50}	Disturbed Small bag sample over depths shown on log Disturbed Bulk sample over depths shown on log Undisturbed 50mm tube sample over depths shown on log
Field Test	N=10 3,5,5 N=R 10,15/100	Standard Penetration Test (SPT) 'N' value. Individual numbers indicate blows per 150mm penetration. 'R' represents refusal to penetration in hard/very dense soils or in cobbles or boulders. The first number represents10 blows for 150mm penetration whereas the second number represents 15 blows for 100mm penetration where SPT met refusal
	DCP/PSP: 5 6 R/10	Dynamic Cone Penetration (DCP) or Perth Sand Penetrometer (PSP). Each number represents blows per 100mm penetration. 'R/10' represents refusal after 10mm penetration in hard/very dense soils or in gravels or boulders.
Classification	GP GW GM GC SP SW SM SC ML MI MH CL CI CH	Poorly Graded GRAVEL Well graded GRAVEL Silty GRAVEL Clayey GRAVEL Poorly graded SAND Well graded SAND Silty SAND Clayey SAND SILT / Sandy SILT / clayey SILT, low plasticity SILT / Sandy SILT / clayey SILT, medium plasticity SILT / Sandy SILT / clayey SILT, high plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, low plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, medium plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, high plasticity
Moisture Condition Cohesive soils Cohesionless soils	 M<PL M=PL M>PL D M W	 Moisture content less than Plastic Limit Moisture content equal to Plastic Limit Moisture content to be greater than Plastic Limit Dry - Runs freely through hand Moist - Tends to cohere Wet - Tends to cohere
Consistency Cohesive soils	 VS S F St VSt H	**Term** / **Undrained shear strength, C_u (kPa)** / **Hand Penetrometer (Qu)** Very Soft / ≤12 / <25 Soft / >12 & ≤25 / 25 – 50 Firm / >25 & ≤50 / 50 – 100 Stiff / >50 & ≤100 / 100 – 200 Very Stiff / >100 & ≤200 / 200 – 400 Hard / >200 / >400
Density Index Cohesionless soils	 VL L M D VD	**Term** / **Density Index, I_D (%)** / **SPT 'N' (blows/300mm)** Very Loose / ≤15 / ≤5 Loose / >15 & ≤35 / >5 & ≤10 Medium Dense / >35 & ≤65 / >10 & ≤30 Dense / >65 & ≤85 / >30 & ≤50 Very Dense / >85 / >50
Hand Penetrometer	100 200	Unconfined compressive strength (q_u) in kPa determined using pocket penetrometer, at depths shown on log
Remarks	 Residual Alluvium Colluvial Aeolian Marine	Geological origin of soils Residual soils above bedrock River deposited Alluvial soils Gravity deposited Colluvial soils Wind deposited Aeolian soils Marine Soils

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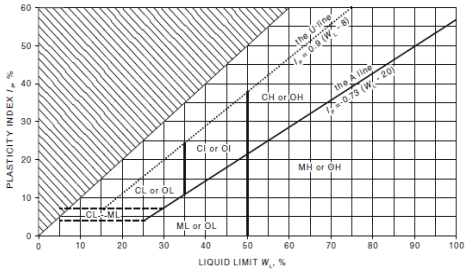
AS1726 : 2017– Unified Soil Classification System

Major Divisions		Particle size (mm)	Group Symbol	Typical Names	Field Identifications Sand and Gravels			Laboratory classification				
OVERSIZE	BOULDERS	>200						Use the gradation of material passing 63mm for classification of fractions according to the criteria given in 'Major Divisions'	% Fines (2)	Plasticity of Fine Fraction	$C_u = D_{60}/D_{10}$	$C_c = (D_{30})^2/(D_{10}D_{60})$	Notes
	COBBLES	63										
COARSE GRAINED SOIL (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm)	Coarse 19	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>4	between 1 and 3	1. Identify lines by the method given for fine grained soils 2. Borderline classifications occur when the percentage of fines (fraction smaller than 0.075mm size) is greater than 5% and less than 12%. Borderline classifications require the use of dual symbols e.g. SP-SM, GW-GC
		Medium 6.7	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			GM	Silty gravels, gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 2.36	GC	Clayey gravels, gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line or I_p>7	-	-	
	SAND (more than half of coarse fraction is smaller than 2.36mm)	Coarse 0.6	SW	Well-graded sands, gravelly sands, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>6	between 1 and 3	
		Medium 0.21	SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			SM	Silty sands, sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 0.075	SC	Clayey sand, sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line of I_p>7	-	-	
FINE GRAINED SOIL (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit<50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	**Dry Strength**	**Dilatancy**	**Toughness**		More than 35% passing 0.075mm	Below 'A' line			
					None to low	Slow to rapid	Low						
			CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium to high	None to very slow	Medium			Above 'A' line			
			OL	Organic silts and organic silty clays of low plasticity	Low to medium	Slow	Low			Below 'A' line			
	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit>50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Low to medium	None to slow	Low to medium			Below 'A' line			
			CH	Inorganic clays of medium to high plasticity, fat clays	High to very high	None	High			Above 'A' line			
			OH (1)	Organic clays of medium to high plasticity, organic silts	Medium to high	None to very slow	Low to medium			Below 'A' line			
	HIGHLY ORGANIC SOILS		Pt (1)	Peat and highly organic soils	Identified by colour, odour, spongy feel and generally by fibrous texture				Effervesces with H_2O_2				



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Log Symbols & Abbreviations (Cored Borehole Log)

Log Column	Symbol / Abbreviation	Description
Core Size		Nominal Core Size (mm)
	NQ	47
	NMLC	52
	HQ	63
Water Loss	◀	Complete water loss
	◁	Partial water loss
Weathering (AS1726:2017)	RS	Residual Soil — Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported
	XW	Extremely Weathered — Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
	HW	Highly Weathered — The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
	MW	Moderately Weathered — The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognizable, but shows little or no change of strength from fresh rock
	SW	Slightly Weathered — Rock is partially discoloured with staining or bleaching along joints but shows little or no change in strength from fresh rock
	FR	Fresh — Rock shows no sign of decomposition of individual minerals or colour changes
		Note : Where it is not possible to distinguish between HW and MW rock the term Distinctly Weathered (DW) may be used. DW is defined as 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased by deposition of weathering products in pores'
Strength (AS1726:2017)		**Term** — **Point Load Strength Index (I_{s50}, MPa)**
	VL	Very Low — ≥0.03 ≤0.1
	L	Low — >0.1 ≤0.3
	M	Medium — >0.3 ≤1
	H	High — >1 ≤3
	VH	Very High — >3 ≤10
	EH	Extremely High — >10
Defect Spacing		**Description** — **Spacing (mm)**
		Extremely closely spaced — <20
		Very closely spaced — 20 to 60
		Closely spaced — 60 to 200
		Medium spaced — 200 to 600
		Widely spaced — 600 to 2000
		Very widely spaced — 2000 to 6000
		Extremely widely spaced — >6000
Defect Description (AS1726:2017) Type		
	Pt	Parting
	Jo	Joint
	Sh	Sheared Surface
	Sz	Sheared Zone
	Ss	Sheared Seam
	Cs	Crushed Seam
	Is	Infilled Seam
	Ews	Extremely Weathered Seam
Macro-surface geometry	St	Stepped
	Cu	Curved
	Un	Undulating
	Ir	Irregular
	Pl	Planar
Micro-surface geometry	Vro	Very Rough
	Ro	Rough
	Sm	Smooth
	Po	Polished
	Sl	Slickensided
Coating or infilling	cn	clean
	sn	stained
	vn	veneer
	cg	coating

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AS1726 – Identification of Sedimentary Rocks for Engineering Purposes

Grain Size mm		Bedded rocks (mostly sedimentary)								
More than 20	20	Grain Size Description		CONGLOMERATE Rounded boulders, cobbles and gravel cemented in a finer matrix		At least 50% of grains are of carbonate			At least 50% of grains are of fine-grained volcanic rock	
	6	RUDACEOUS				LIMESTONE and DOLOMITE (undifferentiated)	Calcirudite		Fragments of volcanic ejecta in a finer matrix	SALINE ROCKS
	2			Breccia Irregular rock fragments in a finer matrix					Rounded grains AGGLOMERATE Angular grains VOLCANIC BRECCIA	Halite Anhydrite
	0.6	ARENACEOUS	Coarse	SANDSTONE Angular or rounded grains, commonly cemented by clay, calcite or iron minerals			Calcarenite		Cemented volcanic ash	Gypsum
	0.2		Medium	Quartzite Quartz grains and siliceous cement					TUFF	
	0.06		Fine	Arkose Many feldspar grains Greywacke Many rock chips						
	0.002	ARGILLACEOUS		MUDSTONE	SILTSTONE Mostly silt	Calcareous Mudstone	Calcisiltite	CHALK	Fine-grained TUFF	
	Less than 0.002			SHALE Fissile	CLAYSTONE Mostly clay		Calcilutite		Very fine-grained TUFF	
Amorphous or crypto-crystalline				Flint: occurs as hands of nodules in the chalk Chert: occurs as nodules and beds in limestone and calcareous sandstone						COAL LIGNITE
				Granular cemented – except amorphous rocks						
				SILICEOUS		CALCAREOUS			SILICEOUS	CARBONACEOUS
				SEDIMENTARY ROCKS Granular cemented rocks vary greatly in strength, some sandstones are stronger than many Igneous rocks. Bedding may not show in hand specimens and is best seen in outcrop. Only sedimentary rocks, and some metamorphic rocks derived from them, contain fossils Calcareous rocks contain calcite (calcium carbonate) which effervesces with dilute hydrochloric acid						

AS1726 – Identification of Metamorphic and Igneous Rocks for Engineering Purposes

Obviously foliated rocks (mostly metamorphic)			Rocks with massive structure and crystalline texture (mostly igneous)					Grain size (mm)
Grain size description			Grain size description	Pegmatite			Pyrosenite	More than 20
		MARBLE						20
COARSE	GNEISS Well developed but often widely spaced foliation sometimes with schistose bands	QUARTZITE	COARSE	GRANITE	Diorite	GABBRO	Peridorite	6
	Migmatite Irregularly foliated: mixed schists and gneisses	Granulite HORNFELS		These rocks are sometimes phorphyritic and are then described, for example, as porphyritic granite				2
MEDIUM	SCHIST Well developed undulose foliation; generally much mica	Amphibolite	MEDIUM	Micorgranite	Microdiorite	Dolerite		0.6
		Serpentine		These rocks are sometimes phorphyritic and are then described as porphyries				0.2
								0.06
FINE	PHYLLITE Slightly undulose foliation; sometimes 'spotted'		FINE	RHYOLITE	ANDESITE	BASALT		0.002
	SLATE Well developed plane cleavage (foliation)			These rocks are sometimes phorphyritic and are then described as porphyries				Less than 0.002
	Mylonite Found in fault zones, mainly in igneous and metamorphic areas			Obsidian	Volcanic glass			Amorphous or cryptocrystalline
CRYSTALLINE				Pale<----------->Dark				
SILICEOUS		Mainly SILICEOUS		ACID Much quartz	INTERMEDIATE Some quartz	BASIC Little or no quartz	ULTRA BASIC	
METAMORPHIC ROCKS Most metamorphic rocks are distinguished by foliation which may impart fissility. Foliation in gneisses is best observed in outcrop. Non-foliated metamorphics are difficult to recognize except by association. Any rock baked by contact metamorphism is described as 'hornfels' and is generally somewhat stronger than the parent rock Most fresh metamorphic rocks are strong although perhaps fissile			IGNEOUS ROCKS Composed of closely interlocking mineral grains. Strong when fresh; not porous Mode of occurrence : 1 Batholith; 2 Laccoliths; 3 Sills; 4 Dykes; 5 Lava Flows; 6 Veins					

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ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Indra Jworchan
Client	Geotechnique
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Project	**14816/1 44-48 Rodlay Avenue,Penrith**
Order Number	(Not specified)
Samples	6

LABORATORY DETAILS

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SGS Reference	**SE215624 R0**
Date Received	19/1/2021
Date Reported	22/1/2021

COMMENTS

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

SIGNATORIES

[redacted]

Shane MCDERMOTT
Inorganic/Metals Chemist

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Soluble Anions (1:5) in Soil by Ion Chromatography [AN245] Tested: 21/1/2021

PARAMETER	UOM	LOR	BH1 SOIL 0.5-0.95 21/10/2020 SE215624.001	BH1 SOIL 2.0-2.45 21/10/2020 SE215624.002	BH1 SOIL 9.0-9.3 21/10/2020 SE215624.003	BH2 SOIL 0.5-0.95 21/10/2020 SE215624.004	BH2 SOIL 2.0-2.45 21/10/2020 SE215624.005
Chloride	mg/kg	0.25	150	650	36	320	370
Sulfate	mg/kg	5	130	<5.0	18	98	<5.0

PARAMETER	UOM	LOR	BH2 SOIL 3.5-3.8 21/10/2020 SE215624.006
Chloride	mg/kg	0.25	120
Sulfate	mg/kg	5	8.2

pH in soil (1:5) [AN101] Tested: 21/1/2021

PARAMETER	UOM	LOR	BH1 SOIL 0.5-0.95 21/10/2020 SE215624.001	BH1 SOIL 2.0-2.45 21/10/2020 SE215624.002	BH1 SOIL 9.0-9.3 21/10/2020 SE215624.003	BH2 SOIL 0.5-0.95 21/10/2020 SE215624.004	BH2 SOIL 2.0-2.45 21/10/2020 SE215624.005
pH	pH Units	0.1	5.4	5.1	7.7	4.9	6.0

PARAMETER	UOM	LOR	BH2 SOIL 3.5-3.8 21/10/2020 SE215624.006
pH	pH Units	0.1	7.8

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Conductivity and TDS by Calculation - Soil [AN106] Tested: 21/1/2021

PARAMETER	UOM	LOR	BH1 SOIL 0.5-0.95 21/10/2020 SE215624.001	BH1 SOIL 2.0-2.45 21/10/2020 SE215624.002	BH1 SOIL 9.0-9.3 21/10/2020 SE215624.003	BH2 SOIL 0.5-0.95 21/10/2020 SE215624.004	BH2 SOIL 2.0-2.45 21/10/2020 SE215624.005
Conductivity of Extract (1:5 as received)	µS/cm	1	150	430	41	220	230
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	190	480	46	290	260
Resistivity of extract (1:5 as received)*	ohm m	0.1	68	23	250	45	43

PARAMETER	UOM	LOR	BH2 SOIL 3.5-3.8 21/10/2020 SE215624.006
Conductivity of Extract (1:5 as received)	µS/cm	1	100
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	110
Resistivity of extract (1:5 as received)*	ohm m	0.1	97

Moisture Content [AN002] Tested: 20/1/2021

PARAMETER	UOM	LOR	BH1 SOIL 0.5-0.95 21/10/2020 SE215624.001	BH1 SOIL 2.0-2.45 21/10/2020 SE215624.002	BH1 SOIL 9.0-9.3 21/10/2020 SE215624.003	BH2 SOIL 0.5-0.95 21/10/2020 SE215624.004	BH2 SOIL 2.0-2.45 21/10/2020 SE215624.005
% Moisture	%w/w	1	22.9	9.8	11.8	22.3	10.9

PARAMETER	UOM	LOR	BH2 SOIL 3.5-3.8 21/10/2020 SE215624.006
% Moisture	%w/w	1	4.1

METHOD SUMMARY

SE215624 R0

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		
***	Indicates that both * and ** apply.				

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

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

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

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

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

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

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

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

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STATEMENT OF QA/QC PERFORMANCE

SE215624 R0

CLIENT DETAILS

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Project	**14816/1 44-48 Rodlay Avenue,Penrith**
Order Number	(Not specified)
Samples	6

LABORATORY DETAILS

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SGS Reference	**SE215624 R0**
Date Received	19 Jan 2021
Date Reported	22 Jan 2021

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Extraction Date	Conductivity and TDS by Calculation - Soil	6 items
	Moisture Content	6 items
	pH in soil (1:5)	6 items
	Soluble Anions (1:5) in Soil by Ion Chromatography	6 items
Analysis Date	Conductivity and TDS by Calculation - Soil	6 items

SAMPLE SUMMARY

HOLDING TIME SUMMARY

SE215624 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1	SE215624.001	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	28 Oct 2020	21 Jan 2021†
BH1	SE215624.002	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	28 Oct 2020	21 Jan 2021†
BH1	SE215624.003	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	28 Oct 2020	21 Jan 2021†
BH2	SE215624.004	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	28 Oct 2020	21 Jan 2021†
BH2	SE215624.005	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	28 Oct 2020	21 Jan 2021†
BH2	SE215624.006	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	28 Oct 2020	21 Jan 2021†

Moisture Content

Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1	SE215624.001	LB217015	21 Oct 2020	19 Jan 2021	04 Nov 2020	20 Jan 2021†	25 Jan 2021	21 Jan 2021
BH1	SE215624.002	LB217015	21 Oct 2020	19 Jan 2021	04 Nov 2020	20 Jan 2021†	25 Jan 2021	21 Jan 2021
BH1	SE215624.003	LB217015	21 Oct 2020	19 Jan 2021	04 Nov 2020	20 Jan 2021†	25 Jan 2021	21 Jan 2021
BH2	SE215624.004	LB217015	21 Oct 2020	19 Jan 2021	04 Nov 2020	20 Jan 2021†	25 Jan 2021	21 Jan 2021
BH2	SE215624.005	LB217015	21 Oct 2020	19 Jan 2021	04 Nov 2020	20 Jan 2021†	25 Jan 2021	21 Jan 2021
BH2	SE215624.006	LB217015	21 Oct 2020	19 Jan 2021	04 Nov 2020	20 Jan 2021†	25 Jan 2021	21 Jan 2021

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1	SE215624.001	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	22 Jan 2021	21 Jan 2021
BH1	SE215624.002	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	22 Jan 2021	21 Jan 2021
BH1	SE215624.003	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	22 Jan 2021	21 Jan 2021
BH2	SE215624.004	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	22 Jan 2021	21 Jan 2021
BH2	SE215624.005	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	22 Jan 2021	21 Jan 2021
BH2	SE215624.006	LB217037	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	22 Jan 2021	21 Jan 2021

Soluble Anions (1:5) in Soil by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH1	SE215624.001	LB217043	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	18 Feb 2021	22 Jan 2021
BH1	SE215624.002	LB217043	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	18 Feb 2021	22 Jan 2021
BH1	SE215624.003	LB217043	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	18 Feb 2021	22 Jan 2021
BH2	SE215624.004	LB217043	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	18 Feb 2021	22 Jan 2021
BH2	SE215624.005	LB217043	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	18 Feb 2021	22 Jan 2021
BH2	SE215624.006	LB217043	21 Oct 2020	19 Jan 2021	28 Oct 2020	21 Jan 2021†	18 Feb 2021	22 Jan 2021

SURROGATES

SE215624 R0

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result
LB217037.001	Conductivity of Extract (1:5 as received)	µS/cm	1	<1
	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	0.78

Soluble Anions (1:5) in Soil by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result
LB217043.001	Chloride	mg/kg	0.25	<0.25
	Sulfate	mg/kg	5	<5.0

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may give a different calculated RPD.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE215624.006	LB217037.014	Conductivity of Extract (1:5 as received)	µS/cm	1	100	92	32	12
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	110	35.4696090794	32	12

Moisture Content

Method: ME-(AU)-[ENV]AN002

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE215624.002	LB217015.011	% Moisture	%w/w	1	9.8	10.4	40	6
SE215642.006	LB217015.022	% Moisture	%w/w	1	19.5145631067	18.6315789473	32	2

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE215624.006	LB217037.014	pH	pH Units	0.1	7.8	7.9	31	1

Soluble Anions (1:5) in Soil by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE215624.006	LB217043.010	Chloride	mg/kg	0.25	120	99	30	22
		Sulfate	mg/kg	5	8.2	8.4	90	3

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Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB217037.002	Conductivity of Extract (1:5 as received)	µS/cm	1	290	303	85 - 115	95
	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	NA	303	85 - 115	95

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB217037.003	pH	pH Units	0.1	7.5	7.415	98 - 102	101

Soluble Anions (1:5) in Soil by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB217043.002	Chloride	mg/kg	0.25	86	100	70 - 130	86
	Sulfate	mg/kg	5	88	100	70 - 130	88

MATRIX SPIKES

SE215624 R0

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

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MATRIX SPIKE DUPLICATES

SE215624 R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

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Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

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

①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to relevant report comments for further information.

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GEOTECHNIQUE PTY LTD

Laboratory Test Request / Chain of Custody Record

Lemko Place
PENRITH NSW 2750

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PENRITH NSW 2751

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email: info@geotech.com.au

Page 1 of 1

TO:	SGS ENVIRONMENTAL SERVICES UNIT 16 33 MADDOX STREET ALEXANDRIA NSW 2015	Sampling By:	RS	Job No	14816/1
				Project:	Proposed Residential Flat Development
PH:	02 8594 0400	FAX:	02 8594 0499	Project Manager:	IJ
ATTN:	Ms Emily Yin			Location:	44-48 Rodlay Avenue, Penrith

Sampling details — **Results required by: 3 Days Turnaround**

Location	Depth	Soil	Water	EC (1:5)	pH	Sulphate	Chloride	Resistivity				Notes	Keep Sample
BH1	0.5-0.95	DSP		✓	✓	✓	✓	✓				Please hold extra samples for	✓
BH1	2.0-2.45	DSP		✓	✓	✓	✓	✓				time being	✓
BH1	9.0-9.3	DSP		✓	✓	✓	✓	✓					✓
BH2	0.5-0.95	DSP		✓	✓	✓	✓	✓					✓
BH2	~~2~~0-~~2~~.45	DSP		✓	✓	✓	✓	✓					✓
BH2	~~3~~.5-~~3~~.95	DSP		✓	✓	✓	✓	✓					✓
	3-3.8 by												

SGS EHS Sydney COC
SE215624

Excel Geotech_Geo Required

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	
Indra Jworchan		21/10/2020	[redacted]		19/1/21 @ 4pm

Legend:

WG	USG	Undisturbed soil sample (gl	DSP	Disturbed soil sample (small plastic bag)	* Purge & Trap
WP	DSG	Disturbed soil sample (glas	✓	Test required	# Geotechnique Screen

Form No 4.7F2-5 SGS

Document Set ID: 9507436
Version: 1, Version Date: 11/03/2021

SAMPLE RECEIPT ADVICE

SE215624

CLIENT DETAILS

Contact	Indra Jworchan
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	indra.jworchan@geotech.com.au
Project	**14816/1 44-48 Rodlay Avenue,Penrith**
Order Number	(Not specified)
Samples	6

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Tue 19/1/2021
Report Due	Fri 22/1/2021
SGS Reference	**SE215624**

SUBMISSION DETAILS

This is to confirm that 6 samples were received on Tuesday 19/1/2021. Results are expected to be ready by COB Friday 22/1/2021. Please quote SGS reference SE215624 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	Client	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	6 Soil
Date documentation received	19/1/2021	Type of documentation received	COC
Samples received in good order	Yes	Samples received without headspace	N/A
Sample temperature upon receipt	12°C	Sufficient sample for analysis	Yes
Turnaround time requested	Three Days		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

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SAMPLE RECEIPT ADVICE

SE215624

CLIENT DETAILS

Client Geotechnique

Project 14816/1 44-48 Rodlay Avenue,Penrith

SUMMARY OF ANALYSIS

No.	Sample ID	Conductivity and TDS by Calculation - Soil	Moisture Content	pH in soil (1:5)	Soluble Anions (1:5) in Soil by Ion Chromatography
001	BH1 0.5-0.95	3	1	1	2
002	BH1 2.0-2.45	3	1	1	2
003	BH1 9.0-9.3	3	1	1	2
004	BH2 0.5-0.95	3	1	1	2
005	BH2 2.0-2.45	3	1	1	2
006	BH2 3.5-3.8	3	1	1	2

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

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