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Project: Proposed Childcare Centre
Site Location: 97 – 99 Victoria Street, Werrington NSW 2747
Reference: 13004-GR-1-1
Report Date: 10 June 2021

Geotechnical Investigation Report

1 Introduction

This report presents the findings of a geotechnical investigation carried out by Alliance Geotechnical Pty Ltd (Alliance) for Lord N' Lady Pty. Ltd. c/- ArtMade Architects (the client) for the proposed childcare centre at 97–99 Victoria Street, Werrington NSW 2747 (the site). The geotechnical investigation was undertaken in accordance with Alliance's email quotation (Estimate No. 04947) dated 13 May 2021 to prepare a geotechnical investigation report to support the Development Application (DA) submission.

Based on the architectural drawings, it is understood that the development includes the demolition of the existing structures and the construction of a single-storey Childcare Centre with one level of basement carpark.

The objectives of the investigation are to assess the subsurface conditions of the site and provide comments and recommendation regarding:

- Existing geotechnical and groundwater conditions;
- Suitable footings and foundation layer;
- Geotechnical design parameters including allowable bearing capacity and lateral earth pressure coefficients for retaining structures;
- Excavation conditions and vibration management;
- Temporary and permanent earth retaining structures;
- Soil aggressivity in regard to concrete and steel; and
- Commentary on groundwater.

The following scope of work has been undertaken to achieve the project objectives:

- Review of geological maps and previous projects in the area;
- Site walkover identifying site features of geotechnical importance;
- Drill four boreholes to a maximum depth of 6.0m;
- Undertake Dynamic Cone Penetrometer (DCP) test and Standard Penetrometer tests (SPT) to assess the soil consistency; and
- Collection soil samples for laboratory analysis.

This report is prepared to provide geotechnical comments and recommendations regarding the proposed development.

2 Site Description and Geological Setting

The site comprises of two adjacent residential lots within the suburb of Werrington in the City of Penrith local council encompassing an irregular rectangular-shaped block of land with an approximate total area of 1277m^2. The site is bounded by other residential houses and by Victoria Street to the south as shown in Figure 1.

As the site is comprised of two adjacent properties, each site can be described as per below at the time of investigation

- 99 Victoria Street – the site comprised of an occupied single-storey residential dwelling with a granny flat and shed in the rear of the site. A concrete driveway on the western side of the property leads to the shed. Vegetation consists of grass ground cover.
- 97 Victoria Street - the site comprised of an occupied single-storey residential dwelling with a granny flat and shed in the rear of the site. Vegetation consists of grass ground cover.

The provided site survey plan shows existing ground levels vary between RL44.571m and RL44.826m AHD (Australian Height Datum) trending from the southeast to northwest side, respectively. The site visually appeared relatively flat with no observable gradient.

Figure 1 - The Site Location

The Penrith 1:100 000 Geological Map (Sheet 9030, 1st Edition, Geological Survey of New South Wales, 1991) indicates the site is underlain by *'Bringelly Shale'* described as '*Shale, carbonaceous claystone, claystone, laminate, fine to medium grained lithic sandstone, rare coal and tuff*'.

3 Proposed Development

To assist with the geotechnical investigation, the following documents were provided by the Client:

- A detailed survey, prepared by Sydney Registered Surveyors, Plan Reference: 6159 Victoria, dated 01-04-2021; and
- A set of architectural drawings, not for final issue, prepared by ArtMade Architects, Project No.: 21621, dated 18 May 2021.

Based on the provided documents, it is understood that the proposed childcare centre includes:

- The construction of eight playrooms with a ground floor level of RL 44.750m and a roof ridge level of RL 48.745m
- A basement carpark, including a driveway, with a basement level of RL 41.450m
- The ground floor has a 4m setback from the site boundary to the north, 9.1m from the site boundary to the south and 1m from the site boundary to the east and west.
- The basement carpark level has a 4m setback from the site boundary to the north, 2m from the site boundary to the south and 1m from the site boundary to the east and west.
-

4 Fieldwork

The fieldwork was carried out on 25 May 2021 by a geotechnical engineer. The selected site photographs taken during the fieldwork is presented in Attachment A.

After the site walkover and inspection, the proposed borehole positions located in front yard and back yard were checked against Dial Before You Dig (DBYD) plans for services and utilities. Two boreholes were drilled on each property, one in the front of the property and one in the rear of the property. A total of 4 boreholes were drilled to a maximum depth of 6.0m below ground level (BGL) using a using a ute-mounted rig with Tungsten Carbide (TC) bit.

Dynamic Cone Penetrometer (DCP) tests were conducted adjacent to each borehole to assess the near-surface soil consistency. Standard Penetration tests (SPT) was conducted within the drilled borehole at 1.5m intervals to assess the soil consistency at depth.

The encountered soil profiles were documented by an experienced geotechnical engineer from Alliance in accordance with AS 1726 - 2017 Geotechnical Site Investigation. The approximate borehole locations and DCP tests are indicated in drawing 12912.1-GR-1-A (Attachment B). The borehole logs, DCP and SPT test results are provided in Attachment C. These results should be read in conjunction with the attached Explanatory Note which explains the terms, abbreviations, and symbols used, together with the interpretation and limitation of the logging procedure.

At completion, the boreholes were backfilled with drilling spoils and made flush with the surrounding surface. The site condition was reinstated to its original condition.

5 Subsurface Conditions

The encountered subsurface conditions are summarised in Table 1. The soil consistency/density is based on the results of the DCP and SPT tests.

The site is underlain by a maximum depth of 0.2m of topsoil/fill followed by poorly compacted clayey silt / silty clay fill. The fill was underlain by alluvial soils comprising soft to stiff silty Clay and firm to very stiff Clay. Bedrock was not encountered.

Table 1 - Summary of the Subsurface Profiles

Soil Profile	BH01 (m)	BH02 (m)	BH03 (m)	BH04 (m)
Topsoil / Fill – Silty Sand / Sandy Silt / Silt / Sand	0.0 – 0.1	0.0 – 0.1	0.0 – 0.25	0.0 – 0.1
Fill – Sand / Sandy Silt / Clayey Silt / Silty Clay / Clay, appears poorly compacted	0.1 – 0.2	0.1 – 0.2	0.25 - 0.3	0.1 – 0.6
Alluvium – Clay, Firm	0.2 – 0.6	0.2 – 1.8		0.6 – 5.0
Alluvium – Sand, Medium Dense		1.8 – 3.2		
Alluvium – Clay / Sandy Clay, Stiff to Very Stiff	0.6 – 6.0	3.2 – 6.0	0.3 – 6.0	3.0 – 6.0
Terminated depth	6.0	6.0	6.0	6.0

Groundwater seepage was observed in BH01 and BH03 at 4.8m and 5.5m below ground level (BGL), respectively. Groundwater is subject to seasonal, climatic conditions and the groundwater level may fluctuate following extended rain falls.

6 Laboratory Results

One soil sample was collected from the borehole for soil aggressivity laboratory testing. Soil aggressivity test was performed on the soil samples for the durability design of concrete and steel purposes. The results and exposure classifications are presented in Table 2 - Summary of Soil Aggressivity Result
. The results are summarised in and the laboratory test certificate and detailed results can be found in Attachment D.

Table 2 - Summary of Soil Aggressivity Result

Test	Unit	BH03 (1.8-2.0m BGL) Alluvial Clay
Chloride	mg/kg	710
Conductivity(1)	uS/cm	430
pH(1)	pH	5.3
Resistivity	Ohm.cm	2300
Sulfate (as SO_4)	$mg.kg^{-1}$ (ppm)	280
Moisture	%	13
Results(2)	In relation to concrete	Mild
	In relation to steel	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)		

7 RECOMMENDATIONS

7.1 Site Classification

The site is underlaid by poorly compacted fill material (assessed as uncontrolled fill) to a maximum depth of 0.6m throughout the site. As such the site is classified as Class P in accordance with AS 2870-2011 Residential Slab and Footings and the footings design should follow the engineering principles provided in Section 6.3.

For the footings founded on the natural alluvial clay below the fill, the site is classified as Class H1, described as 'a highly reactive clay site and may experience high ground movement from moisture changes with an estimated characteristic surface movement.' It may experience high ground movement from moisture changes with an estimated characteristic surface movement, $y_{s,}$ to be in the range between 40 to 60 millimetres for the existing subsurface conditions.

7.2 Groundwater

Groundwater seepage was encountered within boreholes BH01 and BH03 at the time of the investigation. Localised inflows can be expected to occur during and following major rainfall events. As such, the construction should be planned to manage seepage and surface runoff during the basement construction. The pumping from sumps method can be adopted to manage groundwater seepage.

If significant groundwater seepage is encountered during construction the dewatering/groundwater control method should be undertaken following obtaining approval from a geotechnical/hydrogeological engineer.

Adequate drainage measures should therefore be considered for the structural design the permanent retaining walls and the base slab to avoid hydrostatic pressure build up. Long term groundwater flows would be expected to be of limited volume and can be controlled by draining into a sump for periodic pumped disposal into the stormwater system.

7.3 Excavation Conditions and Vibrations

Given the encountered the soil profile and the excavation to a maximum depth of 3.3m is expected to be readily achieved using conventional earthworks excavation equipment (min. 5T excavator). As the excavation is expected to be in alluvial clay soils, construction-related vibrations are expected to be negligible. Generally, the peak particle velocity during any demolition, excavation and construction works should be limited to 5mm/s.

If the encountered ground conditions are not in line with the findings of this investigation, the project geotechnical engineer should be informed prior to advancing the construction works.

Generally, the ground vibration Peak Particle Velocity (PPV) should be limited to 5mm/s at the site boundary and 2mm/s at any sensitive property's boundaries. A dilapidation survey on nearby structures and infrastructure should be carried out by a structural engineer 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.

7.4 Excavation Support

The proposed excavation can be undertaken by adopting unsupported batter slopes provided that the batter slopes in the soil does not extended below the 'zone of influence' of any adjacent structures and infrastructure (i.e. a 30° line in sand and a 45° line in clay drawn from the foundation level of any adjacent structure and

infrastructure). Given the site setbacks, it may be feasible to adopt unsupported batter slope at the northern, southern and western sides. Site setbacks must be calculated from existing property boundaries.

The recommended maximum temporary batter slopes for excavations presented in Table 3. Surface protection of the batter faces will be needed to prevent erosion and loss of surface materials.

Table 3 - Maximum Excavation Batter Slopes above the Groundwater Level

Material	Maximum Temporary Batter Slope (H: V)
Medium Dense Sand	2 : 1
Stiff / Very Stiff Clay	1 : 1

Where the unsupported batter slopes are not feasible, the excavation should be supported by a properly designed shoring system.

The shoring system should be designed to support the existing surcharge within the zone of influence of the excavation.

The shoring system could take the form of a semi-contiguous piled wall or a soldier pile wall with reinforced shotcrete infill panels. Weep holes or drains (e.g. vertical drains) must be provided behind shotcrete to avoid build-up of hydrostatic pressure in the overburden soils. The shoring system piles would need to be extended below the proposed excavation base level. It is recommended that the minimum depth of embedment of the piles be 0.5m or one pile diameter, whichever is greater. The final socket depth of the shoring system should be determined by the design engineer based on the stability of the shoring wall and the applied later loads.

The stability of the shoring system may be provided by designing cantilever shoring piles or internal bracing.

7.5 Earth retaining structure design parameters

Lateral earth pressures parameters for temporary shoring retaining walls are provided in Table 4. A triangular stress distribution should be used for the design of permanently restrained walls if the walls are design as a cantilever.

The retaining wall should be designed in accordance with AS4678 Earth Retaining Structures. If it is critical to limit the horizontal deformation an earth pressure coefficient ‘at rest’ (K_0) should be adopted. Where some lateral movement is acceptable, an ‘active’ lateral earth pressure coefficient (Ka) is recommended. In addition, provisions are to be made for permanent and effective drainage behind the wall.

Table 4 - Geotechnical Design Parameters for Retaining Wall Design

Description	γ	c’	ϕ’	K_0	K_a	K_p	E’	ν
Unit	kN/m^3	kPa	°	–	–	–	MPa	–
Firm Clay	17	3	24	0.59	0.42	2.37	5	0.35
Stiff to Very Stiff Clay / Sandy Clay	18	4	27	0.55	0.38	2.66	15	0.3

Medium Dense Sand	18	0	30	0.50	0.33	3.00	15	0.3

Legends:

γ Bulk Unit Density
ϕ' Effective Friction Angle
c' Effective Cohesion
K_0 Earth pressure at rest
K_a Active earth pressure
K_p Passive earth pressure
E' Elastic Modulus
ν Poisson's ratio

7.6 Foundations

As there is a basement excavation, the proposed structure can be founded on either shallow footings or pier footings on the natural alluvial stiff to very stiff clay.

Generally, it is recommended to found the entire structure on similar foundation material to avoid differential settlement.

As the architectural drawings indicate, an excavation depth of 3.3m below ground level is expected. As such, basement floor level will be located within stiff to very stiff clay / sandy clay. If considering strip and square footings, at the basement level, the recommended design parameters are presented in Table 5. The tabulated data is only applicable where the subsurface condition is confirmed. The provided bearing capacity is for the preliminary footing design and the settlement should be assessed based on the applied loads and the footings' size. It should be noted that the provided bearing capacity does not apply to the raft footing design. If it is proposed to design a raft footing, the allowable bearing capacity should be determined considering the applied loads and tolerable settlement.

Table 5 - Geotechnical Design Parameters for Shallow Foundation

Description	Embedment Depth	Allowable Bearing Capacity
	m	kPa
Alluvial clay: stiff to very stiff	0.5	200

The recommended preliminary design parameters for pier footings are presented in Table 6. A minimum socket of 0.5m or one pier diameter (whichever is greater) is recommended in the target foundation material.

Cased bored pile are suitable footing system for pier footings. The allowable bearing capacity in piles depends on factors including the proving method, the structure's importance, level of construction control. Thus, the allowable bearing capacity should be calculated using $\emptyset_g$ parameter provided in Section 4.3 of Australian Standard "AS 2159-2009 Piling – Design and Installation" considering the tolerable settlements. As such, the settlement of the footing should be calculated based on the final footings size, depth and applied loads.

Table 6 - Recommended Design Parameters for Deep Foundation

Description	End Bearing Capacity(kPa)		Compressive Shaft Adhesion(kPa)		Elastic Modulus (MPa)
	Ultimate	Allowable (assuming $\emptyset_g = 0.33$)	Ultimate	Allowable	
Alluvial stiff to very stiff clay	600	200	45	20	15

If bored piers are adopted for this project, groundwater inflow may occur during pile drilling. Therefore, pumps may be required to remove from the bored pile holes prior to the placement of concrete. Alternatively, tremie concrete placement method could be used for the concrete placement.

The pile foundation will need to be inspected during boring by an experienced geotechnical engineer or engineering geologist to confirm the design embedment depth and the assumptions made in this report regarding the subsoil conditions. The base of footing should be free of soft, loose, wet, or disturbed soils.

It should be noted that in the case of adopting two different footing system for the proposed building (including shallow pad footings and pier footings) the settlements would be different. As such, it is recommended to found the entire structure on similar foundation layer and on the same footing system.

8 LIMITATIONS

Alliance Geotechnical Pty Ltd (Alliance) has prepared this report for the site located at 97 – 99 Victoria Street, Werrington NSW 2747, in accordance with Alliance's fee proposal and Terms of Engagement. This geotechnical report has been prepared for Lord N' Lady Pty. Ltd. c/o ArtMade Architects 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.

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Attachments:

Attachment A – Selected Site Photographs
Attachment B – Site Investigation Plan
Attachment C – Explanatory Notes, Borehole Logs & DCP Test Results
Attachment D – Laboratory Test Certificates

Attachment A – Selected Site Photographs

Photo 1 - Site Overview of 97 Victoria St looking North from the South position (front)

Photo 2 – Site Overview of 97 Victoria St looking North from the South position (rear)

Photo 3 - Site Overview of 99 Victoria St looking North from the South position (front)

Photo 4 – Site Overview of 99 Victoria St looking South from the North position (rear)

Attachment B – Geotechnical Investigation Plan

Borehole Location Plan

Client Name:	Lord N' Lady Pty. Ltd. c/- Artmade Architects	Figure / Drawing Number:	13004-GR-1-A
Project Name:	Proposed Childcare Centre	Figure / Drawing Date:	25/05/2021
Project Location:	97 – 99 Victoria St, Werrington NSW 2747	Report Number:	13004-GR-1-1

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Attachment C – Explanatory Notes, Borehole Logs & DCP Test Results

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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

Abbreviation	Method
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:

Abbreviation	Description
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

Abbreviation	Test
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. Photos are recommended.

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 Name
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	Clay ey 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 to 0.6 mm
Fine grained	0.06 to 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.

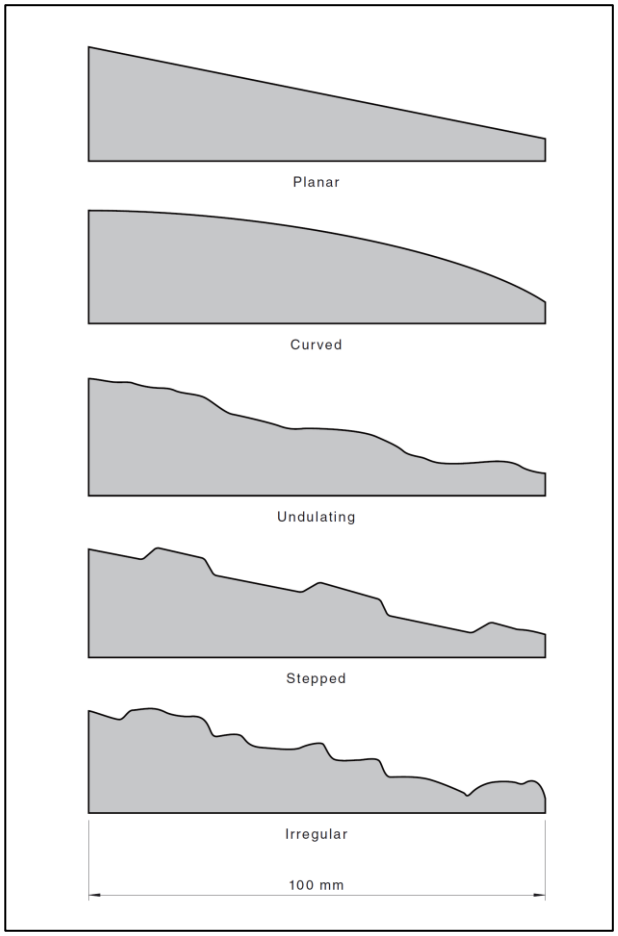
Detailed descriptions are given of defects judged to be particularly significant in the context of the project. For example, crushed seams in an apparently unstable slope. As a minimum, general descriptions outlining the number of defect sets within the rock mass and their broad characteristics are provided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

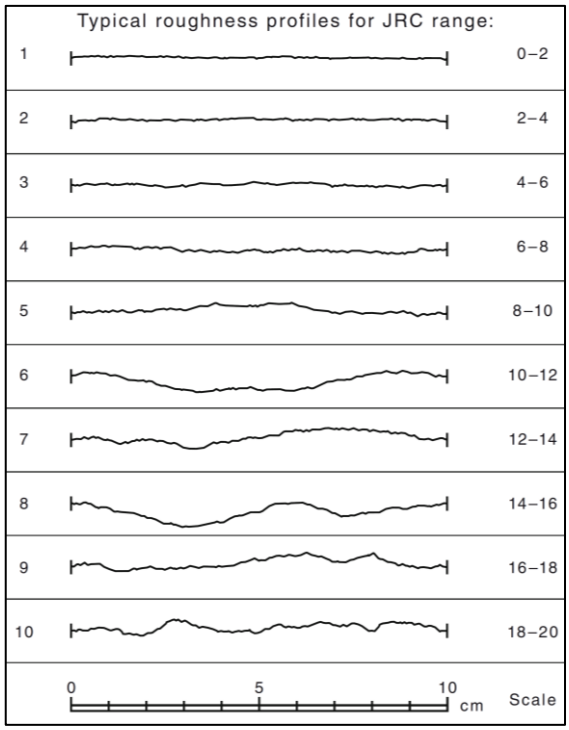
Defect spacing and length (sometimes called persistence), shall be described directly inmillimetres and metres.

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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BH No: BH01
Sheet: 1 of 1
Job No: 13004

Borehole Log

Client: Lord N' Lady Pty. Ltd. c/- Artmade Architects
Started: 25/05/2021
Project: Proposed Childcare Centre
Finished: 25/05/2021
Location: 97-99 Victoria St, Werrington NSW 2747
Hole Location: Refer to Figure 13004-GR-1-A
Borehole Size: 100 mm
Rig Type: TDLR690
Hole Coordinates E, N
Driller: SM
Logged: NL
RL Surface: 44.73m
Contractor: Alliance Geotechnical
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					-	TOPSOIL / FILL: Silty SAND, dark brown, fine to medium grained sand, low plasticity		M	-	TOPSOIL / FILL
					-	silt, poorly graded		M	-	FILL
					CH	FILL: SAND, brown, fine to medium grained sand, poorly graded, trace clay and silt		MC ~ PL	F	ALLUVIUM
						CLAY, high plasticity, brown mottled red orange, with fine sand				
						grades: no sand, red orange mottled brown				
		44			CL	CLAY, low plasticity, brown mottled grey, trace fine sand		MC < PL	St	
			1							
		43					SPT 6, 11 SPT terminated N > 10			
			2							
		42								
			3							
					CL	Sandy CLAY, low plasticity, brown mottled grey, fine sands	SPT 4, 9, 10 N=19	MC < PL	St - VSt	
		41								
			4							
		40					SPT 3, 5, 7 N=12			
	▼				CH	CLAY, high plasticity, brown mottled grey		MC ~ PL	St	PROBABLE groundwater inflow
			5							
		39								
			6							
						Terminated at 6.0m - target depth reached				

Borehole BH01 terminated at 6m

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BH No: BH02
Sheet: 1 of 1
Job No: 13004

Borehole Log

Client: Lord N' Lady Pty. Ltd. c/- Artmade Architects
Started: 25/05/2021
Project: Proposed Childcare Centre
Finished: 25/05/2021
Location: 97-99 Victoria St, Werrington NSW 2747
Hole Location: Refer to Figure 13004-GR-1-A
Borehole Size: 100 mm
Rig Type: TDLR690
Hole Coordinates E, N
Driller: SM
Logged: NL
RL Surface: 44.80m
Contractor: Alliance Geotechnical
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 Encountered				-	TOPSOIL / FILL: Sandy SILT, low plasticity, dark brown, fine grained sand, with fine grained gravel		MC ~ PL	-	TOPSOIL / FILL
					-	FILL: Sandy SILT, high plasticity, brown, fine grained sands			-	FILL
					CH	CLAY, high plasticity, brown red mottled brown grey		MC ~ PL	F	ALLUVIUM
						grades: red		MC ~ PL		
		44						MC ~ PL		
			1			grades: brown mottled grey		MC < PL	St - VSt	
							SPT 7, 10 SPT terminated N > 10			
		43			SP	SAND, fine grained sand, poorly graded, brown mottled grey, with low plasticity clay		D	MD	
			2							
		42								
			3				SPT 4, 8, 10 N=18			
					CL	Sandy CLAY, low plasticity, grey mottled brown, fine grained sands		MC < PL	VSt	
		41			CH	CLAY, high plasticity, brown mottled grey, trace fine grained sand		MC ~ PL	VSt	
			4							
							SPT 3, 7, 7 N=14			
		40								
			5							
		39								
			6							
						Terminated at 6.0m - target depth reached				

Borehole BH02 terminated at 6m

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BH No: BH03
Sheet: 1 of 1
Job No: 13004

Borehole Log

Client: Lord N' Lady Pty. Ltd. c/- Artmade Architects
Started: 25/05/2021
Project: Proposed Childcare Centre
Finished: 25/05/2021
Location: 97-99 Victoria St, Werrington NSW 2747
Hole Location: Refer to Figure 13004-GR-1-A
Borehole Size: 100 mm
Rig Type: TDLR690
Hole Coordinates E, N
Driller: SM
Logged: NL
RL Surface: 44.57m
Contractor: Alliance Geotechnical
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					-	TOPSOIL / FILL: SILT, low plasticity, dark brown, with fine grained sands		MC ~ PL	-	TOPSOIL / FILL
					-	FILL: Clayey SILT, high plasticity, dark brown, with fine grained sands		MC ~ PL	-	FILL
					CH	CLAY, high plasticity, brown orange mottled brown, with fine grained sand			VSt	ALLUVIUM
		44						MC ~ PL		
			1			grades: red mottled grey, trace fine grained sand				
						grades: red				
		43				grades: no sand, grey mottled brown	SPT 5, 8, 10 N=18			
			2							
		42				grades: with fine grained sand				
			3				SPT 3, 7, 8 N=15			
		41				grades: brown				
						grades: brown mottled grey, trace fine grained sand				
			4							
		40					SPT 4, 4, 6 N=10			
			5			grades: brown, with fine grained sand				
	▼	39								PROBABLE groundwater inflow
			6		CH	CLAY, brown, high plasticity, with fine grained gravel, with fine grained sand		MC > LL	F	
						Terminated at 6.0m - target depth reached				

Borehole BH03 terminated at 6m

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BH No: BH04
Sheet: 1 of 1
Job No: 13004

Borehole Log

Client: Lord N' Lady Pty. Ltd. c/- Artmade Architects
Started: 25/05/2021
Project: Proposed Childcare Centre
Finished: 25/05/2021
Location: 97-99 Victoria St, Werrington NSW 2747
Hole Location: Refer to Figure 13004-GR-1-A
Borehole Size: 100 mm
Rig Type: TDLR690
Hole Coordinates E, N
Driller: SM
Logged: NL
RL Surface: 44.64m
Contractor: Alliance Geotechnical
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 Encountered				-	TOPSOIL / FILL: SAND, brown, fine to medium grained poorly sand		M	-	TOPSOIL / FILL
					-	FILL: Silty CLAY, high plasticity, dark brown, with fine grained sand		MC ~ PL	-	FILL
					-	FILL: CLAY, high plasticity, dark brown, trace fine sub-rounded gravel, with fine grained sand		MC ~ PL	-	
		44			CH	CLAY, high plasticity, red mottled grey, trace fine grained sand		MC ~ PL	F	ALLUVIUM
			1			grades: grey mottled red				
		43				grades: grey mottled brown and red	SPT 1, 3, 3 N=6			
			2							
		42								
			3				SPT 2, 3, 5 N=8		St	
		41				grades: grey mottled red, no sand				
			4							
		40					SPT 2, 5, 5 N=10			
			5		CL	Sandy CLAY, high plasticity, brown, fine grained sand, with fine angular gravel		MC ~ PL		
		39								
			6							
						Terminated at 6.0m - target depth reached				

Borehole BH04 terminated at 6m

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Dynamic Cone Penetrometer (DCP) Test Report

Client:	Lord N' Lady Pty. Ltd. c/- Artmade Architects	Report Number:	13004-GR-1-1
Project Name:	Proposed Childcare Centre	Project Number:	13004
Project Location:	97 – 99 Victoria St, Werrington NSW 2747	Date Tested:	25/05/2021
Test Method:	AS 1289.6.3.2		

Test Number	DCP-1	DCP-2	DCP-3	DCP-4
Test Locations	Refer to Drawing No. 13004-GR-1-A			
Surface Material	TOPSOIL / FILL: Silty SAND, moist	TOPSOIL / FILL: Sandy SILT, MC ~ PL	TOPSOIL / FILL: SILT with sand, MC ~ PL	TOPSOIL / FILL: SAND, moist
Surface R.L (m)	44.73	44.80	44.57	44.64
Depth (metres)	N Blow Count			
0.00 – 0.10	4	1	1	3
0.10 – 0.20	4	2	1	1
0.20 – 0.30	1	1	2	1
0.30 – 0.40	2	2	3	3
0.40 – 0.50	2	2	3	2
0.50 – 0.60	2	2	2	2
0.60 – 0.70	2	2	3	3
0.70 – 0.80	2	3	4	3
0.80 – 0.90	2	3	5	3
0.90 – 1.00	4	5	5	2
1.00 – 1.10	4	6	6	2
1.10 – 1.20	6	12	5	3
1.20 – 1.30	10	23*N	8	2
1.30 – 1.40	13		11	2
1.40 – 1.50	16		17	2
1.50 – 1.60	15*T		27*N	3*T

Notes:

This penetrometer test report is intended to be read in conjunction with the geotechnical report by Alliance Geotechnical (ref: 13004-GR-1-1).

*T denotes DCP termination due to target depth reached

*N denotes DCP termination due to N > 20

Attachment 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: **Matt Swinbourn**

Report **798194-S**
Project name PROPOSED CHILDCARE CENTRE
Project ID 13004
Received Date May 25, 2021

Client Sample ID			**BH03 1.80M TO 2.00M**
Sample Matrix			**Soil**
Eurofins Sample No.			**S21-My51899**
Date Sampled			**May 25, 2021**
Test/Reference	LOR	Unit	
Chloride	10	mg/kg	710
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	430
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	5.3
Resistivity*	0.5	ohm.m	23
Sulphate (as SO4)	10	mg/kg	280
% Moisture	1	%	13

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	May 28, 2021	28 Days
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	May 28, 2021	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	May 28, 2021	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Sydney	May 28, 2021	28 Days
- Method: E045 Anions by Ion Chromatography			
% Moisture	Sydney	May 26, 2021	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

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Site # 1254 & 14271

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Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

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NATA # 1261
Site # 23736

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IANZ # 1327

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Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

Company Name:	Alliance Geotechnical	**Order No.:**	**Received:** May 25, 2021 4:40 PM
Address:	10 Welder Road Seven Hills NSW 2147	**Report #:** 798194 **Phone:** 1800 288 188 **Fax:** 02 9675 1888	**Due:** Jun 1, 2021 **Priority:** 5 Day **Contact Name:** Matt Swinbourn
Project Name:	PROPOSED CHILDCARE CENTRE		
Project ID:	13004		

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	BH03 1.80M TO 2.00M	May 25, 2021		Soil	S21-My51899	X	X
Test Counts						1	1

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
ug/L: micrograms per litre
ppm: Parts per million
ppb: Parts per billion
%: Percentage
org/100mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/kg	< 10			10	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	uS/cm	< 10			10	Pass	
Sulphate (as SO4)	mg/kg	< 10			10	Pass	
LCS - % Recovery							
Chloride	%	95			70-130	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	%	79			70-130	Pass	
Resistivity*	%	79			70-130	Pass	
Sulphate (as SO4)	%	100			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
Chloride	S21-My51874	NCP	%	96			70-130	Pass	
Sulphate (as SO4)	S21-My51874	NCP	%	100			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1	Result 2	RPD	Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S21-My51874	NCP	mg/kg	< 10	< 10	<1	30%	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	S21-My51899	CP	uS/cm	430	380	12	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	S21-My51899	CP	pH Units	5.3	5.4	<1	30%	Pass	
Resistivity*	S21-My51899	CP	ohm.m	23	26	12	30%	Pass	
Sulphate (as SO4)	S21-My51874	NCP	mg/kg	31	32	4.0	30%	Pass	
% Moisture	S21-My51707	NCP	%	9.6	9.7	1.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	No
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:

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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.