ACCREDITED FOR TECHNICAL COMPETENCE

ISO 9001 CERTIFIED QUALITY MANAGEMENT

Transport for NSW Authorised Engineering Organisation

GEOTECHNICAL SITE INVESTIGATION & PAVEMENT DESIGN REPORT

PROJECT: 412-414 Cessnock Road, Gillieston Heights, NSW 2321

CLIENT: BATHLA GROUP

DATE: 16/06/22

REPORT No.: NE1169

GEOTESTA

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1 INTRODUCTION

Geotesta was engaged by Bathla Group to conduct a geotechnical site investigation at 412-414 Cessnock Road, Gillieston Heights, NSW 2321. Based on the information received from the client, it is understood that the proposed development comprises of a residential subdivision with on-site roadways. This site investigation was carried out accordance with the fee proposal and scope of work provided to the client and approved on 12 November 2021.

The field work was carried out on 11 April 2022. This report presents the geotechnical investigation results including sub-surface soil profile with interpreted geotechnical properties of the assessed subsurface lithology and recommendations on the design parameters of footing/foundation, footing type, founding depth, geotechnical parameters including allowable bearing capacity, site classification, salinity assessment, and construction/excavation issues. This report also presents recommendations on pavement composition design for the proposed subdivision access road.

This assessment has been carried out in general accordance with the following guidelines:

- Australian Standard (AS1726) 2017: Geotechnical Site Investigation
- Australian Standard (AS2870) 2011: Residential Slabs and Footings
- Australian Standard (AS) 3600 (2009), Concrete Structures
- Salinity Code of Practice March 2003 (Amended January 2004)

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2 FIELD INVESTIGATION

The field investigation involved drilling of four (4) boreholes (BH1-BH4) for a geotechnical site investigation to the maximum depth of 1.3m. All the boreholes were terminated on refusal depths from 0.9m to 1.3m. The boreholes' location was determined by Geotesta, according to site accessibility and the locations of underground services.

A site plan showing the subdivision plan and borehole locations is presented in Figure 1. Borehole drilling was carried out using a Ute-mounted rig using a solid flight auger method. Four (4) Dynamic Cone Penetrometer Testings were performed next to boreholes to determine the soil strength of soil layers.

The fieldwork was performed in the presence of a Geotesta Geotechnical Engineer who positioned boreholes, collected samples, nominated testing depths and prepared borehole logs in accordance with AS1726 – 2017 "Geotechnical Site Investigations". All field observations and in-situ test results are presented in borehole logs attached in Appendix A of this report.

3 FINDINGS

3.1 Site Condition and Topography

The investigation site is at 412-414 Cessnock Road, Gillieston Heights, NSW 2321, located at approximately 40 km (by road) of Newcastle, NSW. The site plan and borehole locations are shown in Figure 1.

The site has a rectangular shape and is relatively flat, with an area of approximately 39,600 m^2. On average, the site sloping (approximately 10%) downward from south and north directions to the middle where a small valley is located.

Regional topographic maps indicate that the site is approximately 30m above sea level referenced to Australian Height Datum (AHD). The site is located within Maitland Council.

3.2 Site Geology

The geological origin of the soil profile was identified from our visual examination of the soil samples, geotechnical experience, and reference to geological maps of the area. The geological map of the area indicates that the site is underlain by the Mailtland Group (Pmt): quart-lithic sandstone (sporadic marine fossils), polymictic pebble to cobble-paraconglomerate, siltstone, fossiliferous siltstone, minor claystone and chert (Newcastle Hunter Area 1:100,000 Coastal Quaternary Geology Map). Figure 2 shows the geology map of the site and surrounding area.

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Figure 1. Site plan and borehole locations

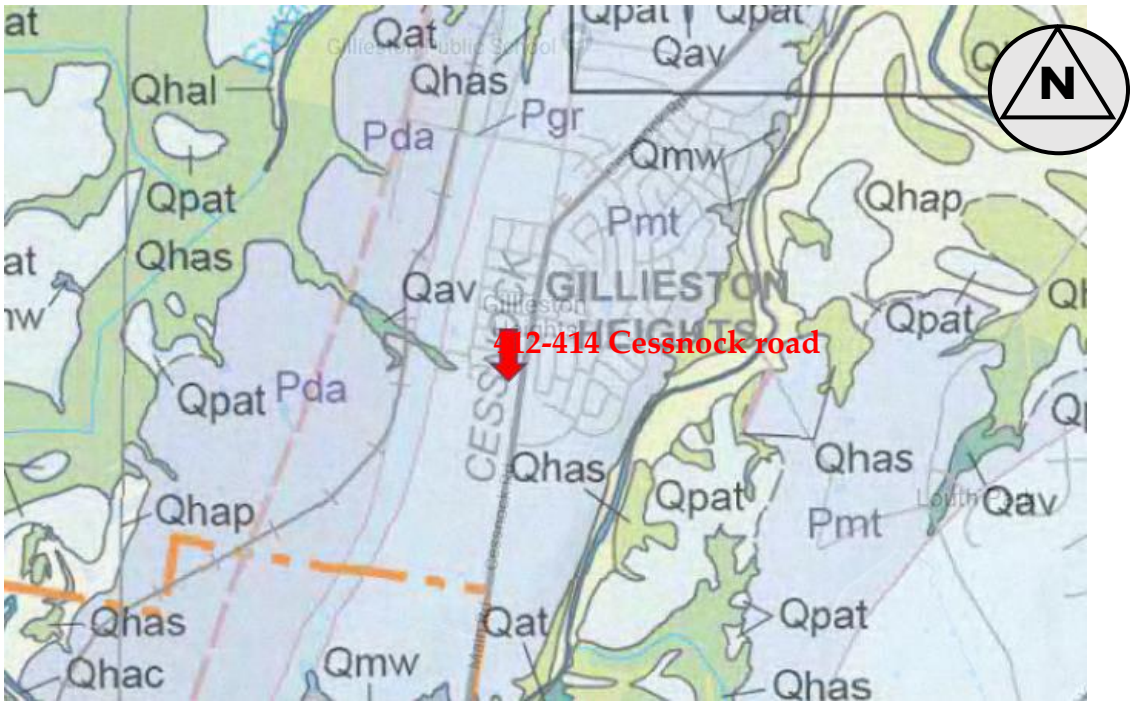

Figure 2. Geology map of the site and surrounding area

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3.3 Soil/rock profile

The encountered soil profiles are presented in the borehole logs in Appendix A and tabulated in detail in Table 1 below.

Topsoil materials were encountered in the boreholes to a maximum depth of 0.4m followed by natural Silty Clay with sand to a maximum depth of 1.0m. The natural/residual silty Clay was underlain by a highly weathered siltstone with strength and weathering characteristic as summarised in Table 1.

Table 1: Summary of Sub-surface Materials

Unit	Material	BH1	BH2	BH3	BH4	Description
1	Topsoil	0.0-0.3	0.0-0.4	0.0-0.4	0.0-0.2	Silty Clay/ Sandy Silt/ Silty sand with grass root and gravel
2	Silty Clay with sand	-	0.4-0.6	-	0.2-0.4	Firm/Stiff
3	Silty Clay with sand	0.3-0.9	0.6-0.8	0.4-1.0	0.4-0.7	Hard
4	Siltstone	09-1.3	0.8-1.0	1.0-1.3	0.7-0.9	Extremely low to very low strength, Extremely to Highly weathered

**measured from the existing ground surface*

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3.4 Site Classification

Four (4) soil samples were taken from the natural soil and sent to Geotesta's laboratory, a NATA accredited laboratory for testing of index properties to assess the site reactivity and classification. The laboratory test results are summarised in Table 2.

Table 2: Summary of Soil Laboratory Test Results

Bore No.	Depth (m)	Soil Type	LL %	PL%	PI %	LS %
BH1	0.5	Silty Clay	52	21	30	12
BH2	0.6	Silty Clay	71	30	42	13
BH3	0.8	Silty Clay	41	20	21	8.5
BH4	0.6	Silty Clay	45	19	26	8.5

Note: LL= Liquid Limit; PL=Plastic Limit; PI= Plasticity Index; LS= Linear Shrinkage

Referring to the above test results, the site clayey soil to a depth of 0.8m is considered medium to high plasticity soil.

After considering the area geology, the soil profile encountered in the boreholes and the linear shrinkage test; the site is classified as CLASS 'M' with respect to foundation construction (Australian Standard 2870-2011 Residential Slabs and Footings). It has been estimated that the Characteristic Surface Movement (ys) of the underlying natural soil material will be in the range of 20-40mm provided the building site is protected from "abnormal moisture conditions" and is drained as described in AS 2870.

It must be emphasized that the heave mentioned, and recommendations referred to in this report are based solely on the observed soil profile observed at the time of the investigation for this report, without taking into account any abnormal moisture conditions as defined in AS2870 – 2011, Clause 1.3.3 that might be created thereafter. With abnormal moisture conditions, distresses will occur and may result in "non-acceptable probabilities of serviceability and safety of the building during its design life," as defined in AS2870-2011, Clause 1.3.1. If these distresses are not acceptable to the builder, owner or other relevant parties then further fieldwork and revised footing recommendations must be carried out.

3.5 Groundwater

Groundwater was not encountered in any of the boreholes.

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3.6 Earthquake Design

Australian Standard AS 1170.4 "Structural design actions, Part 4: Earthquake actions in Australia" outlines the relevant methods used in earthquake risk classification and design requirements, enabling the assessment of an earthquake design category for the structure to be determined. Based on the results of the geotechnical investigation and the soil data gathered from the boreholes, a site sub-soil class of Ce – shallow soil site can be adopted as per Section 4 of the above standard.

A hazard factor (Z) of 0.1 can be adopted for Maitland based on information obtained from Table 3.2 and Figure 3.2(A) of AS 1170.4 – 2007.

3.7 Salinity and Aggressivity Assessment

Four (4) soil samples were submitted to Eurofin MGT Laboratory, a NATA accredited laboratory, for chemical testings for the salinity and aggressivity assessment. The testings were carried out for aggressivity suit and to assess exposure classification for the proposed development.

Sampling was targeted to achieve a representative coverage of site conditions in line with assessed sub-surface profiles, proposed development, and the investigation scope. Laboratory test certificates are presented in Appendix B.

3.7.1 Salinity Assessment

Laboratory test results for salinity assessment are summarised in Table 3.

Table 3: Soil Salinity Test Results

Sample ID	Conductivity (Ec) (1:5 Aqueous extract dS/m)	Ece[1] (ds/m)	Salinity assessment[2]
S1 (BH1-0.8m)	0.03	0.27	Non-Saline
S2 (BH2-0.5m)	0.041	0.369	Non-Saline
S3 (BH3-1.2m)	0.11	0.99	Non-Saline
S4 (BH4-0.8m)	0.18	1.62	Non-Saline

[1]Based on EC to ECe multiplication factors in Department of Land and Water Conservation (2002) Guidelines (Table 6.1), a multiplication factor of 9 were applied to medium clays.
[2]Based on Table 6.2 of Department of Land and Water Conservation (2002) where ECe < 2dS/m = Non-saline; ECe= 2-4dS/m = slightly saline; ECe = 4-8dS/m = moderately saline; ECe = 8-16dS/m = very saline; ECe > 16dS/m = highly saline.

Referring to the above test results, the site is considered to be **non-Saline**.

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3.7.2 Aggressivity assessment

Sulphate and pH test results for aggressivity assessment are summarised in Table 4.

Table 4: Aggressivity classification test results for concrete and steel piles

Sample ID	pH (1:5 Aqueous extract)	Sulphate (SO4) (mg/kg)	Aggressivity assessment[1] concrete	Aggressivity assessment[1] steel
S1 (BH1-0.8m)	5.9	46	Non-aggressive	Non-aggressive
S2 (BH2-0.5m)	5.4	110	Mild	Non-aggressive
S3 (BH3-0.6m)	5.5	84	Mild	Non-aggressive
S4 (BH4-0.8m)	5.6	210	Non-aggressive	Non-aggressive

[1]In accordance with AS3600 (2009)

Referring to the above test result, the site soil considered non-aggressive to mild aggressive to concrete and non-aggressive to steel.

3.7.3 Exposure Classifications for concrete and steel in Saline and sulfate soils

The site soil is considered non-saline, mild aggressive to concrete and non-aggressive to steel. An exposure classification of A1 for concrete in saline soils and an exposure classification of A2 for concrete and A1 for steel in sulphate soils should be adopted for preliminary design of proposed concrete structures.

3.8 California Bearing Ratios

The laboratory test results detailing the index properties and California Bearing Ratios of representative in-situ subgrade materials are summarized in Table 5. The test certificates are attached in Appendix B.

Table 5. Summary of Laboratory CBR Test Results

BH No.	Depth (m)	Soil type	MDD t/m^3	OMC %	CBR %	Swell %
BH1	0.4-1.0	Silty Clay	1.74	17.5	9.0	1.0
BH3	0.4-0.7	Silty Clay	1.56	23.0	2.0	3.5
BH4	0.3-0.7	Silty Clay	1.85	14.0	7.0	0.5

Note:; MDD= Maximum Dry Density; OMC= Optimum Moisture Content; CBR= California Bearing Ratio

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4 Pavement Design Recommendations

4.1 Design CBR Value

For the purpose of designing the pavement composition for the roadways on this site, the CBR values have been adopted as indicated in Figure 3. The road section indicated in green colour needs to be chemically stabilised as the CBR values are lower than 3% in this section.

Figure 3. Adopted CBR values for Pavement Design

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To provide a final pavement design, once the roads are excavated down to subgrade level based on the geotechnical properties of the subgrade a new pavement design will be undertaken to confirm the actual pavement thickness.

4.2 Traffic Data

The design traffic loads have been estimated from Pavement Design in the current Maitland City Council Manual of Engineering Standards and Part 2: Austroads Pavement Structural Design (2017).

Table 6. Design Traffic Loading Values

Road Type	Pavement Type	Design Traffic Loading
Local - Place	Flexible	1.0×10^5 DESAs
Local - Access	Flexible	1.0×10^5 DESAs
Local - Secondary	Flexible	2.0×10^5 DESAs
Local - Primary	Flexible	5.0×10^5 DESAs

4.3 Proposed Pavement Composition for Subdivision Road

The proposed pavement compositions designed based on the current Maitland City Council Manual of Engineering Standards, and Austroads Pavement Structural Design (2017) are presented in Tables 7.

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Table 7. Flexible Pavement Design Details (Adopted CBR value of 3%-(Green Colour))

Pavement Type	Layer	Details	Composition Thickness (mm)		
			$1x10^5$ DESAs	$2x10^5$ DESAs	$5x10^5$ DESAs
Flexible	Wearing Course	AC10 Asphaltic Concrete	50		
	Interlayer	A two-coat hot bitumen seal (10mm & 14mm aggregate)			
	Base Course	The Maitland City Council approved DGB20, compacted to not less than 98% modified compaction AS 1289.5.4.1 (2007)	150	150	150
	Subbase Course	The Maitland City Council approved DGS40 or crushed sandstone to The Maitland City Council Manual of Engineering Standards, compacted to not less than to 98% modified compaction AS 1289.5.4.1 (2007)	235	275	325
	Subgrade	This section needs to be chemically stabilised and should be compacted to not less than 100% of standard compaction AS 1289.5.4.1 (2007). To provide a final pavement design, once the roads are excavated down to subgrade level based on the geotechnical properties of the subgrade a new pavement design will be undertaken to confirm the actual pavement thickness			

Table 8. Flexible Pavement Design Details (Adopted CBR value of 6%-(Blue Colour))

Pavement Type	Layer	Details	Composition Thickness (mm)		
			$1x10^5$ DESAs	$2x10^5$ DESAs	$5x10^5$ DESAs
Flexible	Wearing Course	AC10 Asphaltic Concrete	50		
	Interlayer	A two-coat hot bitumen seal (10mm & 14mm aggregate)			
	Base Course	The Maitland City Council approved DGB20, compacted to not less than 98% modified compaction AS 1289.5.4.1 (2007)	150	150	150
	Subbase Course	The Maitland City Council approved DGS40 or crushed sandstone to The Maitland City Council Manual of Engineering Standards, compacted to not less than to 98% modified compaction AS 1289.5.4.1 (2007)	150	150	175
	Subgrade	Existing natural Silty Clay compacted to not less than 100% of standard compaction AS 1289.5.4.1 (2007). To provide a final pavement design, once the roads are excavated down to subgrade level based on the geotechnical properties of the subgrade a new pavement design will be undertaken to confirm the actual pavement thickness			

4.4 Subgrade Preparation

The subgrade shall be compacted to give a density ratio of 100% Standard determined using AS1289.5.4.1 (2007) – "Methods of Testing Soils for Engineering Purposes". Compaction certificates, from a N.A.T.A. registered laboratory, verifying this are to be submitted to Council's Engineer or the Accredited Certifier prior to placement of the pavement materials. Non-cohesive soils are to be compacted to give a density index of 80%, determined using AS1289.5.6.1 (1998) – "Methods of Testing Soils for Engineering Purposes". Testing to be carried out at the rate of one test per 50 lineal metres of road, with a minimum of two tests on any one road and to be in accordance with the council earthwork specification and related Australia Standards.

Where areas of subgrade fail a roller test the defective material shall be removed and replaced with similar sound material or other material approved by Council's Engineer or the Accredited Certifier and shall be re-tested to ensure a satisfactory inspection.

It is recommended that any uncontrolled fill material or soft spots encountered in the proposed subgrade be removed to reveal stiff/very stiff silty clay. The removed section of the subgrade shall be backfilled to the underside of the pavement level, in layers not exceeding 200 mm loose thickness with select fill or site derived clay material compacted to 98-102% of maximum dry density of standard compaction (AS 1289.5.1.1) with moisture condition at the equilibrium moisture content or -2% to +2% of the optimum.

4.5 Base Preparation

The road pavement shall be constructed on the sub-base in uniform layers to provide the pavement thickness in accordance with the pavement design. No individual layer shall be more than 200mm or less than 100mm compacted thickness. The base course material shall be uniformly compacted with the required moisture content to achieve satisfactory compaction and shall be graded and trimmed parallel to the designed finished surface.

Where stabilised crushed rock is used as the base course material, it shall be spread and compacted within twenty-four (24) hours of delivery.

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4.6 Compaction Requirements

The subbase and base course materials is to be compacted to give a density ratio of at least 98% Modified, determined using AS1289.5.4.1 (2007) – "Methods of Testing Soils for Engineering Purposes". Compaction certificates from a N.A.TA. Registered laboratory, verifying this, are to be submitted to Council's Engineer or the Accredited Certifier prior to placement of the base course. Testing to be carried out at the rate of one test per 50 lineal metres of road, with a minimum of two tests on any one road and to be in accordance with the council earthwork specification and related Australia Standards.

During compaction operations the moisture content of the material of a layer or course shall be uniformly adjusted throughout so as not to exceed Optimum Moisture Content or be less than Optimum minus 3% or as otherwise approved.

Inspection of the subgrade, subbase, and base courses by a Council Engineer or the Accredited Certifier will be a roller test, using a steel wheeled three-point roller having a weight of at least ten (10) tonnes or at Council's discretion. The placement of pavement material shall not commence until after a satisfactory inspection by Council's Engineer or the Accredited Certifier.

4.7 Subsurface Drainage

It should be noted that the pavement construction must be accompanied by improvement of the subsurface and surface drainage of the road.

Subsurface drainage may also be complemented by the use of table or spoon drains on both sides of the pavement, or just on the inside of the pavement if kerb and channel is to be constructed on the lower side. Careful consideration should be given to minimize the potential for the water in the table drain to infiltrate the pavement subgrade. It is recommended that some form of erosion protection is provided to the table drains if these are to be utilized on the outer side of the road shoulders. To improve the trafficability of the site and to minimize any construction delays, adequate drainage of whole site during construction should be provided. No pooling of water at the surface should be allowed. The pavement should be constructed with a minimum of 3% cross fall subject to further design consideration by the Design Engineers.

4.8 Construction Works

It is recommended that Geotesta be engaged to provide a site inspection during the early stage of construction to confirm that the ground conditions of the subgrade along

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the proposed pavement construction are consistent with the assumptions or findings in this report.

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5 FOUNDATION RECOMMENDATION

5.1 Geotechnical Design Parameters

The estimated geotechnical parameters of soil material encountered below the site is provided in Table 8:

Table 8: Estimated Geotechnical Design Parameters

Unit/ Soil Type	γ (kN/m3)	Su (kPa)	c′ (kPa)	Φ′	E′ (MPa)	ν'
Unit 2 / Silty Clay (Firm to Stiff)	19	35	4	27	12	0.3
Unit 3 / Silty Clay (Hard)	20	200	10	28	60	0.3
Unit 4 / Siltstone	22	400	30	28	100	0.3

5.2 Strip/Pad Footing System and Slab panels and internal beams

It is recommended that an engineer designed strip footing system for a Class "M" site be used on this site. We recommend that the designing engineer refer to AS2870-2011 to ensure design compliance to this document.

Strip footings can be founded on Units 3 and 4. The strip footings should penetrate through any fill material, tree roots and founded at least 100mm into the recommended founding material.

As a guide with information obtained from the bores and DCP tests, the allowable bearing capacities presented in Table 9 can be adopted for the design of the pad/strip footings and slab panels/internal beams.

Table 9: Allowable Bearing Capacity for Pad/Strip Footings

Material	Unit 2 Firm to Stiff Silty Clay	Unit 3 Hard Silty Clay	Unit 4 Siltstone
Allowable Bearing Capacity (kPa)	50	350	700

It should be noted that the soil profile may vary across the site. The foundation depths quoted in this report are measured from the surface during our testing and may vary accordingly if any filling or excavation works are carried out. It is recommended that a geotechnical engineer be engaged during footing excavation stage to confirm the founding depth and founding material.

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Strip/Pad footings and Slab panels and internal beams can be founded in the natural soil profile or in compacted surface filling and/or as required in the design by engineering principles. Compacted filling used to raise levels beneath panels must be placed and compacted as per specifications for controlled or rolled fill.

Controlled fill is material that has been placed and compacted in layers by compaction equipment within a defined moisture range to a defined density requirement. Except as provided below, controlled fill shall be placed in accordance with AS 3798.

If more than 400mm of CLAY FILL or 800mm of SAND FILL, imported or site derived, including existing FILL material, is required, then the slab must be designed as a suspended slab and supported by a grid of beams founded through any fill material in accordance with the above edge beam recommendations.

All footings for the same structure should be founded on strata of similar stiffness/consistency/density to minimize the risk of differential movements, with articulation provided where appropriate.

5.3 Bored Piles

Bored piles can be used to support this residential building. Due to shallow bedrocks the piles to be founded on Unit 4 materials. An allowable end bearing capacity of 700kPa can be adopted for the piles founded on Unit 4 Siltstone.

The pier/pile foundation of the proposed structure is assumed to be a high redundancy system and the intrinsic test factor (ϕ_{tf}) is assumed to be equal to basic geotechnical strength reduction factor (ϕ_{gb}), in accordance to AS2159-2009. The overall design average risk rating (ARR) is to be calculated by the designer and the corresponding geotechnical strength reduction shall be adopted.

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6 EARTHWORKS

6.1 Site Preparation

The depth of topsoil across the site up to a depth of 0.4 m. Any Topsoil/Fill encountered during excavation should be treated as uncontrolled. The following measures should be adopted for the site preparation of the site:

- All topsoil from the construction area should be stripped to subgrade/foundation level and stockpiled on site for possible re-use. Topsoil not being re-used should be disposed of offsite following a waste classification report. All trees and stumps are to be similarly removed, and such areas backfilled and compacted as per Australian Standards AS 3798 – 2007 "Guidelines on earthworks for commercial and residential developments".
- Any evidence of contamination or asbestos containing materials found during excavation works should be brought to the attention of the Project Engineer immediately.

It is recommended that Geotesta be engaged to provide a site inspection during the early stage of construction to confirm that the ground conditions of the subgrade for the proposed construction are consistent with the assumptions/findings in this report.

It is recommended that any uncontrolled fill material or soft spots encountered in the proposed subgrade be removed to reveal stiff/very stiff natural soil. The removed section of the subgrade shall be backfilled to the underside of the foundation level, in layers not exceeding 200 mm loose thickness with controlled fill or site derived clay material compacted to 98-102% of maximum dry density of standard compaction (AS 1289.5.1.1) with moisture condition at the equilibrium moisture content or -2% to +2% of the optimum.

6.2 Excavation

Earthworks recommendations in this report should be read in conjunction with AS 3798-2007: 'Guidelines on Earthworks for Commercial and Residential Developments'.

Based on the soil/bedrock profile and conditions encountered at the borehole locations, light excavation machinery should be adequate for the footing excavations (down to 1.5m) in fill materials. Soft/Intermediate excavation condition is expected in Silty Clay (i.e., Unit 2, and Unit 3), while excavations into Siltstone (i.e., Unit 4) will encounter intermediate excavation conditions per SANS 1200D. Table 11 describes the excavation classes as per SANS 1200D.

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Table 10: Excavation classes as per SANS 1200D

Excavation Class	Description
Soft	Excavation in material that can be efficiently removed by a back-acting excavator of flywheel power approximately 0.10kW per millimetre of tined-bucket width, without the use of pneumatic tools such as paving breakers
Intermediate	Excavation in material that requires a back-acting excavator of flywheel power exceeding 0.10 kW per millimetre of tined-bucket width or the use of pneumatic tools before removal by equipment equivalent to that specified for soft excavation.
Hard	Hard rock excavation shall be excavation in material (excluding boulder excavation) that cannot be efficiently removed without blasting or wedging and splitting.

Based on the current investigation, the excavation is unlikely to encounter groundwater. The presence of perched groundwater resulting from infiltration of surface run-off should not be dismissed, particularly during rainy periods. A suitable dewatering system (spears or sump pump) may be required to pump groundwater if the perched groundwater is encountered or any excavation go below groundwater level.

All topsoil from the construction area should be stripped to subgrade level and stockpiled on site for possible re-use. Topsoil not being re-used should be disposed of offsite following a waste classification report.

Any evidence of contamination or asbestos containing materials found during excavation works should be notified to the Project Engineer immediately.

6.3 Excavation Support

If any proposed excavations are within the proximity to adjacent structures, the ground excavation will be undertaken within the footing pressure projection line. There is also likelihood that the existing footing could be undermined.

As a guide, the excavation should be undertaken above the footing projection line at 40° to the horizontal. An earth retaining system must be installed for excavation below existing footing projection line.

6.4 Fill Material Selection

Selected fill material should have little volume change with changes in moisture content. Suitable fill materials include low reactivity sandy clays, silty clays, clayey sands, silty sands and highly to moderately weathered ripped siltstone and sandstone.

In addition, the selected fill material should have the following characteristics:

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- Free of rock larger than 75mm in any direction;
- Free of topsoil, organic soil and root matter;
- The material shall have an Emerson Class Number of 4 or greater in accordance with AS 1289.3.8.1 if the material is exposed to surface runoff or standing water, appropriate erosion protection should be provided;
- Material larger than 37.5mm should comprise less than 20% of the total fill material volume.

6.5 Pre-treatment Prior to Filling

Prior to filling the allotment with the selected fill material, we recommend the following:

- Remove all vegetation, topsoil and existing uncontrolled fill. Based on site observation and material encountered in the boreholes, at least the uppermost 50mm to 100mm of soil containing significant grass root matter should be removed prior to additional fill placement.
- The upper 200mm of exposed silty clay layer will need to be compacted to achieve a dry density ratio of at least 98% Standard Maximum Dry Density (SMDD) with the test performed in accordance with Australian Standard AS 1289.5.1.1 and 5.4.1 or 5.7.1 at moisture content within 3% of the Optimum Moisture Content (OMC).
- Any weak or unstable areas identified during the above compaction process and which do not improve with further rolling should be excavated and replaced with compacted select fill. The fill should be placed in uniform horizontal layers not exceeding 250mm loose thickness and compacted to achieve a dry density ratio of at least 98% Standard Maximum Dry Density (SMDD) with the test performed in accordance with Australian Standard AS 1289.5.1.1 and 5.4.1 or 5.7.1 at moisture content within 3% of the Optimum Moisture Content (OMC).

It is recommended that subgrade preparation and the placement of fill and compaction be undertaken under Level 1 supervision. Testing should be undertaken in accordance with the test methods specified in the Australian Standards AS 1289 "Methods of testing soils for engineering purposes" and AS 3798 "Guidelines on earthworks for commercial and residential developments".

6.6 Engineered Fill

Controlled or Rolled fill can be constructed on the foundation in uniform layers to provide the required design level in accordance with the foundation design.

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Controlled/Rolled SAND fill must be well compacted in layers not exceeding 200mm thick. Controlled/Rolled CLAY fill must be well compacted in layers no more than 150mm thick.

The fill material shall be uniformly compacted with the required moisture content to achieve satisfactory compaction and shall be graded and trimmed parallel to the designed finished surface.

Filling used to raise levels beneath foundations must be placed and compacted as per specifications for controlled or rolled fill.

All fill material is to be compacted to give a density ratio of 98% Standard determined using AS1289.5.4.1 (2007) – "Methods of Testing Soils for Engineering Purposes". Strict moisture control is maintained (within 3% of the Optimum Moisture Content (OMC)) throughout the filling and compaction process).

The exiting sandy clay and sandy silt can be reused on the site as long as they are clear of any deleterious and unsuitable materials.

6.7 Temporary Cut Batters

Temporary unsupported excavation up to 1.5m deep within the existing Unit2/3 silty clay layer should be no steeper than 1.5H:1V; Temporary unsupported cut batters more than 1.5m up to 3m deep within the existing silty clay should not be steeper than 2H:1V.

The above recommendations assume that there is no existing structures or underground services directly adjacent to the excavation area. The allowable cut batter slopes may need to be revised based on the location of any adjacent structures and services following the commencement of earthworks at the site. It should be noted that following rainy periods, some degree of deterioration and minor slumping of unsupported cut batters is to be anticipated.

It should be noted that following rainy periods, some degree of deterioration and minor slumping of unsupported cut batters is to be anticipated.

It is recommended that a geotechnical engineer be engaged during excavation stage to confirm/identify the material for the whole excavation depth.

The batter slope angles are recommended subjected to the following measures:

- The batters should be protected against erosion
- Permanent batters should be drained

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- Temporary batters shall not be left unsupported for more than 2 months without further advice. Following heavy rains (raining more than 6 hours with the intensity of greater than 15 mm/day) should be inspected by a geotechnical engineer.
- A minimum offset distance of 1.5 m from the batter crest should be maintained for surcharge loads and the offset distance should be increased to match the maximum depth of excavation.

6.8 Erosion and Sediment Control

An Erosion and Sediment control plan should be implemented before commencing any earthworks for the proposed project. Some general guidelines to be taken into consideration when preparing an Erosion and Sediment control plan include:

• Establishing a single entry and exit point when construction work commences;

• Minimise the area to be cleared and retain as much vegetation as possible;

• Install sediment control fences along the low side of the site before commencing work;

• Fill in and compact all areas as soon as practicable;

• Divert rainwater run-off away from the work site and install a silt trap around the site perimeter during construction;

• Provide temporary earth drain around the proposed site if possible, to prevent water logging within the exposed earth banks

6.9 Drainage of Retention Systems

As seepage infiltration from perched water table is quite likely to be present in the zones of influence during wet season, it is recommended that a suitable drainage system be installed and maintained behind all retaining wall structures to ensure the dissipation of any hydrostatic forces which may result from the accumulation of any seepage water behind the wall structures. Such seepage water flows should readily be able to be intercepted by the construction of a suitable sub-surface cut-off drain on the high side of the subject site.

6.10 Compaction Requirements

Compaction of backfill material is required to ensure that excessive surface settlement does not occur. The required backfill density and minimum frequency of testing for compaction control as detailed in AS 3798 – 2007 are summarised below:

• 1 test per layer per 500m^2; or

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- 1 test per 100m^3 distributed reasonably evenly throughout full depth and area; or
- 3 tests per visit (whichever requires the most tests)

Testing should be undertaken in accordance with AS 1289 "Methods of testing for soil engineering purposes". Tested layers that do not satisfy the outlined criteria are to be stripped, replaced, re-compacted and re-tested to achieve the minimum compaction requirement specified above.

Testing of compaction density should be undertaken by a suitably qualified geotechnical testing company.

All engineered fills should be compacted to achieve a dry density ratio of at least 98% Standard Maximum Dry Density (SMDD) with the test performed in accordance with Australian Standard AS 1289.5.1.1 and 5.4.1 or 5.7.1 at moisture content within 3% of the Optimum Moisture Content (OMC).

DOCUMENT CONTROL

Date	Version	Report Prepared By:	Report Reviewed by:
16 June 2022	NE1169	**Ngoc Thang Pham** BEng MSc PhD Geological Engineer	**Mohammad Hossein Bazyar** BEng MEng Ph.D MIEAust CPEng NER Senior Geotechnical Engineer

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7 REFERENCES

- Australian Standard (AS1726) 2017: Geotechnical Site Investigation
- Australian Standard (AS2870) 2011: Residential Slabs and Footings
- Salinity Code of Practice March 2003 (Amended January 2004);
- Australian Standard (AS) 3600 (2009), Concrete Structures
- Australian Standard (2009), Piling - Design and Installation (AS2159).
- Australian Standard (2002), Earth-retaining Structures (AS4678).
- Australian Standard (2004), Bridge Design Part 5: Concrete (AS5100.5).
- Pells, P.J.N., Mostyn, G., Walker, B.F. (1998) Design Loadings for Foundations on Shale and Sandstone in the Sydney Region.

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Information about This Report

The report contains the results of Soil and water quality Assessment conducted for a specific purpose and client. The results should not be used by other parties, or for other purposes, as they may contain neither adequate nor appropriate information.

Test Hole Logging

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information.

Groundwater

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeability (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, pheratic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

Interpretation of Results

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data. Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

Change in Conditions

Local variations or anomalies in the generalised ground conditions do occur in the natural environment, particularly between discrete test hole locations. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural forces.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to GEOTESTA for appropriate assessment and comment.

Reproduction of Reports

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions should include at least all of the relevant test hole and test data, together with the appropriate standard description sheets and remarks made in the written report of a factual or descriptive nature. Reports are the subject of copyright and shall not be reproduced without the permission of Geotesta.

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Appendix A

Borehole Logs

BOREHOLE LOG

BOREHOLE No: BH1

Page: 1 **of** 1

Client:	Bathla 412-414 Cessnock road Gillieston	Drilling Co:	Geotesta Pty Ltd	Easting:	---
Project:	Heights	Driller:	M.A/N.T	Northing:	---
Job No:	NE1169	Rig Type:	Ute Mounted	Grid Ref:	See Figure 1
Location:	412-414 Cessnock road Gillieston	Inclination:	Vertical	Collar RL:	
Date Drilled:	11/04/22	Bearing:	Vertical	Logged by:	M.A/N.T Checked by: M.H.B

Test Method: AS 1289.6.3.2-1997 & AS 1726-2017

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Strength	DCP blows/100mm	FIELD TESTS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00											0.00
				TOPSOIL/ FILL: Sandy **SILT**, dark brown, with clay and gravel			2 3 7				
0.50	Solid Flight Auger		CI	**Silty CLAY**: medium plasticity, orange brown, with sand motlet gray with siltstone fragments		H	13 20 R	ATT1@ 0.5m S1@ 0.8m CBR1 @ 0.4-1.0m			0.50
1.00				**SILTSTONE/SHALE**: brown, sandy laminations, extremly weathered, very low strength							1.00
1.50				Borehole terminated due to refusal at 1.3m							1.50
2.00											2.00
2.50											2.50
3.00											3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
ST	stiff
VST	very stiff
H	hard
WC	well compacted

relative density:

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

EL: extremly low strength

moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water:

water level

level risen to

water inflow

sampling / testing:

intact sample from core

intact tube sample

Standard Penetration Test

B Bulk sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

soil classification:
soil is classified in accordance with AS1726 unless otherwise noted

Notes:

BOREHOLE LOG

BOREHOLE No: BH2

Page: 1 **of** 1

Client:	Bathla 412-414 Cessnock road Gillieston	Drilling Co:	Geotesta Pty Ltd	Easting:	---
Project:	Heights	Driller:	M.A/N.T	Northing:	---
Job No:	NE1169	Rig Type:	Ute Mounted	Grid Ref:	See Figure 1
Location:	412-414 Cessnock road Gillieston	Inclination:	Vertical	Collar RL:	
Date Drilled:	11/04/22	Bearing:	Vertical	Logged by:	M.A/N.T Checked by: M.H.B

Test Method: AS 1289.6.3.2-1997 & AS 1726-2017

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Strength	DCP blows/100mm	FIELD TESTS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00											0.00
				TOPSOIL/ FILL: Sandy **SILT**, dark brown, with clay and gravel			1 1 2 2				
0.50			Cl	**Silty CLAY**: medium plasticity, orange brown, with sand	M	ST	2 4	ATT2 @ 0.6m			0.50
				with siltstone fragments		H	20 R	S2 @ 0.5m			
1.00				**SILTSTONE/SHALE**: brown, sandy laminations extremly weathered, very low strength							1.00
				Borehole terminated due to refusal at 1.0m							
1.50											1.50
2.00											2.00
2.50	Solid Flight Auger										2.50
3.00											3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
ST	stiff
VST	very stiff
H	hard
WC	well compacted

relative density:

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

EL: extremly low strength

moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water:

water level

level risen to

water inflow

sampling / testing:

intact sample from core

intact tube sample

Standard Penetration Test

B Bulk sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

soil classification:
soil is classified in accordance with AS1726 unless otherwise noted

Notes:

BOREHOLE LOG

BOREHOLE No: BH3

Page: 1 **of** 1

Client:	Bathla 412-414 Cessnock road Gillieston	Drilling Co:	Geotesta Pty Ltd	Easting:	---
Project:	Heights	Driller:	M.A/N.T	Northing:	---
Job No:	NE1169	Rig Type:	Ute Mounted	Grid Ref:	See Figure 1
Location:	412-414 Cessnock road Gillieston	Inclination:	Vertical	Collar RL:	
Date Drilled:	11/04/22	Bearing:	Vertical	Logged by:	M.A/N.T Checked by: M.H.B

Test Method: AS 1289.6.3.2-1997 & AS 1726-2017

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Strength	DCP blows/100mm	FIELD TESTS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00											0.00
				TOPSOIL/ FILL: Sandy **SILT**, dark brown, with clay and gravel			2 1 2 2				
0.50			CI	**Silty CLAY**: medium plasticity, orange brown, with sand motlet gray with sandy- gravely laminations		H	17 R	ATT3 @ 0.8m CBR2 @ 0.4-0.7m			0.50
1.00				**SILTSTONE/SHALE**: brown, sandy laminations, extremly weathered, very low strength				S3 @ 1.2m			1.00
1.50				Borehole terminated due to refusal at 1.3m							1.50
2.00											2.00
2.50	Solid Flight Auger										2.50
3.00											3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
ST	stiff
VST	very stiff
H	hard
WC	well compacted

relative density:

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

EL: extremly low strength

moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water:

- water level
- level risen to
- water inflow

sampling / testing:

- intact sample from core
- T — intact tube sample
- Standard Penetration Test
- B — Bulk sample
- Supp — Su from Pocket Penetrometer
- Suv — Su from Field Vane Shear test

soil classification:
soil is classified in accordance with AS1726 unless otherwise noted

Notes:

BOREHOLE LOG

BOREHOLE No: BH4

Page: 1 **of** 1

Client:	Bathla 412-414 Cessnock road Gillieston	Drilling Co:	Geotesta Pty Ltd	Easting:	---
Project:	Heights	Driller:	M.A/N.T	Northing:	---
Job No:	NE1169	Rig Type:	Ute Mounted	Grid Ref:	See Figure 1
Location:	412-414 Cessnock road Gillieston	Inclination:	Vertical	Collar RL:	
Date Drilled:	11/04/22	Bearing:	Vertical	Logged by:	M.A/N.T Checked by: M.H.B

Test Method: AS 1289.6.3.2-1997 & AS 1726-2017

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Strength	DCP blows/100mm	FIELD TESTS & NOTES	Sampling / Runs	Water Levels	Depth (m)
0.00											0.00
				TOPSOIL/ FILL: Silty **CLAY**, dark brown, with sand and gravel			1 1				
			CI	**Sandy CLAY**: medium plasticity, brown with siltstone fragments			4 8	CBR4: 0.3-0.7m			
0.50						H	19 R	S4 @ 0.8m ATT4 @ 0.6m			0.50
				SILTSTONE/ SHALE: brown, extremly weathered, very low strength							
1.00				Borehole terminated due to refusal at 0.9m							1.00
1.50											1.50
2.00											2.00
2.50	Solid Flight Auger										2.50
3.00											3.00
3.50											3.50
4.00											4.00
4.50											4.50
5.00											5.00

consistency:

VS	very soft
S	soft
F	firm
ST	stiff
VST	very stiff
H	hard
WC	well compacted

relative density:

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

EL: extremly low strength

moisture:

D	Dry
M	Moist
W	Wet
S	Saturated

water: water level; level risen to; water inflow

sampling / testing: intact sample from core; intact tube sample; Standard Penetration Test

B Bulk sample
Supp Su from Pocket Penetrometer
Suv Su from Field Vane Shear test

soil classification:
soil is classified in accordance with AS1726 unless otherwise noted

Notes:

Appendix B

Laboratory Test Results

CBR Test Report

Geotesta Pty Ltd
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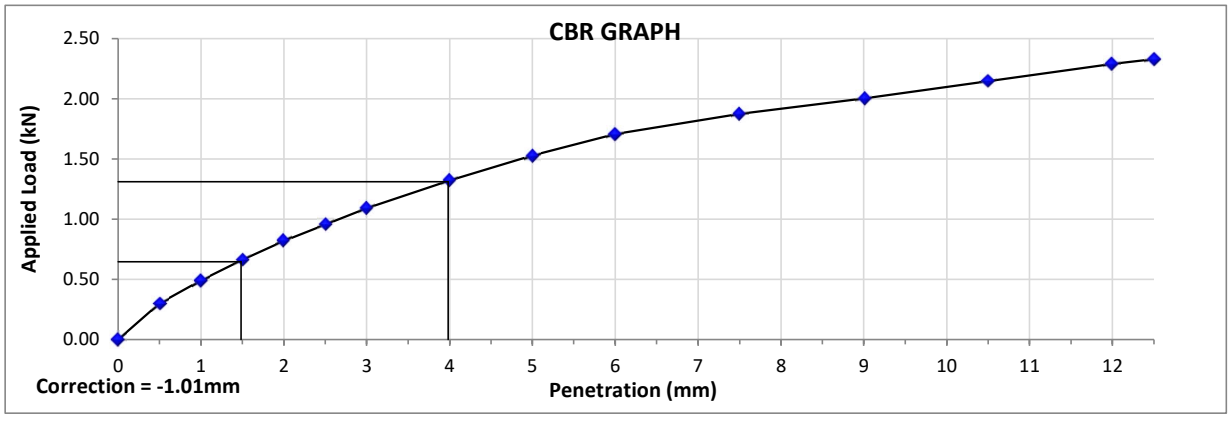
Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigation*	**Client**	*Bathla Group*
Report No	*S0419*	**Project No**	*NE1169*	**Client ID**	*-*
Sample ID	*SL1061-S0419*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH4@0.30-0.70*				

Base Site: *9 Redwood Drive, Notting Hill, VIC 3168* **Branch Site:** *6/20-22 Foundry Road, Seven Hills, NSW 2147*

Sample Description *silty Clay, brown*
Sampling Method *CLIENT*

Test performed according to AS 1289 - 6.1.1. Moisture content performed according to AS 1289 - 2.1.1.

California Bearing Ratio	7 %	**Compactive Effort**	AS1289 - 5.1.1 (Standard)
Penetration Depth	5.0 mm	Rammer Mass	2.7 kg
Maximum Standard Dry Density	1.85 t/m³	Drop Height	300 mm
Optimum Moisture Content	14.0 %	No. Layers	3
Retained 19.0mm oversize	0 %	No. Blows/Layer	50
Oversize material not replaced			
Curing Time	≥ 96 hrs	**Moisture Contents**	
Swell / Soaking Period	0.5 % - 4 Days	At Compaction	14.2 %
Surcharge	4.5 kg	After Soaking	15.5 %
Seating Load	0.050 kN	After Penetration	
Maximum Penetration	12.5 mm	Top 30 mm	17.5 %
		Remaining Depth	15.4 %
Dry Density			
At Compaction	1.82 t/m³	**Lab Density Ratio**	99.0 % MDD
After Soaking	1.81 t/m³	**Lab Moisture Ratio**	102.0 % OMC



NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*
Date issued: 28/04/2022

CBR Test Report

Geotesta Pty Ltd
9 Redwood Drive, Notting Hill
VIC 3168
T. 03 9562 9135
E. info@geotesta.com.au

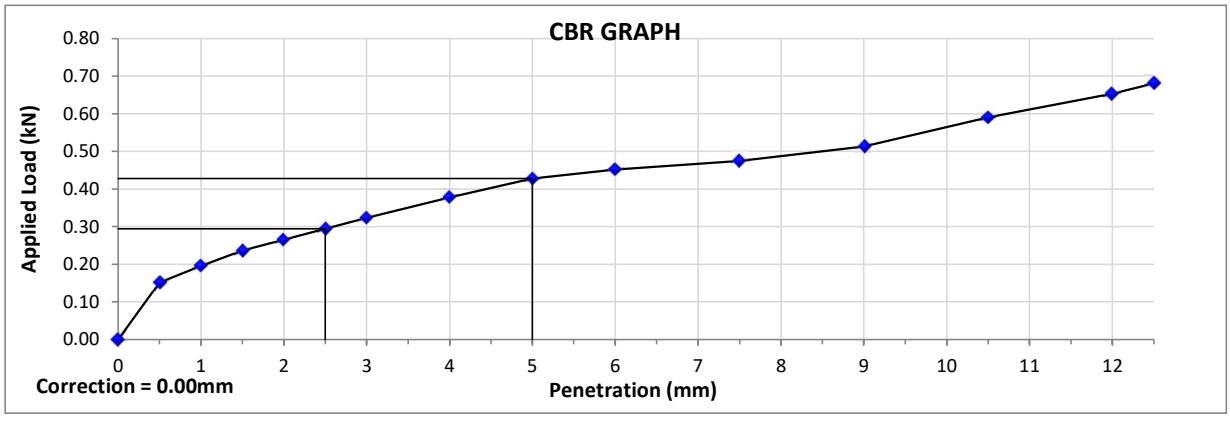
Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigation*	**Client**	*Bathla Group*
Report No	*S0418*	**Project No**	*NE1169*	**Client ID**	*-*
Sample ID	*SL1061-S0418*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH3@0.40-0.70*				

Base Site: *9 Redwood Drive, Notting Hill, VIC 3168* **Branch Site:** *6/20-22 Foundry Road, Seven Hills, NSW 2147*

Sample Description *silty Clay, brown*
Sampling Method *CLIENT*

Test performed according to AS 1289 - 6.1.1. Moisture content performed according to AS 1289 - 2.1.1.

California Bearing Ratio	2 %	**Compactive Effort**	AS1289 - 5.1.1 (Standard)
Penetration Depth	2.5 mm	Rammer Mass	2.7 kg
Maximum Standard Dry Density	1.56 t/m³	Drop Height	300 mm
Optimum Moisture Content	23.0 %	No. Layers	3
Retained 19.0mm oversize	0 %	No. Blows/Layer	53
Oversize material not replaced			
Curing Time	≥ 96 hrs	**Moisture Contents**	
Swell / Soaking Period	3.5 % - 4 Days	At Compaction	22.8 %
Surcharge	4.5 kg	After Soaking	26.5 %
Seating Load	0.050 kN	After Penetration	
Maximum Penetration	12.5 mm	Top 30 mm	34.2 %
		Remaining Depth	26.5 %
Dry Density			
At Compaction	1.54 t/m³	**Lab Density Ratio**	99.0% MDD
After Soaking	1.49 t/m³	**Lab Moisture Ratio**	99.0 % OMC



NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*
Date issued: 28/04/2022

CBR Test Report

Geotesta Pty Ltd
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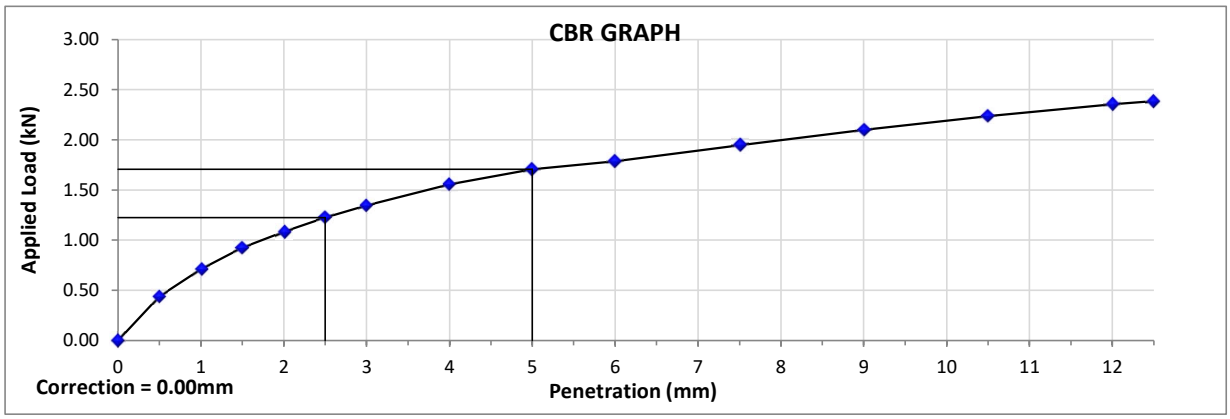
Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigation*	**Client**	*Bathla Group*
Report No	*S0417*	**Project No**	*NE1169*	**Client ID**	*-*
Sample ID	*SL1061-S0417*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH1@0.40-1.00*				

Base Site: *9 Redwood Drive, Notting Hill, VIC 3168* **Branch Site:** *6/20-22 Foundry Road, Seven Hills, NSW 2147*

Sample Description *silty Clay, brown*
Sampling Method *CLIENT*

Test performed according to AS 1289 - 6.1.1. Moisture content performed according to AS 1289 - 2.1.1.

California Bearing Ratio	9 %	**Compactive Effort**	AS1289 - 5.1.1 (Standard)
Penetration Depth	2.5 mm	Rammer Mass	2.7 kg
Maximum Standard Dry Density	1.74 t/m³	Drop Height	300 mm
Optimum Moisture Content	17.5 %	No. Layers	3
Retained 19.0mm oversize	0 %	No. Blows/Layer	50
Oversize material not replaced			
Curing Time	≥ 96 hrs	**Moisture Contents**	
Swell / Soaking Period	1.0 % - 4 Days	At Compaction	17.0 %
Surcharge	4.5 kg	After Soaking	19.0 %
Seating Load	0.050 kN	After Penetration	
Maximum Penetration	12.5 mm	Top 30 mm	20.4 %
		Remaining Depth	18.5 %
Dry Density			
At Compaction	1.73 t/m³	**Lab Density Ratio**	99.5% MDD
After Soaking	1.72 t/m³	**Lab Moisture Ratio**	97.5 % OMC



NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

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Date issued: 28/04/2022

Compaction Test Report

Geotesta Pty Ltd
9 Redwood Drive, Notting Hill
VIC 3168
T. 03 9562 9135

Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigatio*	**Client**	*Bathla Group*
Report No	*S0416*	**Project No**	*NE1169*	**Client ID**	*-*
Sample ID	*SL1061-S0416*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location	*BH4@0.30-0.70*				
Base Site:	*9 Redwood Drive, Notting Hill, VIC 3168*			**Branch Site:**	*6/20-22 Foundry Road, Seven Hills, NSW 2147*

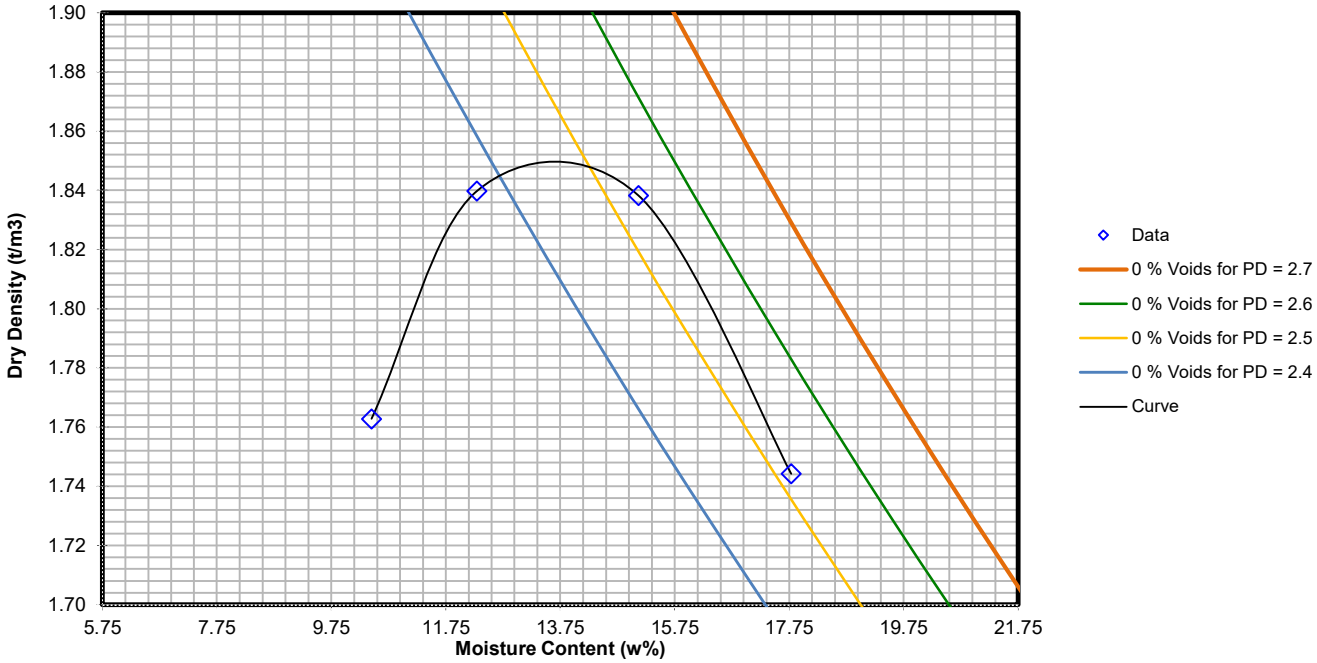
Sample Description *silty Clay, brown*

Sample submitted by Client *CLIENT*

Test method: AS 1289 5.1.1 - Standard Compaction

Maximum dry density: 1.85 t/m3

Optimum moisture content at maximum dry density: 14.0 %



Comments Curing time: 5 days

Material retained on the 19.0 mm sieve 0 %

Material retained on the 37.5 mm sieve 0 %

NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*

Date issued: 28/04/2022

Compaction Test Report

Geotesta Pty Ltd
9 Redwood Drive, Notting Hill
VIC 3168
T. 03 9562 9135

Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigatio*	**Client**	*Bathla Group*
Report No	*S0415*	**Project No**	*NE1169*	**Client ID**	-
Sample ID	*SL1061-S0415*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location	*BH3@0.40-0.70*				
Base Site:	*9 Redwood Drive, Notting Hill, VIC 3168*			**Branch Site:**	*6/20-22 Foundry Road, Seven Hills, NSW 2147*

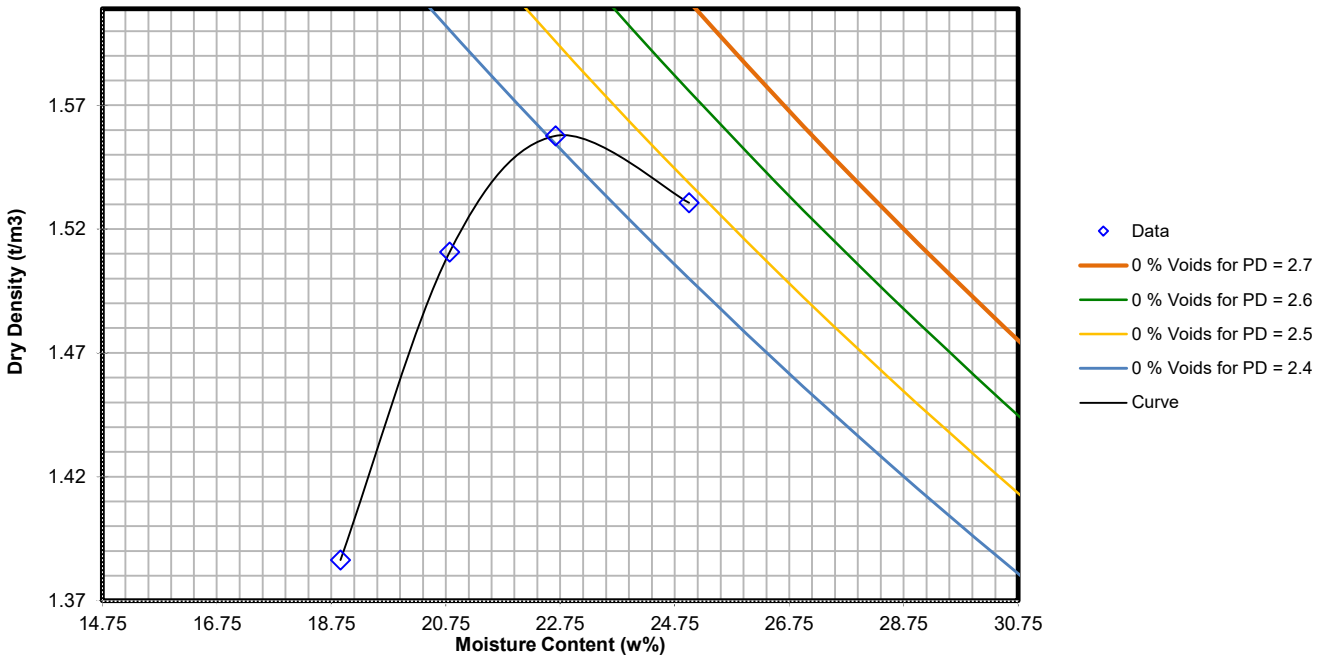
Sample Description *silty Clay, brown*

Sample submitted by Client *CLIENT*

Test method: AS 1289 5.1.1 - Standard Compaction

Maximum dry density: 1.56 t/m3

Optimum moisture content at maximum dry density: 23.0 %



Comments curing time 5 days

Material retained on the 19.0 mm sieve 0 %

Material retained on the 37.5 mm sieve 0 %

NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*

Date issued: 28/04/2022

Compaction Test Report

Geotesta Pty Ltd
9 Redwood Drive, Notting Hill
VIC 3168
T. 03 9562 9135

Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigatio*	**Client**	*Bathla Group*
Report No	*S0414*	**Project No**	*NE1169*	**Client ID**	-
Sample ID	*SL1061-S0414*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location	*BH1@0.40-1.00*				

Base Site: *9 Redwood Drive, Notting Hill, VIC 3168* **Branch Site:** *6/20-22 Foundry Road, Seven Hills, NSW 2147*

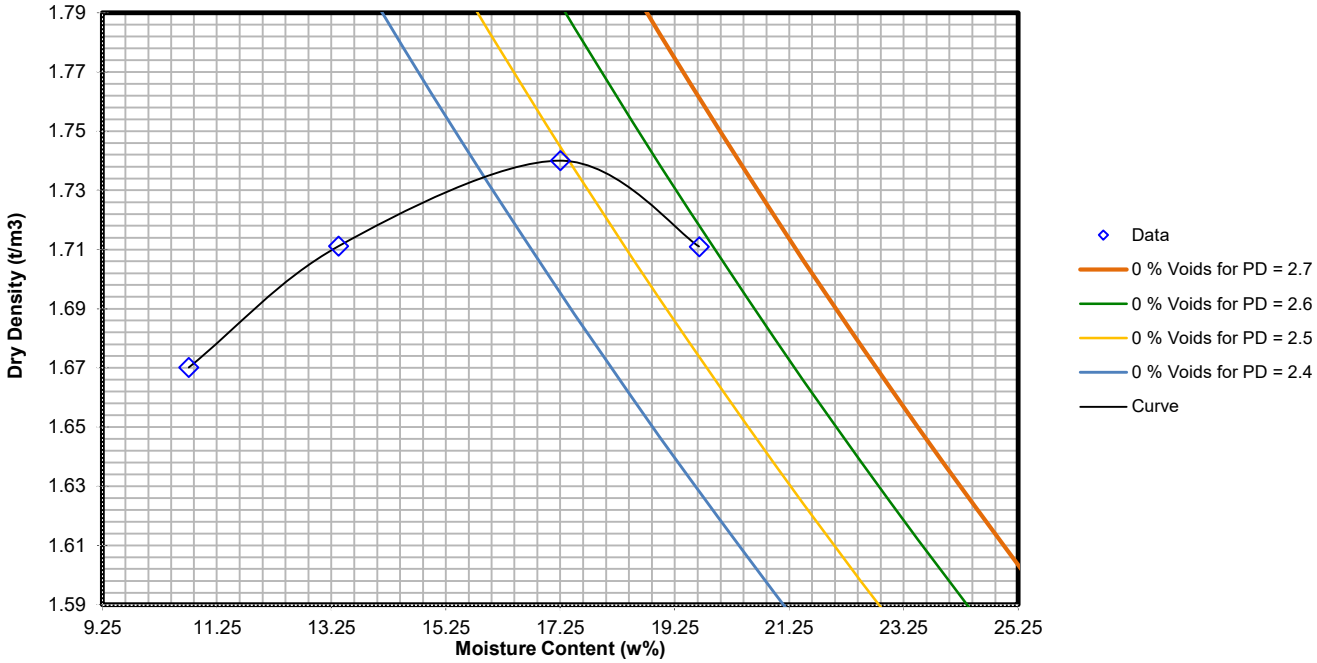
Sample Description *silty Clay, brown*

Sample submitted by Client *CLIENT*

Test method: AS 1289 5.1.1 - Standard Compaction

Maximum dry density: $1.74 t/m3

Optimum moisture content at maximum dry density: : 17.5 %



Comments curing time 5 days

Material retained on the 19.0 mm sieve 0 %

Material retained on the 37.5 mm sieve 0 %

NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*

Date issued: 28/04/2022

Atterberg Limits
Plasticity Index & Linear Shrinkage
Test Report

GEOTESTA Pty Ltd
9 Redwood Drive
Notting Hill , Vic 3168
Ph: 1300 852216

Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigation*	**Client**	*Bathla Group*
Report No	*S0412*	**Project No**	*NE1169*	**Client ID**	-
Sample ID	*SL1061-S0412*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH3@0.80*				

Base Site: *9 Redwood Drive, Notting Hill, VIC 3168* **Branch Site:** *6/20-22 Foundry Road, Seven Hills, NSW 2147*

Sample Description *silty Clay,medium plasticity, brown*

Sampling Method *CLIENT*

Results

Liquid limit	41 %	AS 1289-3.1.2
Plastic limit	20 %	AS 1289-3.2.1
Plasticity index	21 %	AS 1289-3.3.1
Linear shrinkage	8.5 %	AS 1289-3.4.1
Shrinkage type	-	

Preparation

History of sample:	Oven-dried ≤ 50 ºC
Method of preparation:	Dry Sieving
Linear shrinkage mould:	250 mm

Comments

Test methods: AS 1289, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*

Date issued: 26/04/2022

Atterberg Limits
Plasticity Index & Linear Shrinkage
Test Report

GEOTESTA Pty Ltd
9 Redwood Drive
Notting Hill , Vic 3168
Ph: 1300 852216

Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigation*	**Client**	*Bathla Group*
Report No	*S0413*	**Project No**	*NE1169*	**Client ID**	-
Sample ID	*SL1061-S0413*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH4@0.60*				

Base Site: *9 Redwood Drive, Notting Hill, VIC 3168* **Branch Site:** *6/20-22 Foundry Road, Seven Hills, NSW 2147*

Sample Description *silty Clay, medium plasticity, brown*

Sampling Method *CLIENT*

Results

Liquid limit	45 %	AS 1289-3.1.2
Plastic limit	19 %	AS 1289-3.2.1
Plasticity index	26 %	AS 1289-3.3.1
Linear shrinkage	8.5 %	AS 1289-3.4.1
Shrinkage type	cracked	

Preparation

History of sample:	Oven-dried ≤ 50 ºC
Method of preparation:	Dry Sieving
Linear shrinkage mould:	250 mm

Comments

Test methods: AS 1289, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*

Date issued: 22/04/2022

Atterberg Limits
Plasticity Index & Linear Shrinkage
Test Report

GEOTESTA Pty Ltd
9 Redwood Drive
Notting Hill , Vic 3168
Ph: 1300 852216

Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigation*	**Client**	*Bathla Group*
Report No	*S0411*	**Project No**	*NE1169*	**Client ID**	-
Sample ID	*SL1061-S0411*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH2@0.60*				

Base Site: *9 Redwood Drive, Notting Hill, VIC 3168* **Branch Site:** *6/20-22 Foundry Road, Seven Hills, NSW 2147*

Sample Description *silty Clay, high plasticity, pale brown*

Sampling Method *CLIENT*

Results

Liquid limit	71 %	AS 1289-3.1.2
Plastic limit	30 %	AS 1289-3.2.1
Plasticity index	42 %	AS 1289-3.3.1
Linear shrinkage	13 %	AS 1289-3.4.1
Shrinkage type	Cracked	

Preparation

History of sample:	Oven-dried ≤ 50 ºC
Method of preparation:	Dry Sieving
Linear shrinkage mould:	250 mm

Comments

Test methods: AS 1289, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*

Date issued: 26/04/2022

Atterberg Limits
Plasticity Index & Linear Shrinkage
Test Report

GEOTESTA Pty Ltd
9 Redwood Drive
Notting Hill , Vic 3168
Ph: 1300 852216

Laboratory	*Geotesta*	**Project Type**	*Geotechnical Investigation*	**Client**	*Bathla Group*
Report No	*S0410*	**Project No**	*NE1169*	**Client ID**	-
Sample ID	*SL1061-S0410*	**Project**	*412-414 Cessnock road*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH1@0.50*				

Base Site: *9 Redwood Drive, Notting Hill, VIC 3168* **Branch Site:** *6/20-22 Foundry Road, Seven Hills, NSW 2147*

Sample Description *silty Clay, high plasticity, dark brown*

Sampling Method *CLIENT*

Results

Liquid limit	52 %	AS 1289-3.1.2
Plastic limit	21 %	AS 1289-3.2.1
Plasticity index	30 %	AS 1289-3.3.1
Linear shrinkage	12 %	AS 1289-3.4.1
Shrinkage type	cracked	

Preparation

History of sample:	Oven-dried ≤ 50 ºC
Method of preparation:	Dry Sieving
Linear shrinkage mould:	250 mm

Comments

Test methods: AS 1289, 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

NATA Accredited Facility No. 19167

Accredited for compliance with ISO/IEC 17025 - Testing

The results obtained in this report correspond exclusively to the sample(s) tested.

Report issued by: *Chandana Liyanage*

Date issued: 26/04/2022

eurofins | Environment Testing

Certificate of Analysis

Geotesta Pty Ltd (NSW)
Unit 6, 20/22 Foundry 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, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **- Mohammad Hossein Bazyar**

Report **880914-S**
Project name 412-414 CESSNOCK ROAD GILLESTON HEIGHTS
Project ID NE1169
Received Date Apr 14, 2022

Client Sample ID			**S1-BH1**	**S2-BH2**	**S3-BH3**	**S4-BH4**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S22-Ap0037028**	**S22-Ap0037029**	**S22-Ap0037030**	**S22-Ap0037031**
Date Sampled			**Apr 14, 2022**	**Apr 14, 2022**	**Apr 14, 2022**	**Apr 14, 2022**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	16	19	120	170
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	30	41	110	180
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	5.9	5.4	5.5	5.6
Resistivity*	0.5	ohm.m	340	240	87	55
Sulphate (as SO4)	10	mg/kg	46	110	84	210
% Moisture	1	%	13	21	11	12

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	Apr 20, 2022	28 Days
- Method: LTM-INO-4270 Anions by Ion Chromatography			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	Apr 20, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	Apr 20, 2022	7 Days
- Method: LTM-GEN-7090 pH by ISE			
Sulphate (as SO4)	Sydney	Apr 20, 2022	28 Days
- Method: In-house method LTM-INO-4270 Sulphate by Ion Chromatograph			
% Moisture	Sydney	Apr 19, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins | Environment Testing

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ABN: 50 005 085 521

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Girraween NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

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Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

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46-48 Banksia Road
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NATA # 2377 Site # 2370

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43 Detroit Drive
Rolleston, Christchurch 7675
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IANZ # 1290

Company Name: Geotesta Pty Ltd (NSW)
Address: Unit 6, 20/22 Foundry Road
Seven Hills
NSW 2147

Project Name: 412-414 CESSNOCK ROAD GILLESTON HEIGHTS
Project ID: NE1169

Order No.:
Report #: 880914
Phone: 1300852 216
Fax:

Received: Apr 14, 2022 9:13 AM
Due: Apr 26, 2022
Priority: 5 Day
Contact Name: - Mohammad Hossein Bazyar

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA # 1261 Site # 1254							
Sydney Laboratory - NATA # 1261 Site # 18217						X	X
Brisbane Laboratory - NATA # 1261 Site # 20794							
Mayfield Laboratory - NATA # 1261 Site # 25079							
Perth Laboratory - NATA # 2377 Site # 2370							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	S1-BH1	Apr 14, 2022		Soil	S22-Ap0037028	X	X
2	S2-BH2	Apr 14, 2022		Soil	S22-Ap0037029	X	X
3	S3-BH3	Apr 14, 2022		Soil	S22-Ap0037030	X	X
4	S4-BH4	Apr 14, 2022		Soil	S22-Ap0037031	X	X
Test Counts						4	4

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.

Units

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

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - 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.
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.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

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%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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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. 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.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. 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			%	104			70-130	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)			%	106			70-130	Pass	
Resistivity*			%	106			70-130	Pass	
Sulphate (as SO4)			%	113			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Chloride	S22-Ap0037029	CP	%	105			70-130	Pass	
Sulphate (as SO4)	S22-Ap0037029	CP	%	112			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S22-Ap0037028	CP	mg/kg	16	16	2.0	30%	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	S22-Ap0037028	CP	uS/cm	30	29	<1	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	S22-Ap0037028	CP	pH Units	5.9	5.6	<1	30%	Pass	
Resistivity*	S22-Ap0037028	CP	ohm.m	340	340	<1	30%	Pass	
Sulphate (as SO4)	S22-Ap0037028	CP	mg/kg	46	46	<1	30%	Pass	
% Moisture	S22-Ap0036768	NCP	%	31	30	4.0	30%	Pass	

Comments

Sample Integrity

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

Authorised by:

Asim Khan	Analytical Services Manager
Roopesh Rangarajan	Senior Analyst (NSW)
Ryan Phillips	Senior Analyst (NSW)

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

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

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