GEOTECHNICAL SITE INVESTIGATION

PROJECT: 131 Wollombi Road, Farley, NSW 2320

CLIENT: Bathla Group

DATE: 6 September 2022

REPORT No.: NE1372

GEOTESTA

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Table of Contents

Table Index

Figures

Appendixes

Laboratory Test Results

1. INTRODUCTION

Geotesta was engaged by Bathla Group to conduct a geotechnical site investigation at 131 Wollombi Road, Farley, NSW 2320. 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 12th July 2022.

The field work was carried out on 05th August 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 recommendations.

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)

2. FIELD INVESTIGATION

The investigation involves drilling three (3) boreholes (BH1–BH3) to a maximum depth of 2.2m due to auger refusal. The boreholes' location was determined by Geotesta, according to site accessibility and the locations of underground services.

A site plan showing the boreholes location is presented in Figure 1. Borehole drilling was carried out using a Ute-mounted drilling rig using a solid flight auger method. 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 borehole, 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.

Figure 1: Site Plan and Boreholes

3. FINDINGS

3.1 Site Condition and topography

The investigation site at 131 Wollombi Road, Farley, NSW 2320 with an area of approximately 17,000 m^2 is located within Maitland City Council. The site is bounded by Wollombi Road to the north, a residential dwelling to the west, and vacant lands to the south and the east. At the time of the investigation, a single-story residential dwelling is located at the northwest corner.

Regional topographic maps indicate that the site is approximately 11-17m AHD and slopes down towards the east with slope angle < 4^0.

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 Newcastle-Hunter Area 1:100 000, Coastal Quaternary Geology Map (2016) indicates the site is situated in Dalwood Group (Pda) comprising of sandstone, lithic sandstone, conglomerate, siltstone, and basalt. The geology map of the site and surrounding areas is shown in Figure 2.

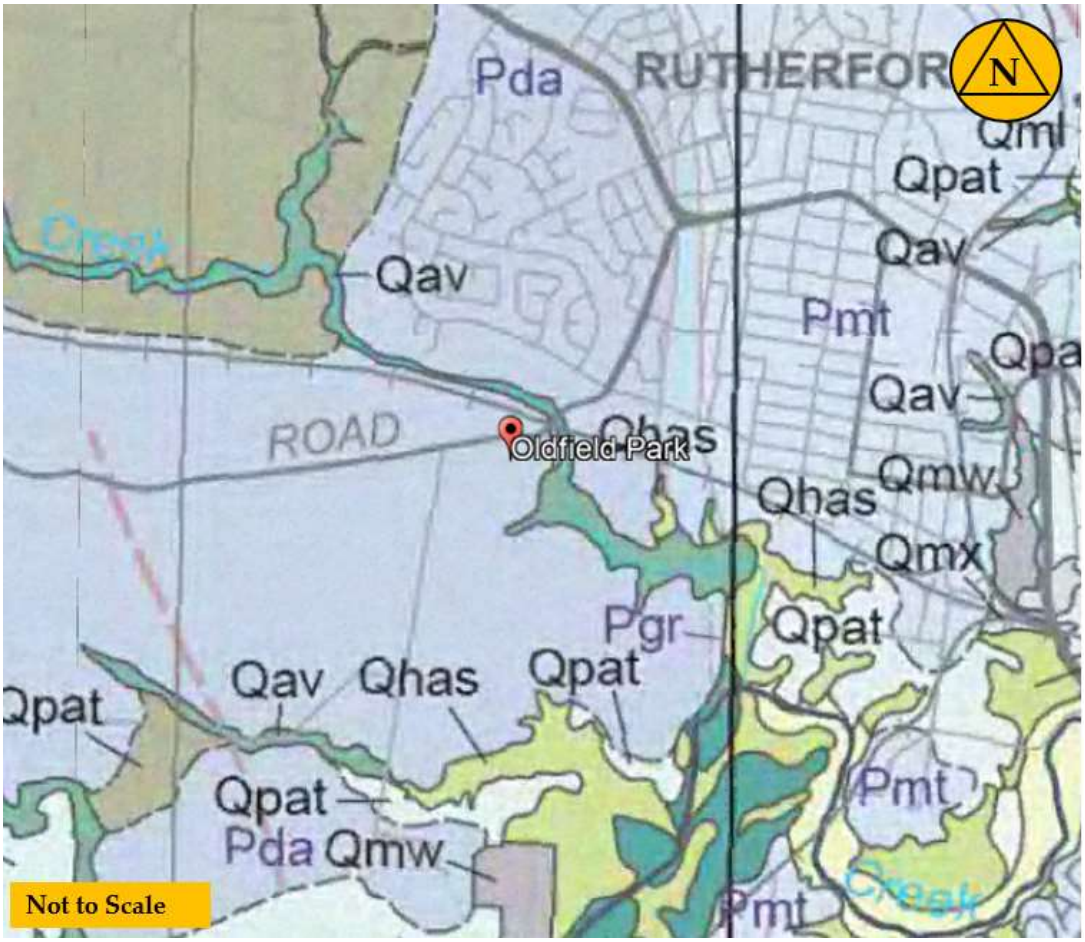

Figure 2: Geology Map of Site and surrounding area

3.3 Soil/Rock Profile

Information gathered from the geotechnical fieldwork indicates that the site is overlain by topsoil/fill to a maximum depth of 0.6m. This layer is underlain by natural soil comprising firm to hard Silty CLAY to the depths ranging from 0.8 to 1.4m. Very low strength, extremely weathered Sandstone bedrock was encountered during the investigation at boreholes BH1 and BH2 from a depth of 1.9m. The encountered soil profiles are presented in the borehole logs in Appendix A and tabulated in detail in Table 1. The boreholes ground surface elevation is also depicted in Table 1.

Table 1: Summary of Sub-surface Materials

Unit	Material	Approximate Depth range of Unit (mBGL*)			Description
		BH1 (RL 13.0)	BH2 (RL 11.0)	BH3 (RL 14.0)	
1	TOPSOIL/FILL	0.0-0.3	0.0-0.4	0.0-0.4	-
2	Silty SAND	0.3-1.3	0.4-0.8	0.4-0.8	Loose
3A	Silty CLAY	1.3-1.7	0.8-1.6	0.8-1.6	Stiff to Very Stiff
3B	Silty CLAY	1.7-1.9	1.6-2.0	1.6-2.0	Hard
4	SANDSTONE	Below 1.9	Below 2	Below 2.0	Very Low Strength, Extremely Weathered

**Measured from the existing ground surface*

3.4 Site Classification

Three (3) soil samples were taken from the natural Silty CLAY soil in all boreholes 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	1.4	Silty CLAY	47	18	29	9.0
BH2	1.2	Silty CLAY	63	20	43	12.0
BH3	0.8	Silty CLAY	60	22	38	14.0

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

Atterberg limit test results indicate that the natural Silty CLAY at the site is a medium to high plasticity soil.

After considering the area geology, the soil profile encountered in the bores, the site is classified as **CLASS 'H1'** with respect to foundation construction (Australian Standard 2870-2011 Residential Slabs and Footings). We assume topsoil/fill materials will be removed and natural Silty Clay (Unit 3) ground will be exposed.

It has been estimated that the Characteristic Surface Movement (ys) of the underlying natural soil material will be in the range of 40-60mm 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 considering 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 boreholes to 2.2m below the ground surface.

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 area 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]
S4-BH101	0.011	0.099	Non-Saline
S5-BH102	0.07	0.63	Non-Saline
S6-EBH1	0.014	0.126	Non-Saline
S7-EBH2	0.12	1.08	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.

3.7.2 Aggressivity assessment

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

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

Sample ID	pH (1:5 Aqueous extract)	Sulphate (SO4) (mg/kg)	Chloride (mg/kg)	Aggressivity assessment[1] concrete	Aggressivity assessment[1] steel
S4-BH101	6.7	15	17	Non-aggressive	Non-aggressive
S5-BH102	6.4	180	130	Non-aggressive	Non-aggressive
S6-EBH1	6.4	10	10	Non-aggressive	Non-aggressive
S7-EBH2	6.0	110	110	Non-aggressive	Non-aggressive

[1]In accordance with AS2159 (2009)

Referring to the above test results, the site is considered non-aggressive to concrete and steel.

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

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

4. FOUNDATION RECOMMENDATIONS

4.1 Geotechnical Design Parameters

The estimated geotechnical parameters of the soil materials encountered below the site is provided in Table 5:

Table 5: Estimated Geotechnical Design Parameters

Unit/ Soil Type	γ (kN/m3)	Su (kPa)	c′ (kPa)	Φ′	E′ (MPa)	ν'
Unit 1/ Topsoil/ Fill (Silty SAND)	18	-	-	22	10	0.3
Unit 2/ Silty SAND (Loose)	18	-	-	28	12	0.3
Unit 3A/ Silty CLAY (Stiff to Very Stiff)	19	60	6	27	20	0.3
Unit 3B/ Silty CLAY (Hard)	20	200	10	28	60	0.3
Unit 4/ SANDSTONE (Class V)	24	-	100	30	300	0.3

4.2 Strip Footing

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

All footings for the same structure should be founded on strata of similar stiffness to minimize the risk of differential movements. We recommend that the designing engineer refer to AS2870-2011 to ensure the tolerable limits for differential movement.

As a guide with information obtained from the boreholes and DCP tests, the allowable bearing capacity for strip footings founding on the natural Silty CLAY and SANDSTONE at the test locations should be as follow:

Table 6: Allowable Bearing Capacity for Strip Footings

Capacity \ Materials	Unit 3A **Silty CLAY** (Stiff to Very Stiff)	Unit 3B **Silty CLAY** (Hard)	Unit 4 **SANTONE** (Class V)
Allowable Bearing Capacity (kPa)	120	350	800

It should be noted that the soil/rock 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.

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.

The settlement of a footing is dependent on the load applied to the footing and the foundation conditions below the footing. However, it can be expected that the settlement of a strip footing designed using the parameters in Table 6 will be ≤ 1% of the footing width.

4.3 Bored or Screw Piles

Bored piles can be used to support the proposed development. The piles should be founded into SANDSTONE bedrock to gain high pile capacity and minimise absolute and differential settlements. It should be note that to minimise the risk of differential settlements, all piles in a building should be founded on strata of similar stiffness.

The piles should embed at least four (4) pile diameter into the founding material for the utilisation of adhesion for the embedment in the respective materials. The allowable end bearing capacities and allowable shaft adhesions of class V SANDSTONE presented in Table 7.

Table 7: Allowable Skin Friction and End Bearing Capacity

Capacity \ Materials	Unit 3A **Silty CLAY** (Stiff to Very Stiff)	Unit 3B **Silty CLAY** (Hard)	Unit 4 SANTONE (Class V)
Allowable Shaft Adhesion (kPa)	10 kPa	30 kPa	50 kPa
Allowable End Bearing Capacity (kPa)	-	-	800 kPa

**Minimum embedment depths of one (1) and three (3) pile diameters into the founding material are necessary to achieve these allowable design values for end bearing and adhesion, respectively*
50% of the shaft adhesion in compression can be adopted for the shaft adhesion in tension.

For limit state design, AS2159-2009 "Piling - Design and Installation" specifies that the ultimate geotechnical pile capacity is multiplied by a geotechnical reduction factor (Φgb). The geotechnical reduction factor is derived from an Average Risk Rating (ARR) that takes into account geotechnical uncertainties, redundancy of the foundation system, construction supervision, and quantity and type of pile testing.

The designer must determine the Average Risk Rating and the corresponding geotechnical strength reduction factor once all details of the design methods and installation requirements have been identified.

At this stage, we cannot accurately calculate the geotechnical strength reduction factor due to our lack of knowledge of design and installation factors. Our estimates of the Average Risk Rating and geotechnical strength reduction factor are based on the following assumptions:

- Designer has experience with similar foundations under similar geological conditions.
- The design method used is well established and soundly based.
- The use of in-situ test results is based on indirect measurements obtained during installation rather than static load tests.
- Detailed level of construction control with professional geotechnical supervision.
- Post-construction monitoring is not undertaken.
- The pile foundation of the proposed structure is assumed to be a high redundancy system.

Based on the above assumptions and our geotechnical knowledge, we estimate an ARR of 2.5 using Equation 4.3.2 and Table 4.3.2(A) of AS2159-2009. Thus, the overall risk category is Low resulting in a geotechnical strength reduction factor (Φgb) of 0.64 for high redundancy systems can be adopted, as detailed in Table 4.3.2(C) of AS2159-2009.

5. EXCAVATION, EARTHWORKS, RETAINING WALL & LATERAL EARTH PRESSURES

5.1 Site Preparation

The depth of topsoil/fill varies across the site up to a depth of 0.4m. Any 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.
- 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.

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

5.2 Excavation

Based on the soil/bedrock profile and conditions encountered at the borehole locations, light excavation machinery should be adequate for the footing excavations into the Unit 1-3 (Topsoil/Fill, Silty SAND, and Silty CLAY), should be comparable with Soft to Intermediate Excavation Classes as per SANS 1200D. Table 8 describes the excavation classes as per SANS 1200D. Excavations into the Unit 4 SANDSTONE (below 1.9m) will encounter Intermediate to Hard excavation conditions per SANS 1200D (see Table 8).

Table 8: 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.

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.

5.3 Engineered Fill

Controlled or Rolled fill can be constructed in uniform layers to provide the required design level in accordance with the project foundation design requirements (if applicable). Controlled/Rolled fill must be well compacted in layers not exceeding 200 mm 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 a minimum of 98% Standard Maximum Dry Density (SMDD) ratio determined in accordance with AS 1289.5.4.1.

Generally, the soils encountered on site will be suitable for reuse as engineered fill within the site. The natural clayey soils are best suited for bulk filling within site. The material should not contain any particle sizes greater than 150 mm. It is expected that bedrock of low strength or less (if applicable) should readily break down beneath the

weight of the rollers, however, bedrock of medium strength or higher may potentially need to be crushed using a rock crusher.

5.4 Temporary Cut Batters

Temporary unsupported excavation up to 1.5m deep within the existing Unit 2/3 Silty SAND and Silty CLAY layers should be no steeper than 1.5H:1V; Temporary unsupported cut batters more than 1.5m up to 3.0m deep within the existing Unit 3 Silty CLAY should not be steeper than 2H:1V.

The above recommendations assume that there is no existing structure directly adjacent to the excavation area. 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
- 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.

5.5 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 are summarised below:

• 1 test per layer per 500 m^2; or

• 1 test per 100 m^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.

5.6 Retaining Walls

Any proposed retaining walls at the site should be engineer designed adopting the geotechnical parameters summarised in Table 9 below.

Table 9: Retaining wall design parameters

Unit/ Soil Type	γ (kN/m3)	K_0	K_a	K_P/Ultimate passive earth pressure
Unit 1/ Topsoil/ Fill	18	0.63	0.45	2.22
Unit 2/ Silty SAND (Loose)	18	0.53	0.36	2.77
Unit 3A/ Silty CLAY (Stiff to Very Stiff)	19	0.55	0.38	2.63
Unit 3B/ Silty CLAY (Hard)	20	0.53	0.36	2.78
Unit 4/ SANDSTONE (Class V)	24	0.43	0.27	300kPa

For construction methods which minimise deflection and where restraint is applied via struts, bracings or anchors, the temporary or short-term lateral earth pressure distribution should be approximated as a trapezoidal "at-rest" distribution for the site clay soils. For the at-rest condition, the maximum lateral earth pressure may be estimated by a trapezoidal distribution with a maximum lateral earth pressure of 9H kPa beginning at a depth of 0.20H to a depth of 0.80H and reducing linearly to zero (0) at the top and bottom of the wall. For basement walls where wall deflections are not critical (an "active" condition), the maximum lateral earth pressure may be estimated by a trapezoidal distribution with a maximum lateral earth pressure of 5H kPa beginning at a depth of 0.30H to a depth of 0.80H and reducing linearly to zero (0) at the top and bottom of the wall.

It must be emphasised that where adjoining footings exist near the retaining walls, the "at rest" earth pressures must be maintained, and the active design condition is not appropriate.

DOCUMENT CONTROL

Date	Version	Report Prepared By:	Report Reviewed by:
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6. 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.
- Troedson A.L. & Deyssing L. 2016. Newcastle-Hunter Area 1:100 000, Coastal Quaternary Geology Map Series. Geological Survey of New South Wales, Maitland.

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.

Appendix A

Borehole Logs

BOREHOLE LOG

BOREHOLE No: BH1

Client:	The Bathla Group	Drilling Co:	Geotesta Pty Ltd	Easting:	---
Project:	131 Wollambi Road, Farley	Driller:	M.A	Northing:	---
Job No:	NE1372	Rig Type:	Ute Mounted	Grid Ref:	See Figure 1
Location:	131 WOLLOMBI ROAD, FARLEY NSW,	Inclination:	Vertical	Collar RL:	
Date Drilled:	5/08/2022	Bearing:	Vertical	Logged by:	E 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
	Solid Flight Auger		FILL	**TOPSOIL/FILL:** Clayey SAND, dark brown, trace of rootlets	M		2 2 4				
0.50			SM	Silty **SAND**, medium grained, Brown	M	L	2 2 3 3 3 2 3 2 3 2				0.50
1.00											1.00
1.50			CI	Silty **CLAY**: medium plasticity, pale brown	M	ST VST H	3 4 8 9 11 20	S1 @ 1.8m			1.50
2.00			SS	**SANDSTONE**, medium grained, Brown to yellow, extremely weathered, very low strength				DCP refusal at 1.9m, 20 blows			2.00
2.50				Borehole terminated at 2.1m due to auger refusal							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

soil classification:

soil is classified in accordance with AS1726 unless otherwise noted

sampling / testing:

intact sample from core

Standard Penetration Test

T intact tube sample

B Bulk sample

Supp Su from Pocket Penetrometer

Suv Su from Field Vane Shear test

Notes:

BOREHOLE LOG

BOREHOLE No: BH2

Client:	The Bathla Group	Drilling Co:	Geotesta Pty Ltd	Easting:	---
Project:	131 Wollambi Road, Farley	Driller:	M.A	Northing:	---
Job No:	NE1372	Rig Type:	Ute Mounted	Grid Ref:	See Figure 1
Location:	131 WOLLOMBI ROAD, FARLEY NSW,	Inclination:	Vertical	Collar RL:	
Date Drilled:	5/08/2022	Bearing:	Vertical	Logged by:	E 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
	Solid Flight Auger		FILL	**TOPSOIL**/FILL**:** Silty SAND, dark brown, trace of gravel and rootlets			1 1 1 2				
0.50			SM	Silty **SAND**, medium grained, Brown grey		L	3 3 2 2	S1 @ 0.7m			0.50
1.00			CH	Silty **CLAY**: high plasticity, brown		F ST VST	2 3 3 5 7 6 9 9				1.00
1.50						H	12 12				1.50
2.00				Grades: mottled pale grey, with sandstone fragments			20	DCP refusal at 0.8m, 20 blows			2.00
			SS	**SANDSTONE**, medium grained, Brown to yellow extremely weathered, very low strength							
2.50				Borehole terminated at 2.2m due to auger refusal							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 (T); 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: 3 of 3

Client:	The Bathla Group	Drilling Co:	Geotesta Pty Ltd	Easting:	---
Project:	131 Wollambi Road, Farley	Driller:	M.A	Northing:	---
Job No:	NE1372	Rig Type:	Ute Mounted	Grid Ref:	See Figure 1
Location:	131 WOLLOMBI ROAD, FARLEY NSW,	Inclination:	Vertical	Collar RL:	
Date Drilled:	5/08/2022	Bearing:	Vertical	Logged by:	E 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
0.00									
	Solid Flight Auger		FILL	**TOPSOIL**/FILL**:** Silty SAND, dark brown, trace of gravel and sandstone fragments and rootlets	M		1 1 1 2 3		
0.50			CH	Silty **CLAY**: high plasticity, brown mottled grey, trace sandstone fragments		ST VST H	4 4 5 6 10 10 16	S1 @ 0.9m	
1.00				Grades: mottled pale grey, with sandstone fragments					
			SS	**SANDSTONE**, medium grained, Brown to yellow, extremely weathered, very low strength			20		
1.50				Borehole terminated at 1.4m due to auger refusal					
2.00									
2.50									
3.00									
3.50									
4.00									
4.50									
5.00									

Water Levels	Depth (m)
0.00	
0.50	0.50
1.00	1.00
1.50	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 (T); 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

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	*S0847*	**Project No**	*NE1372*	**Client ID**	*-*
Sample ID	*SL1109-S0847*	**Project**	*131 WOLLAMBI ROAD FARLEY*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH3@0.80m*				

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,brown*

Sampling Method *CLIENT*

Results

Liquid limit	60 %	AS 1289-3.1.2
Plastic limit	22 %	AS 1289-3.2.1
Plasticity index	38 %	AS 1289-3.3.1
Linear shrinkage	14.0 %	AS 1289-3.4.1
Shrinkage type	Curling	

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: 16/08/22

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	*S0846*	**Project No**	*NE1372*	**Client ID**	*-*
Sample ID	*SL1109-S0846*	**Project**	*131 WOLLAMBI ROAD FARLEY*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH2@1.20m*				

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,brown grey*

Sampling Method *CLIENT*

Results

Liquid limit	63 %	AS 1289-3.1.2
Plastic limit	20 %	AS 1289-3.2.1
Plasticity index	43 %	AS 1289-3.3.1
Linear shrinkage	12.0 %	AS 1289-3.4.1
Shrinkage type	Curling	

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: 16/08/22

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	*S0845*	**Project No**	*NE1372*	**Client ID**	*-*
Sample ID	*SL1109-S0845*	**Project**	*131 WOLLAMBI ROAD FARLEY*	**Address**	*7 Business Park Drive, Notting Hill VIC 3168*
Location ID	*BH1@1.40m*				

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	47 %	AS 1289-3.1.2
Plastic limit	18 %	AS 1289-3.2.1
Plasticity index	29 %	AS 1289-3.3.1
Linear shrinkage	9.0 %	AS 1289-3.4.1
Shrinkage type	Curling	

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: 16/08/22

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 **912924-S**
Project name 131 WOLLAMBI ROAD FARLEY
Project ID NE1372
Received Date Aug 09, 2022

Client Sample ID			**S4-BH101**	**S5-BH102**	**S6-EBH1**	**S7-EBH2**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S22-Au0020815**	**S22-Au0020816**	**S22-Au0020817**	**S22-Au0020818**
Date Sampled			**Aug 08, 2022**	**Aug 08, 2022**	**Aug 08, 2022**	**Aug 08, 2022**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	17	130	< 10	110
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	11	70	14	120
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	6.7	6.4	6.4	6.0
Resistivity*	0.5	ohm.m	920	140	720	86
Sulphate (as SO4)	10	mg/kg	15	180	< 10	110
% Moisture	1	%	15	21	12	21

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	Aug 10, 2022	28 Days
- Method: LTM-INO-4270 Anions by Ion Chromatography			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Sydney	Aug 10, 2022	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25 °C as rec.)	Sydney	Aug 10, 2022	7 Days
- Method: LTM-GEN-7090 pH by ISE			
Sulphate (as SO4)	Sydney	Aug 10, 2022	28 Days
- Method: In-house method LTM-INO-4270 Sulphate by Ion Chromatograph			
% Moisture	Sydney	Aug 09, 2022	14 Days
- Method: LTM-GEN-7080 Moisture			

eurofins

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

Project Name: 131 WOLLAMBI ROAD FARLEY
Project ID: NE1372

Order No.:
Report #: 912924
Phone: 1300852 216
Fax:

Received: Aug 9, 2022 2:35 PM
Due: Aug 16, 2022
Priority: 5 Day
Contact Name: - Mohammad Hossein Bazyar

Eurofins Analytical Services Manager : Asim Khan

Sample Detail						CANCELLED	Aggressivity Soil Set	Moisture Set
Sydney Laboratory - NATA # 1261 Site # 18217						X	X	X
External Laboratory								
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**			
1	S1-BH1	Aug 08, 2022		Soil	S22-Au0020812	X		
2	S2-BH2	Aug 08, 2022		Soil	S22-Au0020813	X		
3	S3-BH3	Aug 08, 2022		Soil	S22-Au0020814	X		
4	S4-BH101	Aug 08, 2022		Soil	S22-Au0020815		X	X
5	S5-BH102	Aug 08, 2022		Soil	S22-Au0020816		X	X
6	S6-EBH1	Aug 08, 2022		Soil	S22-Au0020817		X	X
7	S7-EBH2	Aug 08, 2022		Soil	S22-Au0020818		X	X
Test Counts						3	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.

.

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			%	105			70-130	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)			%	98			70-130	Pass	
Resistivity*			%	98			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Chloride	S22-Au0016281	NCP	%	86			70-130	Pass	
Sulphate (as SO4)	S22-Au0016281	NCP	%	102			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	S22-Au0020815	CP	uS/cm	11	15	32	30%	Fail	Q15
pH (1:5 Aqueous extract at 25 °C as rec.)	S22-Au0020815	CP	pH Units	6.7	6.6	<1	30%	Pass	
Resistivity*	S22-Au0020815	CP	ohm.m	920	660	32	30%	Fail	Q02
% Moisture	S22-Au0020506	NCP	%	4.5	5.3	15	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

Qualifier Codes/Comments

Code	Description
Q02	The duplicate %RPD is outside the recommended acceptance criteria. Further analysis indicates sample heterogeneity as the cause
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised by:

Asim Khan	Analytical Services Manager
Dilani Samarakoon	Senior Analyst-Inorganic
Ryan Phillips	Senior Analyst-Inorganic

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.