GEOTECHNICAL AND SALINITY INVESTIGATION REPORT

ADDRESS: 146 Regent Street, Riverstone, NSW

CLIENT: The Bathla Group

DATE: 7 February 2018

REPORT NO: NE236

GEOTESTA

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1. INTRODUCTION

Geotesta was engaged by The Bathla Group to conduct geotechnical investigation and soil contamination assessment at 146 Regent Street, Riverstone NSW. The proposed development includes residential development.

The field work was carried out on 18 December 2017. This report presents the geotechnical investigation results including sub-surface soil profile with interpreted geotechnical properties of the assessed subsurface lithology, chemical analysis in relation to aggressivity, and recommendations on the design parameters of footing, geotechnical parameters including allowable bearing capacity, shaft friction, friction angle, cohesion, and young's modulus.

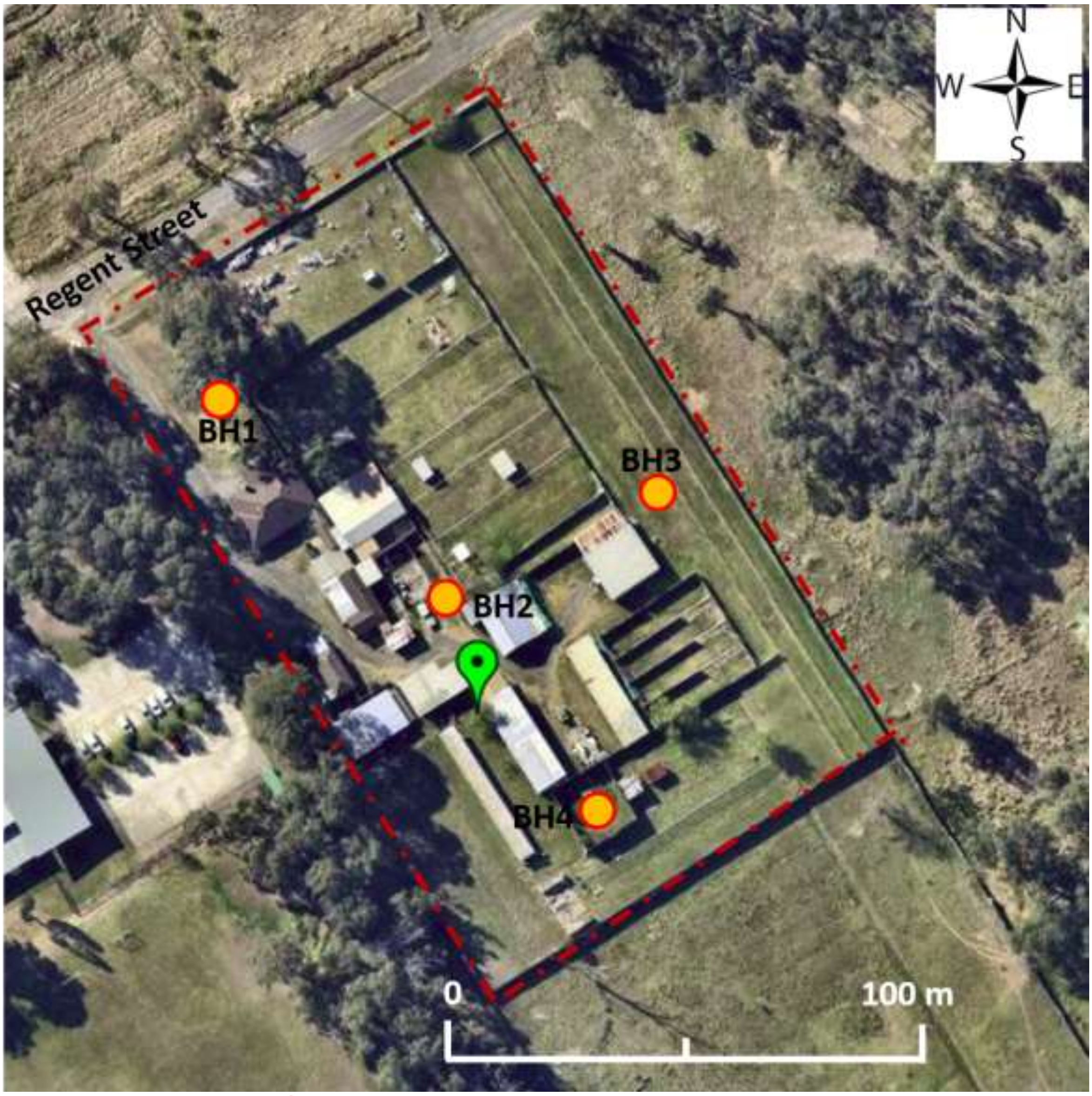
This assessment has been carried out in general accordance with the following guidelines:

- Salinity Code of Practice March 2003 (Amended January 2004);
- Australian Standard (AS) 3600 (2009), Concrete Structures

2. FIELD INVESTIGATION

The investigation involved drilling of total four (4) boreholes to a maximum depth of 3.0m and four (4) DCP tests beside the boreholes for the proposed residential development at 146 Regent Street, Riverstone, NSW. The area investigated is highlighted in Figure 1 within the red dash-and-dot line.
A site plan showing the borehole and DCP test locations is presented in Figure 1. Borehole drilling was undertaken using a drilling rig PIXY 41T. All boreholes were drilled using solid flight augering method.

The soil profiles encountered in the boreholes were logged by a Geotechnical Engineer from Geotesta in accordance with Australian Standard AS 1726-1993. All field observations are presented on the borehole logs attached in Appendix A.



Denotes borehole and DCP Test locations

Figure 1: Site Plan, Borehole and DCP test Locations

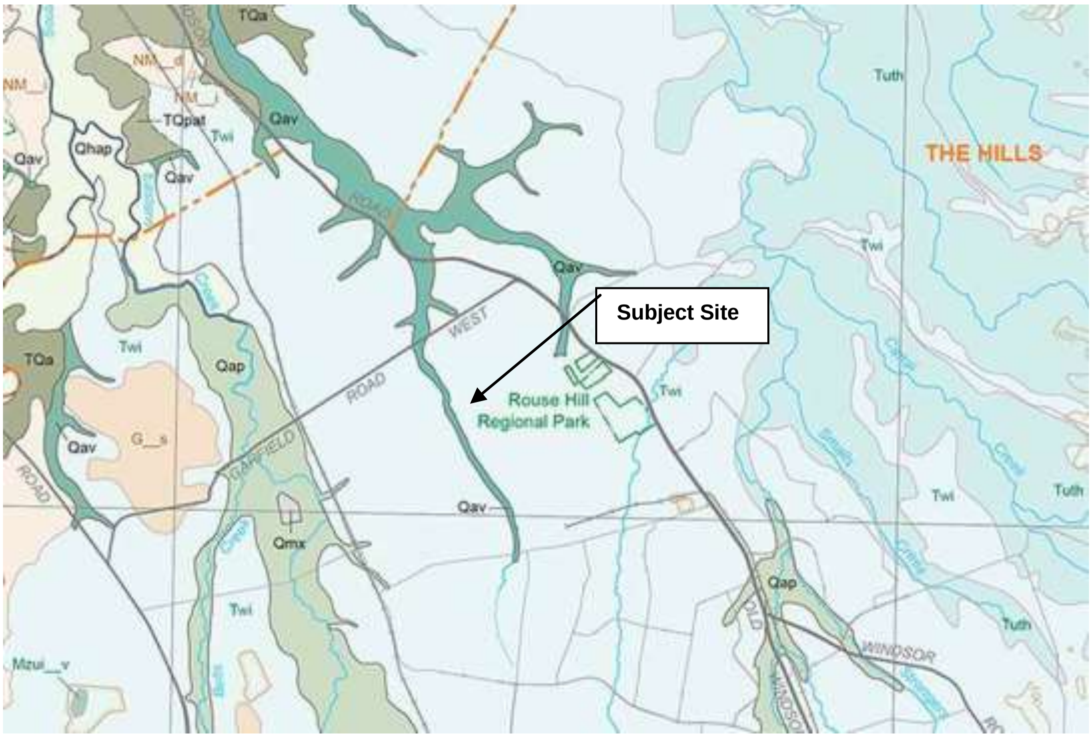
3. FINDINGS

3.1 Site Details, Location and Topography

The investigation area is situated at 146 Regent Street-Riverstone, NSW. The site under investigation is located on the southern side of Regent and, approximately 50 km (by road) northwest of Sydney CBD. The site location is shown in Figure 1. The proposed site at 146 Regent Street in Riverstone is very gently undulate and very gently sloping towards the east. The proposed site is a residential land with dwellings, sheds, grazing and farming facilities of rectangular shape with an area of approximately 16,000 square metres. Some of the surface is covered by short grass (2-10 cm) with few small to medium trees. Dwellings and sheds are still present onsite. The site is surrounded by Riverstone High School to the west, a vacant land to the south, Sydney Bee Farm to the east, and Regent Street to the north. Site lies at an elevation of approximately 35 metres Australian Height Datum (AHD) (http://en-au.topographic-map.com/maps).The site is within the Blacktown City Council Site.

3.2 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 siltstone, sandstone and shale of Wianamatta Group.



Geological Unit: *Wianamatta Group (Twi) - Sandstone, siltstone and shale; common bioturbation*

Figure 2: Geology Map of the Site with Package Code

3.2 Soil/Rock Profile

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

Table 1: Summary of Sub-Surface Materials

Borehole No.	Depth (m)	Soil/Rock Type	Consistency/ Class
BH 1	0.0-0.8	Sandy and Clayey SILT	Stiff to Hard
	0.8-1.4	Silty CLAY	Very Stiff
	1.4-1.5	Shale IV	Low Strength
BH 2	0.0-0.3	Sandy and Clayey SILT	Hard
	0.3-1.4	Silty CLAY	Very Stiff to Hard
	1.4-1.7	Shale V-IV	Very Low to Low Strength
BH 3	0.0-0.2	Clayey SILT	Very Stiff
	0.2-0.6	Silty CLAY	Very Stiff
	0.6-1.7	Shale V-IV	Very Low to Low Strength
BH 4	0.0-0.4	Sandy and Clayey SILT	Firm to Hard
	0.4-0.9	Silty CLAY	Very Stiff to Hard
	0.9-1.8	Shale V-IV	Very Low to Low Strength

3.3 Site Classification

After considering the area geology, the soil profile encountered in the bores; 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.

3.4 Groundwater

Groundwater was not encountered in any of the boreholes.

3.5 Geotechnical Laboratory Testing

One (1) representative soil sample was sent to the Soil Test Services NATA accredited laboratory for testing of index properties. The laboratory test results are summarised in Table 2.

Table 2: Summary of Soil Laboratory Test Results

Bore No.	Depth (m)	Soil Type	Wn %	LL %	PI %	LS %
BH2	1.0	Silty CLAY	38.0	21	17	8.0

Note: Wn= Moisture content; LL= Liquid Limit; PI= Plasticity Index; LS= Linear Shrinkage

3.6 Laboratory Testing and Analysis – Salinity

Total two (2) soil samples were submitted to Eurofin MGT Laboratory, a NATA accredited laboratory, for chemical testings. The testings were carried out for salinity classification 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.

Analysis Frequency	Analyses
2 Samples	Salinity suite including Electrical Conductivity (EC), pH, soluble SO4, and moisture

3.6.1 Salinity Classification

Laboratory test results for salinity classification 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)	Aggressivity Classification[2]
BH1 (0.5m)	0.35	2.45	Slightly saline
BH3 (1.0 m)	0.63	4.41	Moderately 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 7 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 slightly to moderately saline.

3.6.2 Exposure Classification

Sulphate and pH test results for exposure classification are summarised in Table 4.

Table 4: Exposure classification test results

Sample ID	pH (1:5 Aqueous extract)	Sulphate (SO_4) (mg/kg)	Exposure Classification[1]
BH1 (0.5 m)	7.9	66	A2
BH3 (1.0 m)	7.6	120	A2

[1]In accordance with AS3600 (2009)

3.6.3 Results – Exposure Classification

An exposure classification for concrete of A2 should be adopted for preliminary design of proposed concrete structures.

4. FOUNDATION RECOMMENDATION

4.1 Strip/Pad Footing System

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

The strip footings should be founded in the natural soil layer and 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 actual founding depth for strip/pad footings at the test locations should be as follow:

Table 5: Allowable Bearing Capacities for Pad/Strip Footings

Borehole No.	Founding Depth (mm)	Founding Material	Allowable Bearing Capacity (kPa)
BH1-BH4	500	Sandy and Clayey SILT	120 kPa
	1,000	Silty CLAY	180 kPa
	2,000	Silty CLAY and SHALE V-IV	250 kPa
	3,000	SHALE IV or better	600 kPa

The founding depth should be as stipulated above or to hard layer, whichever is encountered first. 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.

4.2 Slab on Ground

It is recommended that an engineer designed slab on ground 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.

The edge and load bearing beams for the slab footings should be founded in the natural soil layer and penetrate through any fill material, tree roots and founded at least 100 mm into the recommended founding material. As a guide with information obtained from the bores and DCP tests the actual founding depth for edge and load bearing beams at the test locations should be as follows:

Table 6: Geotechnical parameters for Slab on Ground Footings

Borehole No.	Founding Depth (mm)	Founding Material	Allowable Bearing Capacity (kPa)
BH1-BH4	500	Sandy and Clayey SILT	120 kPa
	1,000	Silty CLAY	180 kPa
	2,000	Silty CLAY and SHALE V-IV	250 kPa
	3,000	SHALE IV or better	600 kPa

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.

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.

4.3 Bored Piers or Screw Piles

Bored piers or Screw piles can be used to support the proposed residential units. The pier/pile foundation of the proposed structure is assumed to be a high redundancy system and the intrinsic test factor (ϕtf) is assumed to be equal to basic geotechnical strength reduction factor (ϕgb), 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.

Table 7: Allowable Skin Friction and End Bearing Capacity

Borehole No.	Depth (m)	Soil Type	Allowable Skin Friction (kPa)	Allowable End Bearing Capacity (kPa)
BH1 to BH4	0 - 0.7	Sandy and Clayey SILT	25	-
	0.7-1.5m	Silty CLAY and SHALE V-IV	50	-
	Below 1.5m	SHALE IV or better	100	750

4.3.1 Pile Construction Considerations

Where necessary and appropriate, at contractor's discretion, a temporary casing may be used to prevent the pile excavation from collapsing. The inside of the casing must be clean and free of any projections (such as weld backing bars) which could be an obstacle to the placing and positioning of the reinforcement cage for the piles. Temporary casings may be left in place provided that the minimum socket length is not cased and the minimum cover to reinforcement is maintained. Where a casing is left in place, gaps between the casing and the sides of excavations shall be filled with sand, and compact the sand by flooding. In the case of piles subject to high lateral loads (e.g. abutment piles and anchor pier piles), fill such gaps with a cementitious grout containing fine aggregates proportioned to produce a pourable liquid without segregation, with a compressive strength at 28 days not less than 10MPa when sampled and tested to Test Method RMS T375. Cement used for the grout must conform to Specification RMS 3211.

5. EXCAVATION, RETAINING WALL & LATERAL EARTH PRESSURES

5.1 Temporary Cut Batter and Excavation

Excavation in the stiff to very stiff silty clay can be undertaken to 1.0m depth without battering back. While for an excavation deeper than 1.0m, the cut batter should be no steeper than 1H: 1V. The above recommendations are based on the assumption that there is no existing structure adjacent to the excavation area. Even at the above cut batters it should be noted that following rainy periods, some degree of fretting and minor slumping could be anticipated.

Soft excavation condition is expected below approximately 2.0 to 3.0m depth. The table below describes the 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.

5.3 Lateral Earth Pressures

For minimum wall deflection, and for construction methods where restraint is applied via struts, bracing or anchors, the temporary or short-term lateral earth pressure distribution should approximate a trapezoidal distribution, in which a maximum pressure of 10H kPa is obtained at a depth of 0.25H, and where H is the total depth of the excavation to be retained.

For basement walls, where wall deflections are not critical, the maximum pressure may be reduced to 6H kPa.

The above parameters assume that the drained situation exists and that any adjacent surcharge loading be superimposed using an "at rest" earth pressure coefficient (Ko) of 0.57. It is emphasised that where adjoining footings exist, the "at rest" pressures must be maintained and the active design condition is not appropriate.

The lateral earth pressures can be estimated by adopting the following soil parameters, for retaining walls where the active earth pressure condition is permitted to be mobilised.

Table 8: Materials Strength Parameters for Retaining Wall Design

Borehole No.	Depth (m)	Soil/Rock Type	Unit Weight (kN/m³)	Cohesion, c′ (kPa)	Friction Angle ϕ′ (°)
BH 1-BH4	0 - 0.7	Sandy and Clayey SILT	18	-	28
	0.7-1.5m	Silty CLAY and SHALE V-IV	19	5	30
	Below 1.5m	SHALE IV or better	22	15	30

Note: *c′=effective cohesion; ϕ′=effective angle of friction*

5.4 Anchored Soldier Pile Retention Systems

The use of anchored secant or contiguous piles can be adopted for this site. In considering such a retention system, the following aspects should be taken into account in the design and construction of the proposed retaining walls:

- The anchors should be considered with earth pressure "at rest" condition as the design criteria.
- Additional reinforced Shotcrete layer should be applied to all the exposed faces of the basement excavation prior to the next level of excavation. Shotcrete should be applied before the bulk excavation exceeds a depth of approximately 1.0 meters. However, this may require review once the levels of adjoining footings are known.
- Excavation for the basement level should not extend more than 0.5 meters below the level of the ground anchors if they are used to maintain at rest earth pressures before the anchors are installed and fully pre-stressed.

5.7 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.

If the groundwater is encountered, then the earth retaining wall system should be designed as either an impermeable tank system with installation of contiguous piles or secant piles and additional impervious layer to prevent groundwater flow into the basement.

5.8 Basement Floor Construction

Provided that the basement excavation does not intersect the groundwater table and no hydrostatic pressures will be generated on the underside of the basement floor, the use of a conventional concrete ground slab should perform satisfactorily in relation to the proposed utilisation. Such floor slabs should be constructed on stiff to very stiff silty clay subgrade at the proposed basement level and may be designed using a Modulus of Subgrade reaction of 40kPa/mm. Under-slab drainage should be provided to the basement to prevent hydrostatic build-up in the event of rising ground water.

Preparation of the basement floor subgrade should consist of stripping to grade and proof rolling the subgrade, ensuring that any localised soft spots are removed and made good with clean granular filling compacted to a dry density not less than 98% of the maximum dry density value determined by the Standard Compaction test in accordance with Australian Standard AS1289 5.11 – 1993.

A suitable dewatering system (spears or sump pump) may be required to pump groundwater in the event that the groundwater is encountered above the basement level. Although groundwater was not encountered during the geotechnical investigation, the presence of perched groundwater resulted from infiltration of surface run-off should not be dismissed.

DOCUMENT CONTROL

Date	Version	Report Prepared By:	Report Reviewed by:
06 February 2018		**Paolo Abballe** BSc (Hons) PhD Engineering Geologist	**Amir Farazmand** BEng MEng MIEAust CPEng Senior Geotechnical Engineer

6. REFERENCES

- Australian Standard (1993), Geotechnical Site Investigations (AS1726).
- 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.
- National Environment Protection Council, December 1999. National Environment Protection (Assessment of Site Contamination) Measure.
- Australian Standard AS 3600: 2009, Concrete Structures
- Department of Land and Water Conservation (DLWC, 2002) Site investigations for urban salinity.
- CSIRO BTF 18 (2003) Foundation Maintenance and Footing Performance: A homeowner's Guide.
- Department of Infrastructure Planning and Natural Resources (DIPNR, 2002) Salinity Potential in Western Sydney Map.
- Western Sydney Regional Organisation of Councils (WSROC, 2003) Western Sydney Salinity Code of Practice.

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.

SITE PHOTOGRAPHS

Location of borehole BH1

Location of borehole BH2

Location of borehole BH3

Appendix A

Borehole Logs

BOREHOLE LOG

SOIL

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BORE No: BH1

Page: 1 of 1

Client:	The Bathla Group	Excavated by	Paolo Abballe	Easting:	See Plan
Project:	NE236	Operator	Ali	Northing:	See Plan
		Rig Type:	Auger - Pixy 41T	Grid Ref:	See Plan
Location:	146 Regent Street, Riverstone, NSW	Pit size		Collar RL:	See Plan
Date of test:	18 December 2017		-	Logged by:	PA Checked by: AF

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Density / Strength	Dynamic Cone Blows per 100 mm	DCP estimated CBR	FIELD TESTS & NOTES	Sampling / Runs	Water Levels
0.00	Solid Auger		ML	Sandy SILT with traces of gravel, stiff, moist, brown, roots	M	ST	4		Grass cover absent		0.00
				Clayey SILT, hard, dry to moist, minor roots		H	20		Groundwater		
				Brown / orange			10		not encountered		
							35				
0.50							19		Sample for Salinity	●	0.50
							11				
							17				
							12				
			CH	Silty CLAY, very stiff, high plasticity	M	VST	8				
1.00				Red, moist			8				1.00
							7				
							7				
							16				
							Refusal				
1.50			SH	SHALE IV, low strength, pale grey, dry to moist	D-M	L					1.50
				Borehole terminated at 1.5 m in SHALE IV from auger refusal							
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

relative density:
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

moisture:
- D Dry
- M Moist
- W Wet

strength:
- EH Extremely High
- VH Very High
- H High
- M Medium
- L Low
- VL Very Low
- EL Extremely Low

Notes:

water:
- ▼ water level
- ▼ level risen to
- water inflow

sampling / testing:
- ● disturbed sample
- ■ intact sample from core
- B bulk sample
- Suv Su from Field Vane Shear test
- T intact tube sample
- SPT standard penetration test

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

BOREHOLE LOG

SOIL

GEOTESTA

BORE No: BH2

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Client:	The Bathla Group	Excavated by	Paolo Abballe	Easting:	See Plan
Project:	NE236	Operator	Ali	Northing:	See Plan
		Rig Type:	Auger - Pixy 41T	Grid Ref:	See Plan
Location:	146 Regent Street, Riverstone, NSW	Pit size		Collar RL:	See Plan
Date of test:	18 December 2017		-	Logged by:	PA Checked by: AF

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Density / Strength	Dynamic Cone Blows per 100 mm	DCP estimated CBR	FIELD TESTS & NOTES	Sampling / Runs	Water Levels
0.00	Solid Auger		ML	Sandy SILT with traces of gravel, stiff, moist, brown, roots	M	ST	8		Grass cover 0-5 cm		0.00
				Clayey SILT, hard, dry to moist, minor roots	D-M	H	27		Groundwater		
				Brown / orange			13		not encountered		
			CL	Silty CLAY with minor amount of sand, very stiff	D-M	VST	9				
0.50				Brown, dry to moist, low to medium plasticity			10				0.50
							4				
							5				
							5				
							5				
1.00							8		Sample for Attenberg	●	1.00
							6				
				Grades to red, high plasticity			8				
							12				
							Refusal				
1.50			SH	SHALE V-IV, very low to low strength, pale grey, dry to moist	D-M	L					1.50
				Borehole terminated at 1.7 m in SHALE IV from auger refusal							
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

relative density:
VL very loose
L loose
MD medium dense
D dense
VD very dense

moisture:
D Dry
M Moist
W Wet

strength:
EH Extremely High
VH Very High
H High
M Medium
L Low
VL Very Low
EL Extremely Low

Notes:

water:
▼ water level
▼ level risen to
water inflow

sampling / testing:
intact sample from core
T intact tube sample
● disturbed sample
B bulk sample
Suv Su from Field Vane Shear test
SPT standard penetration test

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

BOREHOLE LOG

SOIL

GEOTESTA

BORE No: BH3

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Client:	The Bathla Group	Excavated by	Paolo Abballe	Easting:	See Plan
Project:	NE236	Operator	Ali	Northing:	See Plan
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Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Density / Strength	Dynamic Cone Blows per 100 mm / DCP estimated CBR	FIELD TESTS & NOTES	Sampling / Runs	Water Levels
0.00	Solid Auger		ML	Clayey SILT with traces of gravel, very stiff, moist, brown, roots	M	VST	6 8	Grass cover 0-5 cm Groundwater		0.00
			CL	Silty CLAY with gravel, very stiff, low to medium plasticity Brown / red, dry to moist, minor roots Gravel consists of shale fragments	D-M	VST	10 9 42 Refusal	not encountered		
0.50										0.50
			SH	SHALE V, very low strength, pale grey / pale brown, dry to moist	D-M	VL				
1.00				Grades to brown / red				Sample for Salinity	●	1.00
1.50				SHALE IV, low strength, pale grey, dry to moist		L				1.50
				Borehole terminated at 1.8 m in SHALE IV from auger refusal						
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

relative density:
VL very loose
L loose
MD medium dense
D dense
VD very dense

moisture:
D Dry
M Moist
W Wet

strength:
EH Extremely High
VH Very High
H High
M Medium
L Low
VL Very Low
EL Extremely Low

Notes:

water:
▼ water level
▼ level risen to
water inflow

sampling / testing:
intact sample from core
T intact tube sample
● disturbed sample
B bulk sample
Suv Su from Field Vane Shear test
SPT standard penetration test

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

BOREHOLE LOG

SOIL

GEOTESTA

BORE No: BH4

Page: 1 of 1

Client:	The Bathla Group	Excavated by	Paolo Abballe	Easting:	See Plan
Project:	NE236	Operator	Ali	Northing:	See Plan
		Rig Type:	Auger - Pixy 41T	Grid Ref:	See Plan
Location:	146 Regent Street, Riverstone, NSW	Pit size		Collar RL:	See Plan
Date of test:	18 December 2017		-	Logged by:	PA Checked by: AF

Depth (m)	Drilling Method	Graphic Log	Group Symbol	MATERIAL DESCRIPTION Type, colour, particle size and shape, structure	Moisture	Consistency / Density / Strength	Dynamic Cone Blows per 100 mm DCP estimated CBR	FIELD TESTS & NOTES	Sampling / Runs	Water Levels
0.00	Solid Auger		ML	Sandy SILT with traces of gravel, firm, moist, dark grey, roots	M	F	2	Grass cover absent		0.00
				Clayey SILT with traces of gravel, hard, moist, brown		H	13	Groundwater		
				Minor roots			21	not encountered		
							12			
0.50			CL	Silty CLAY with gravel, very stiff to hard, low to medium plasticity	D-M	VST	8			0.50
				Brown / red, dry to moist		H	12			
				Gravel consists of shale fragments			18			
							29			
							Refusal			
1.00			SH	SHALE V, very low strength, pale grey / pale brown, dry to moist	D-M	VL				1.00
1.50				SHALE IV, low strength, pale grey, dry to moist		L				1.50
				Borehole terminated at 1.8 m in SHALE IV from auger refusal						
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

relative density:
VL very loose
L loose
MD medium dense
D dense
VD very dense

moisture:
D Dry
M Moist
W Wet

strength:
EH Extremely High
VH Very High
H High
M Medium
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EL Extremely Low

Notes:

water:
water level
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sampling / testing:
intact sample from core
T intact tube sample
disturbed sample
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Suv Su from Field Vane Shear test
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Appendix B

Laboratory Test Results

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES

ABN 43 002 145 173

ATTERBERG LIMITS, LIQUID LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client: Geotesta Pty Ltd
Location: Riverstone
Client Job No.: NE236

Ref No: L4040E4
Report: 1
Report Date: 29/01/2018
Page 1 of 1

AS 1289	TEST METHOD	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER		**LIQUID LIMIT %**	**PLASTIC LIMIT %**	**PLASTICITY INDEX %**	**LINEAR SHRINKAGE %**
4		38	21	17	8.0

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 22/01/2018.

NATA

NATA Accredited Laboratory
Number:1327

Accredited for compliance with ISO/IEC 17025 - Testing.
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Authorised Signature / Date
(D. Treweek) 29/1/18

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	BH18 Soil M17-De32468 Dec 27, 2017	BH19 Soil M17-De32469 Dec 27, 2017	S1 Soil M17-De32470 Dec 27, 2017	S2 Soil M17-De32471 Dec 27, 2017
Organophosphorus Pesticides						
Azinphos-methyl	0.2	mg/kg	-	< 0.2	-	-
Bolstar	0.2	mg/kg	-	< 0.2	-	-
Chlorfenvinphos	0.2	mg/kg	-	< 0.2	-	-
Chlorpyrifos	0.2	mg/kg	-	< 0.2	-	-
Chlorpyrifos-methyl	0.2	mg/kg	-	< 0.2	-	-
Coumaphos	2	mg/kg	-	< 2	-	-
Demeton-S	0.2	mg/kg	-	< 0.2	-	-
Demeton-O	0.2	mg/kg	-	< 0.2	-	-
Diazinon	0.2	mg/kg	-	< 0.2	-	-
Dichlorvos	0.2	mg/kg	-	< 0.2	-	-
Dimethoate	0.2	mg/kg	-	< 0.2	-	-
Disulfoton	0.2	mg/kg	-	< 0.2	-	-
EPN	0.2	mg/kg	-	< 0.2	-	-
Ethion	0.2	mg/kg	-	< 0.2	-	-
Ethoprop	0.2	mg/kg	-	< 0.2	-	-
Ethyl parathion	0.2	mg/kg	-	< 0.2	-	-
Fenitrothion	0.2	mg/kg	-	< 0.2	-	-
Fensulfothion	0.2	mg/kg	-	< 0.2	-	-
Fenthion	0.2	mg/kg	-	< 0.2	-	-
Malathion	0.2	mg/kg	-	< 0.2	-	-
Merphos	0.2	mg/kg	-	< 0.2	-	-
Methyl parathion	0.2	mg/kg	-	< 0.2	-	-
Mevinphos	0.2	mg/kg	-	< 0.2	-	-
Monocrotophos	2	mg/kg	-	< 2	-	-
Naled	0.2	mg/kg	-	< 0.2	-	-
Omethoate	2	mg/kg	-	< 2	-	-
Phorate	0.2	mg/kg	-	< 0.2	-	-
Pirimiphos-methyl	0.2	mg/kg	-	< 0.2	-	-
Pyrazophos	0.2	mg/kg	-	< 0.2	-	-
Ronnel	0.2	mg/kg	-	< 0.2	-	-
Terbufos	0.2	mg/kg	-	< 0.2	-	-
Tetrachlorvinphos	0.2	mg/kg	-	< 0.2	-	-
Tokuthion	0.2	mg/kg	-	< 0.2	-	-
Trichloronate	0.2	mg/kg	-	< 0.2	-	-
Triphenylphosphate (surr.)	1	%	-	89	-	-
Conductivity (1:5 aqueous extract at 25°C)	10	uS/cm	-	-	35	63
pH (1:5 Aqueous extract)	0.1	pH Units	-	-	7.9	7.6
Sulphate (as SO4)	30	mg/kg	-	-	66	120
% Moisture	1	%	8.2	7.4	7.9	8.8
Heavy Metals						
Arsenic	2	mg/kg	7.2	-	-	-
Cadmium	0.4	mg/kg	< 0.4	-	-	-
Chromium	5	mg/kg	100	-	-	-
Copper	5	mg/kg	42	-	-	-
Lead	5	mg/kg	20	-	-	-
Mercury	0.1	mg/kg	< 0.1	-	-	-
Molybdenum	5	mg/kg	< 5	-	-	-
Nickel	5	mg/kg	91	-	-	-