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Report on
Geotechnical Investigation

Proposed New Primary School
28 Wallarah Circuit, Gregory Hills

Prepared for
School Infrastructure NSW

Project 213594.00
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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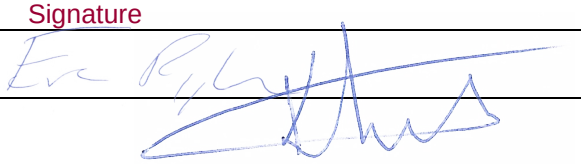
Author		7 October 2022
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Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
18 Waler Crescent
Smeaton Grange NSW 2567
Phone (02) 4647 0075

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Table of Contents

Report on Geotechnical Investigation
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1. Introduction

This report presents the results of a geotechnical investigation undertaken for the proposed development of an educational establishment. The investigation was commissioned by School Infrastructure NSW and was undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal 213594.00.PS.002.Rev0 dated 24 March 2022.

Investigation is required to provide information on subsurface conditions to support the conceptual layout design of the proposed school. Information from this report may be used to provide general construction advice for footing and floor slab design recommendations and assessment of excavation conditions onsite.

The investigation comprised borehole drilling, test pit excavation and in-situ testing, followed by sampling, logging, core photography, laboratory testing of selected samples and engineering evaluation. Details of the field and laboratory work are given in the report together with suggested design parameters and comments on design and construction practice.

This geotechnical investigation report supports an Environmental Impact Statement (EIS) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), in support of a State Significant Development Application (SSDA) for the construction and operation of a new primary school at Gregory Hills (SSD-41306367).

The geotechnical investigation was carried out concurrently with a contamination investigation which has been reported separately.

2. Site Description

The site is located in Dharawal Country at 28 Wallarah Circuit, Gregory Hills NSW 2557, and is legally described as Lot 3257 DP1243285. The site is located within the Camden Local Government Area and is within the Turner Road Precinct of the South-West Growth Centre.

The site has an area of approximately 2.926ha (by Deposited Plan). This will be reduced to 2.907ha under approved DA2022/742/1 once Long Reef Circuit has been widened. Topography is minimal with a fall from the south-east corner (RL116.5) to the north- west corner (RL113).

The site has three (3) street frontages:

- Wallarah Circuit (southern boundary)
- Gregory Hills Drive (northern boundary)

- Long Reef Circuit (eastern Boundary)

The site is primarily vacant land, with the exception of an existing group of trees in the southwest corner of the site that pre-date the subdivision and development of the precinct. There is also an existing electrical substation located on the south-eastern boundary.

There are easements of varying widths located to the northern boundary identified for drainage.

To the north, east and south of the site is emerging and recently completed residential development. To the east of the residential area fronting Long Reef Circuit are high voltage power lines within an easement which include pedestrian paths and cycleways. To the west of the site, beyond Sykes Creek and Howard Park, is the Gregory Hills town centre. A pedestrian bridge links Wallarah Circuit with the town centre across Sykes Creek.

Relevant site features are shown in the photo plates in Appendix B.

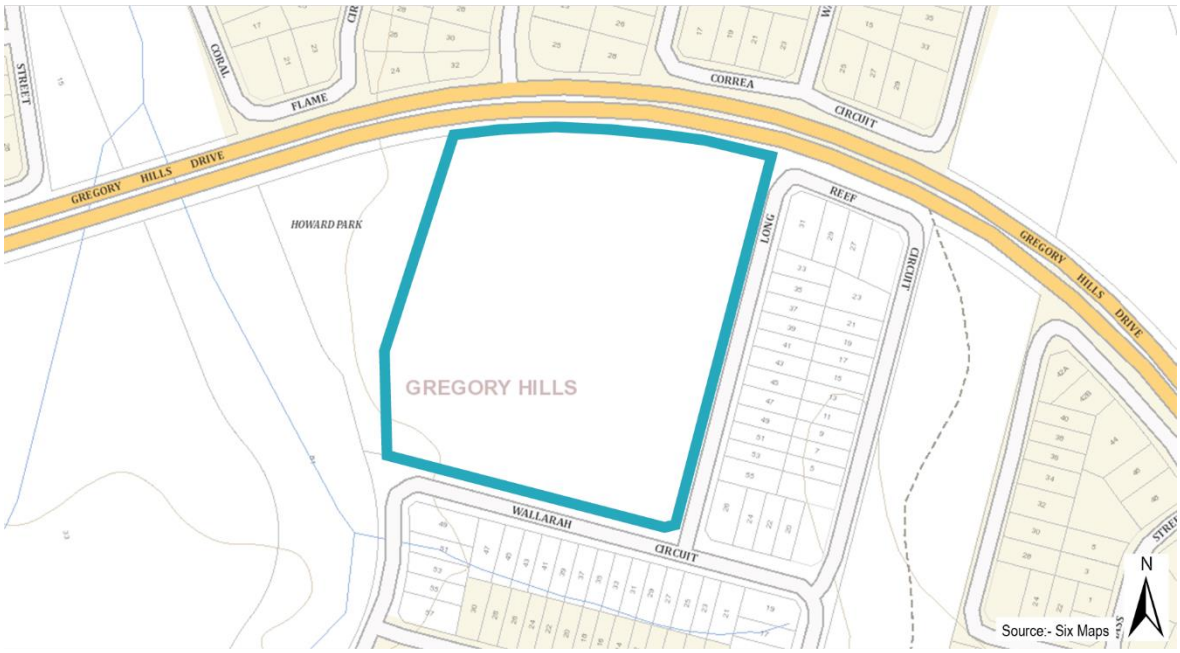

Figure 1 – Locality Map (Six Maps)

Figure 2 – Site Aerial Map, (Source Bennet and Trimble)

3. Regional Geology and Soils

Reference to the Wollongong – Port Hacking 1:100 000 Geological Series Sheets indicates that the site is underlain by Bringelly Shale belonging to the Wianamatta Group of Triassic age. Bringelly Shale typically comprises shale, carbonaceous claystone, laminite, fine to medium-grained lithic sandstone, and some minor coaly bands which weather to form clays of high plasticity. The results of the investigation were consistent with geological mapping with shale bedrock encountered in all of the test locations.

According to the publicly available mapping of Soil Landscapes of Central and Eastern NSW (NSW DPIE, 2015), the site is underlain with residual soil of the Blacktown unit (9029bt), common across the Cumberland Plains and associated with shales of the Wianamatta Group. Blacktown unit soils are typically shallow to moderately deep, comprising of red and brown podzols, and may exhibit potentially moderately reactive and highly plastic behaviours.

Reference to the Map of Salinity Potential in Western Sydney (Department of Natural Resources, 2002) mapping infers moderate to high salinity potential. The mapping is based on soil type, surface level and general groundwater considerations and, as such are approximate only.

Reference to the Acid Sulfate Soils Risk Maps produced by NSW Department of Land and Water Conservation indicate that the site is located in an area of no known acid sulphate soil risk.

4. Field Work

4.1 Methods

The field investigation comprised a combination of boreholes and test pits. Six boreholes (101, 104, 105, 107, 109, 112) were drilled across the site using a truck-mounted drill rig, to depths in the range 6.5 to 7.7 m below existing surface levels. The boreholes were started using spiral flight augers in the near surface soils to the top of rock. The boreholes were continued using NMLC rotary core drilling in the bedrock. Standard penetration tests (SPT) were conducted at regular depth intervals whilst augering to provide information on the engineering properties of the strata.

Sixteen test pits (1 to 10, 102, 103, 106, 108, 110, 111) were excavated to depths in the range 0.5 – 3 m using a 6 t excavator fitted with a 450 mm toothed bucket attachment. Regular, disturbed samples and selected bulk disturbed samples were collected throughout the site to allow for a wide coverage in laboratory testing. Dynamic Cone Penetrometer (DCP) testing was undertaken from the ground surface at each test pit location up to a maximum depth of 1.2 m to provide information regarding shallow soil consistency and density.

Upon completion of the investigation, all test locations were backfilled with spoil material obtained from the drilling and excavation, whilst two of the boreholes (Bores 101 and 109) were converted into standpipe piezometers to allow on going measurement of groundwater levels. A 3 m section of slotted PVC casing (50 mm diameter) was inserted at the bottom of the boreholes, with the annulus between the borehole wall and the slotted casing filled with coarse sand, and then capped with a bentonite seal to prevent any external inflows from surface drainage and other intersecting aquifers. The remainder of the piezometer installation is comprised of blank PVC casing, with drilling spoil used to backfill the annulus to the ground surface. The piezometers were finished with a 1 m PVC stickup from the ground surface and closed with a well cap to prevent any surface or rainwater inflow.

The test locations were nominated by DP. Locations 1 – 10 are at general locations across the site whilst locations 101 – 112 are within the proposed building footprint. The location of the bores and test pits are shown on Drawing 1 in Appendix B. The locations (to GDA94 / MGA94 Zone 56) and surface levels (to AHD) at each borehole location were determined using a differential GPS with a nominal accuracy of 0.1 m.

4.2 Results

The detailed borehole logs and core photographs are provided in Appendix A which also contains notes defining the classification methods and terms which are used to describe the strata rock.

The bores encountered relatively uniform conditions over the site. The typical succession of strata comprised topsoil and filling typically to 0.5 m in depth overlying residual silty clay then shale.

A summary of the sequence of subsurface conditions encountered at site is presented below:

TOPSOIL / FILL:	Encountered at all test locations to a depth of between 0.15 to 0.30 m. Typically low to medium plasticity, grey brown to brown silty clay, with fine gravel and rootlets.
FILL (CONTROLLED):	Typically low to medium plasticity, silty clay with fine sand and gravel was encountered to depths in a range of 0.15 to 1.60 m in at all test locations. Gravelly sand fill was also encountered at test locations 8, 10, 109 and 111 at the southern portion of the site to depths in the range of 0.15 to 0.80 m.
RESIDUAL CLAY:	Typically medium to high plasticity silty clay was encountered underlying the fill layer to a depths in the range 0.8 to 3.0 m (limit of investigation at 9 and 10).
BEDROCK:	Shale bedrock (Bringelly Shale) was first encountered from depths in the range 0.4 – 1.5 m in all Pits and Bores except Pits 9, 10 and 110 which were terminated in clay at a depth of 3.0 m. The bedrock is typically very low strength initially and then increases to low to medium strength with depth. Shallow shale bedrock was encountered underlying the fill layer at test locations 3, 6, 101, 102, 103, 104 and 105 in the north eastern to eastern portion of the site, with no clear residual clay layer in between.

The resulting rock classifications for the cored boreholes (in accordance with Pells et al) including the corresponding reduced levels (RL) and depths are summarised in Table 1. A summary of the levels at which rock was encountered in the test pits is provided in Table 2. These indicate some variation across the site which is typical for sites underlain by Bringelly Shale.

Table 1 – Summary of Rock Class Levels observed in Cored Boreholes

Test Location ID	Surface RL (mAHD)	Depth and RL at Top of Strata					
		Class V Shale		Class IV Shale		Class III Shale	
		Depth (m)	RL (m)	Depth (m)	RL (m)	Depth (m)	RL (m)
101	115.2	0.6	114.6	1.5	113.7	5.0	110.2
104	116.1	0.8	115.3	1.2	114.9	3.5	112.6
105	115.8	0.8	115.0	2.2	113.6	3.4	112.4
107	116.3	1.6	114.7	5.6	110.7	-	-
109	115.7			2.2	113.5		
112	115.0			2.4	112.6	5.2	109.8

Table 2 – Summary of Top of Rock depths encountered in Test Pits

Test Location ID	Surface RL (mAHD)	Depth and RL at Top of Strata			
		Class V Shale		Class IV Shale**	
		Depth (m)	RL (m)	Depth (m)	RL (m)
1	113.1	1.2	111.9	2.1	111.0
2	114.2	0.8	113.4	1.7	112.5
3	115.0	0.5	114.5	1.5	113.5
4	115.4	0.9	114.5	2.5	112.9
5	113.9	1.0	112.9	1.9	112.0
6	114.9	0.6	114.3	2.5	112.4
7	115.1	0.9	114.2	1.0	114.1
8	115.4	1.4	114.0	2.0	113.4
9*	114.2	-	-	-	-
10*	114.7	-	-	-	-
102	115.4	0.4	115.0	0.5	114.9
103	115.6	0.5	115.1	0.8	114.8
106	116.3	0.9	115.4	1.1	115.2
108	115.8	1.4	114.4	2.0	113.8
110*	114.8	-	-	-	-
111	115.8	1.4	114.4	1.7	114.1

Notes: * Top of rock was not encountered in test pit down to a depth of 3 m
** Class IV Shale inferred from excavation refusal

No free groundwater was encountered whilst augering through the near surface soils in all of the boreholes and test pits, and it was not possible to observe any permanent groundwater levels once rotary core drilling commenced because water was used for flushing and cooling during the coring process. Following completion of the borehole, the piezometers were developed using a bailer to remove excess drilling-induced liquids and given time to recharge.

The results of water level measurements in the two standpipe piezometers are summarised in Table 3.

Table 3 – Results of Water Level Measurements 13 July 2022

Borehole	Ground Surface RL (m AHD)	Depth to Water (m)	RL of Water Level (m AHD)
101	115.2	3.8	111.4
109	115.7	5.0	110.7

Groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

5. Laboratory Testing

5.1 Plasticity and Moisture Content

Selected samples were tested in the laboratory for measurement of the soil moisture content, Atterberg limits and linear shrinkage. The detailed results are given in the report sheets in Appendix B, with the results summarised in Table 4.

Table 4: Results of Soil Moisture Content, Atterberg Limits and Linear Shrinkage Testing

Test Location ID	Depth (m)	Material	Field Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
4	0.5	Silty CLAY	20.7	51	20	31	13.0
5	0.5 – 0.7	Silty CLAY	18.1	59	21	38	13.0
5	0.5 – 1.0	Silty CLAY	17.6	67	21	46	13.5
7	0.5 – 0.7	Silty CLAY	11.0	42	20	22	11.0
7	0.8	Silty CLAY	14.5	57	21	36	12.5
8	1.0	Silty CLAY	17.3	62	22	40	15.5
10	0.8 – 1.0	Silty CLAY	16.0	53	19	34	13.0
107	1.0 – 1.39	Silty CLAY	14.1	55	18	37	13.5

The field moisture contents of the natural soil samples were generally dry of the plastic limit (down to 9.0% dry of plastic limit) to around plastic limit state. The plasticity results indicate the soils tested are of medium to high plasticity and would be susceptible to shrink-swell movements with changes in soil moisture content.

5.2 California Bearing Ratio

California bearing ratio (CBR) tests was carried out on three bulk soil samples of silty clay compacted to approximately 100% dry density ratio relative to standard maximum dry density at near standard optimum moisture content. The samples were soaked for four days under surcharge loadings of 4.5 kg. The detailed results are given in the report sheets in Appendix B and are summarised in Table 5.

Table 5: Results of CBR and Standard Compaction Testing

Test Location ID	Depth (m)	Material	Field Moisture Content (%)	Optimum Moisture Content (%)	Standard Maximum Dry Density (t/m^3)	Swell (%)	CBR (%)
7	0.5 – 0.9	Silty CLAY	14.2	17.0	1.77	6.0	1.0
9	0.5 – 1.0	FILL: Silty CLAY	15.2	15.5	1.82	0.5	4.0
10	0.8 – 1.0	Silty CLAY	14.6	18.5	1.73	1.5	3.0

The results of the field moisture content tests (at the time of the sampling) listed in Table 5 indicate the soils were in the range of 3.9% to 0.3% dry of standard optimum moisture content.

5.3 Point Load Index

Point load index ($Is_{(50)}$) tests were carried out on selected samples of the rock core and the results of these tests are given on the cored borehole logs. The results indicate rock strength ranging from very low to medium in shale and very low to high in sandstone. Axial and diametral testing were undertaken at 1 m intervals where possible.

5.4 Aggressivity and Salinity Testing

Selected samples from test locations throughout the site were tested in the laboratory for determination of aggressivity (to concrete and steel) and salinity. The detailed results are given in the laboratory report sheets and are summarised in Appendix B Table B1. The number of samples tested for each parameter and the range of test results obtained are summarised in Table 6.

Table 6: Summary of Test Results – Aggressivity Suite

Parameter		Units	Number of Tests	Range of Results
pH		pH units	25	4.9 – 9.1
Chlorides		(mg/kg)	6	22 – 300
Sulphates		(mg/kg)	6	10 – 360
Aggressivity AS2159: 2009	To Concrete	-	31	Non-aggressive to Mild
	To Steel	-	31	Non-aggressive
$EC_{1:5}$ [Lab.]		(mS/cm)	22	61.6 – 536.1
Electrical Resistivity		Ω.cm	22	6160 – 53610

Parameter	Units	Number of Tests	Range of Results
EC_e [M x $EC_{1:5}$]	(dS/m)	22	0.5 – 4.7
Salinity Class	-	22	Non-saline to Moderately Saline

Where: M = soil textural factor

5.4.1 Aggressivity

Sample aggressivity classifications (refer Table B1, Appendix B) are based on pH, sulphate concentration, chloride concentration and calculated resistivity values and are assessed in accordance with AS 2159 *Piling Design and Installation"* (AS 2159, 2009). The absence of free groundwater in all the test locations and the inferred very low permeability of the sampled clayey soils indicate that soils at all test locations are in Condition "B" (AS 2159, 2009).

The results indicate that of the thirty-one (31) samples tested:

- Twenty-seven (27) samples were non-aggressive and four (4) samples were mildly aggressive to concrete; and
- Thirty-one (31) samples were non-aggressive to steel.

5.4.2 Salinity

Sample salinity classifications (refer Table B1, Appendix B) are based on calculated EC_e values using the method of Richards *"Diagnosis of Saline and Alkaline Soils"* (Richards, 1954).

The results indicate that of the twenty-two (22) samples tested for salinity, thirteen (13) were non-saline, seven (7) were slightly saline and two (2) were moderately saline.

6. Proposed Development

It is understood that the staged development of the primary school will include the following:

- Construction of two 3-storey buildings and one 2-storey building in the south eastern portion of the site. The proposed finished floor levels will be at RL 116.1 and are expected to comprise slab on ground construction.
- At this stage, no information has been provided on the likely foundation loads but given the scope of the development it is likely that loads of the order of 1000 – 2000 kN could occur.
- Only minor bulk earthworks (level adjustments less than 0.5 m) will be required within the building footprint
- Bulk earthworks elsewhere on site will include placement of fill to depths of up to 1.3 m
- Construction of a new carparks with flexible pavements;

7. Comments

7.1 General

It is understood that the project is in a preliminary planning and development phase. As such, geotechnical investigation has been undertaken to provide comments with respect to reactivity, site classification, site preparation, earthworks, foundations and pavements to assist in conceptual planning and design. Once the design details (and structural loads) have been finalised, clarification of the comments provided within should be sought from DP and a revision to this report may be required.

7.2 Geotechnical Site Model

Based on the results of the investigation, the inferred subsurface geotechnical model underlying the site comprises:

- A surficial layer of topsoil fill over most of the site;
- Controlled fill typically comprising silty clay with some sand and gravel to depths of up to 1.6 m
- Residual clays of very stiff to hard consistency underlying the existing fill;
- Weathered rock (siltstone) underlying the residual clay at depths of 0.5 to in excess of 3 m; and
- Groundwater at depths of 3.8 – 5.0 m (RL110.7 – 111.4 m) but would be subject to preceding climatic conditions. Periodic seepage would be expected along the clay/rock interface particularly during and following inclement weather.

7.3 Existing Fill on Site

The existing fill on site was placed in April 2019. Level 1 inspection and testing was provided by DP. The results of the Level 1 are summarised in report a prepared for the previous site developers (DP Project 670721.67 dated 12 May 2020).

The report indicates that a minimum dry density ratio of 98% relative to Standard maximum dry density has been achieved. Moisture content of the fill was maintained within 2% of OMC (where OMC is the optimum moisture content for Standard compaction). On the basis of the previous testing, the fill onsite can be considered controlled fill.

7.4 Site Classification

The results of field work indicate that the site is underlain by clayey fill and natural residual clays to depths of 0.5 to in excess of 3 m.

Based on the subsurface profiles and results of the laboratory testing, the site is considered to be Class H1 (highly reactive) from the reactivity viewpoint, when assessed in accordance with the requirements of AS 2870:2011.

It is noted however, that the above classifications are appropriate for the undeveloped site and are independent of proposed earthworks. Furthermore, AS 2870:2011 is only directly applicable to small residential structures. The main requirement for this site is therefore for designs to be undertaken by a structural engineer. Reference should be made to Section 6.9 of this report for advice relating to foundation design.

7.5 Slope Stability

The site is gently sloping with an average grade of about 1 in 60. Inspection of the site and the site grades indicate an extremely low risk of any instability of any natural slopes. Reference should be made to the following section for support of fill or excavations.

7.6 Excavations

7.6.1 Excavation Conditions

Excavations on site are likely to be limited to footings and service trenches. The results of the investigation indicate that bulk excavation to depths of up to 2 m could encounter fill and clay and then weathered rock which varies in strength from very low strength to low strength. It is anticipated that bulk excavation of the clays and low strength rock could be readily achieved using conventional earthmoving equipment with some light ripping.

There are medium strength and high strength bands at depth and if deeper excavation is proposed medium ripping may be required. The degree of difficulty in any excavation is a function of rock strength and fracturing together with the type of equipment used and the skill of the machine operator. It is therefore suggested that the construction tenderers be required to inspect the core and the core photographs and make their own judgment on the equipment required to carry out the work and the rate at which excavation can be performed.

7.6.1.1 Temporary Batter Slopes

Suggested temporary batter slopes for unsupported excavations up to a maximum height of 4 m are shown in Table 7.

Table 7: Recommended Batter Slopes for Exposed Material

Material	Temporary
Stiff to hard clay, extremely weathered shale and compacted filling	1H:1V
Shale: very low to low strength	0.75H:1V*

*These batter slope angles are subject to inspection by a qualified geotechnical engineer or engineering geologist.

Further analysis will be required if batters greater than 4 m in height are proposed or where surcharge loads will be applied near the crest.

7.7 Retaining Walls

Where engineer-designed retaining walls are proposed such as may be required surrounding the detention basins, retaining wall design could be based on the parameters given in Table 8.

Table 8: Suggested Design Parameters – Retaining Structures

Retained Material	Bulk Density (kN/m^3)	Ko	Ka	
			Short Term	Long Term
Engineered fill	20	0.6	0.25	0.30
Clay - Stiff to hard	20	0.6	0.25	0.30
Shale – very low strength or greater	22	0.4	0.20	0.25

Where: Ka = active earth pressure co-efficient
Ko = at-rest earth pressure co-efficient

'At rest' earth pressure coefficient (Ko) is appropriate where support is to be provided for movement intolerant structures or services. Additional surcharge (lateral) pressures on the retaining walls must also be accommodated in design should building loads, pavement areas, driveways etc. be within the zone of influence of the walls.

Earth pressures due only to retained soils acting on anchored or propped retaining structures can be calculated based on a trapezoidal pressure distribution (i.e. triangular to 0.25H, uniform from 0.25H - 0.75H and triangular decreasing to zero from 0.75H to H) with depth using appropriate values for unit weight and 'at rest' (K_o) earth pressures coefficients as set out in Table 8.

It is suggested that earth pressures on cantilever retaining walls due to the retained soils be based on a triangular pressure distribution using the appropriate values for unit weight and earth pressure coefficient in Table 8 and calculated as follows:

$$\sigma_z = \gamma.K.z$$

Where: σ_z = Horizontal pressure at depth z
γ = Unit weight of retained soil
K = Earth pressure coefficient

The pressure distribution given above does not include hydrostatic pressure due to groundwater behind retaining walls (although not expected), which should be included in the design unless adequate drainage is provided to prevent the build-up of hydrostatic pressures.

The design of any batter slopes and retaining walls should account for any surcharge loads, including adjacent pavements, access roads, buildings or similar. Design should also consider the effects of plant operating above excavations and/or retaining walls during construction.

7.8 Groundwater

Monitoring of the groundwater levels during the investigation has indicated that the groundwater is at a depth of at least 3.8 m below existing surface levels. Consequently, it is considered the design of floor

slabs for uplift or for permanent hydraulic loads on retaining walls may be governed by flood levels rather than measured groundwater level. If bored piers founded at depths near the measured groundwater levels are proposed, then allowance should be made for casing or CFA piles.

The expected effect of the development on groundwater is expected to be insignificant and additional groundwater investigation is not considered necessary due to the lack of deep excavations proposed.

7.9 Site Preparation and Earthworks

Where earthworks are required to prepare the site for proposed building platforms, pavements and playing fields, the following procedures are suggested:

- Strip all vegetation and organic topsoil. The organic topsoil could be separately stockpiled for use in landscaping or removed off site.
- Compaction of the exposed surface with at least of 6 passes of a 12 tonne minimum dead weight roller, followed by test rolling in the presence of a geotechnical engineer;
- If any excessively low strength or heaving areas are identified, they should generally be treated by excavation to a sound base and replaced with engineered fill. Should the weak material exceed 500 mm in depth, a bridging layer may be required.

Good site drainage should be maintained at all times by adopting appropriate cross – falls within the site. Surface drainage should be installed as soon as is practicable in order to capture and remove surface flows to prevent erosion and softening of the exposed soils / weathered bedrock. Conventional sediment and erosion control measures should be implemented during the earthworks operation, with final surfaces to be topsoiled and vegetated as soon as practicable following the completion of earthworks.

7.9.1 Reuse of Excavated Materials

Generally, the fill and natural soils encountered during the investigation will be suitable for reuse as engineered fill within the site provided that any pre – treatment (moisture conditioning, removal of oversize and deleterious material), is carried out prior to fill placement. The material should not contain any particle sizes greater than 150 mm or excess moisture as these may cause inadequate compaction and should not contain silts due to their propensity for erosion if it becomes saturated. It is expected that bedrock of low strength or less will break down to a suitable size beneath the construction plant used for placement.

7.9.2 Engineered Fill

Controlled filling should be placed in near horizontal layers with a maximum loose thickness of 300 mm then compacted to a minimum density ratio of at least 98% relative to standard maximum dry density. The moisture content should to be maintained within 2% of standard optimum moisture content. Where filling is placed beneath road alignments, the upper 0.5 m depth should be placed at a minimum density ratio of 100% relative to standard maximum dry density.

During inclement weather or if the site is to be left unattended for an extended period, the upper surfaces of fill should be crowned and if possible blinded by smooth wheeled plant. Any stockpiles should be blinded to allow water to run off.

7.9.3 Geotechnical Inspections and Testing

It is recommended that the site be inspected by a geotechnical engineer following stripping of vegetation, topsoils and uncontrolled filling and during the test rolling undertaken prior to the placement of filling. Geotechnical testing should be carried out in accordance with AS3798: 'Guidelines on Earthworks for Commercial and Residential Developments. As a minimum, placement of controlled filling beneath structures must be to a Level 1 standard as described in AS3798 whilst Level 2 standard is usually considered appropriate for pavement construction and backfilling of service trenches, unless otherwise specified by the designer. It is also recommended that the Geotechnical Inspection and Testing Authority (GITA) should be engaged directly on behalf of the Principal and not by the earthworks contractor.

7.10 Foundations

For lightly loaded or settlement insensitive structures, shallow pad, strip or raft footing founding on controlled fill or natural clay are considered appropriate and could be based on an allowable base bearing pressure of 150 kPa. However, given that the expected typical loadings for the main structures may be in the order of 1000 – 2000 kN, footings founding uniformly within Class IV or stronger shale is recommended to limit both total and differential settlements.

The top of rock surface in the proposed building area slopes away to the south and west from a depth of approximately 0.5 m (RL 114.2) in the north west (Bore 101) to a depth of 2.4 m (RL 112.6) in the south east (Bore 112). A combination of pads and bored piles founded on the very low to low strength shale should be feasible.

Where bored piles are proposed to extend below the water table (approximate RL 111), then allowance should also be made for seepage inflows and removal of water during construction.

Footings may be designed using the values given in Table 9. For bored piles, shaft adhesion values for uplift (tension) may be taken as being equal to 70% of the values for compression.

Table 9: Recommended Design Parameters for Foundation Design

Material		Ultimate Parameters		Serviceability Parameters		Youngs Modulus, E' (MPa)
		Shaft Adhesion[1] (kPa)	End Bearing Pressure (kPa)	Shaft Adhesion[1] (kPa)	End Bearing Pressure (kPa)	
Shale	Class V	100	3000	70	700	75
	Class IV	150	3000	100	1000	150
	Class III or better	500	20000	250	2500	800

Note 1: Based on adequately cleaned and roughened pile sockets;

It may be feasible to adopt higher values for footing design, however additional testing would need to be carried out to verify the depth and extent of higher strength rock (Class III or better) beneath the site and additional verification during construction would also be required.

Foundations proportioned using the allowable bearing pressure in Table 9 would be expected to have total settlements of less than 1% of the footing width under the applied working load, with differential settlements between adjacent columns expected to be less than half of this value. The serviceability criteria must be considered for footings designed using the values in Table 9.

The limit state design requires calculation of pile capacities using both the ultimate design parameters and serviceability design parameters. Based on previous experience serviceability factors usually drive the design pile dimensions.

A geotechnical strength reduction factor Φg of 0.4 should be used until the details of the design are sufficiently advanced to allow for the recalculation of an appropriate Φg.

All footings should be inspected by a geotechnical engineer to confirm that foundation conditions are suitable for the design parameters.

7.11 Pavements and Floor Slabs on Ground

The laboratory testing gave CBR values in the range 1.0 – 4.0% for natural clay underlying the site. To allow for variations in subgrade conditions, it is suggested that a design CBR value of 2% be adopted for design of ground slabs following subgrade improvement in the area where the CBR value of 1% was recorded. An indicative modulus of subgrade reaction value (ks) of 15 – 20 kPa/mm is also suggested. Based on a design CBR of 2% following localised rectification of weak subgrade, a Young's Modulus (Es) of 20MPa can be adopted for design of ground slabs.

If a design subgrade of CBR of 3% or higher is preferred, improvement will be necessary and can be made by excavation and replacement with a higher quality material such as granular material with a CBR value greater than 15%. Where filling is required to achieve design levels, placement of a higher quality material can be adopted to improve the design CBR value.

7.12 Seismic site Class

The site stratigraphy encountered comprised a surface layer of more than 3 m of highly weathered or completely weathered rock or soil (a material with a compressive strength less than 1 MPa). The site's sub-soil class when assessed in accordance with AS 1170.4 – 2007 (Ref 5) is therefore considered a shallow soil site and a classification of Class C_e is suggested.

8. Summary

The geotechnical investigation undertaken has indicated that the site generally comprises topsoil, filling and natural clays overlying shale bedrock which is considered suitable for the proposed development. Comments have been provided on site preparation and earthworks, indicative design parameters, excavation methodologies and support, foundation options and geotechnical limitations relevant to the site. The comments and recommendations given within this report must be considered as being preliminary in nature as detailed design has not yet been undertaken. Once design has been suitably progressed, it must be forwarded to DP for review and comment.

9. References

Soil and Land Information System, 2015, Blacktown 9029bt. NSW Department of Planning, Industry and Environment.

Rose G., 1966, Wollongong 1:250 000 Geological Sheet SI/56-09, 2nd edition, Geological Survey of New South Wales, Sydney.

Foundations on Shales and Sandstones in the Sydney Region, Pells *et al*, Australian Geomechanics Journal (1998).

Australian Standard AS 2159: 2009 "*Piling – Design and Installation*".

10. Limitations

DP has prepared this report for the proposed school development at Gregory Hills in accordance with DP's proposal 213594.00.P.002.Rev0 dated 24 March 2022 and acceptance received from Jacobs Group on behalf of School Infrastructure NSW dated 26 April 2022. The work was carried out under a NSW Education School Infrastructure Consultancy Services Agreement SINSW03031/22 dated 22 April 2022. This report is provided for the exclusive use of School Infrastructure for this project only and for the purposes as described in the report. It should not be used for other projects or purposes or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

The site investigation and report inform the proposed extent of works and design required at the time of reporting. It is intended to assist in construction contractor pricing for site preparation, civil and structural/building works. Notwithstanding this, the report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726-1993, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 2007. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approximate Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$. It should be noted that the UCS to $Is_{(50)}$ ratio varies significantly for different rock types and specific ratios should be determined for each site.

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and longer sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq 100 \text{ mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

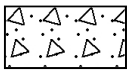
Symbols & Abbreviations

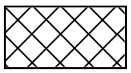
Graphic Symbols for Soil and Rock

General

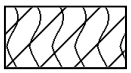

Asphalt

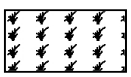

Road base

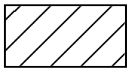

Concrete

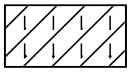

Filling

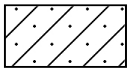
Soils


Topsoil

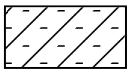

Peat

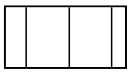

Clay

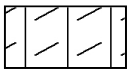

Silty clay

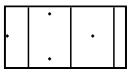

Sandy clay

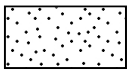

Gravelly clay

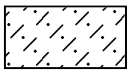

Shaly clay

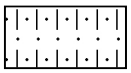

Silt


Clayey silt


Sandy silt

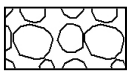

Sand

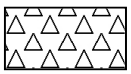

Clayey sand


Silty sand


Gravel

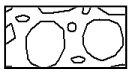

Sandy gravel


Cobbles, boulders

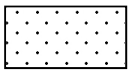

Talus

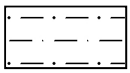
Sedimentary Rocks

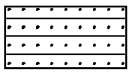

Boulder conglomerate

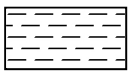

Conglomerate


Conglomeratic sandstone

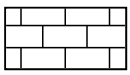

Sandstone


Siltstone

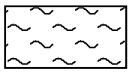

Laminite

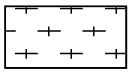

Mudstone, claystone, shale

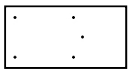

Coal


Limestone

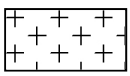
Metamorphic Rocks

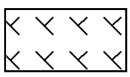

Slate, phyllite, schist

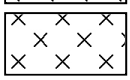

Gneiss

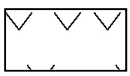

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia

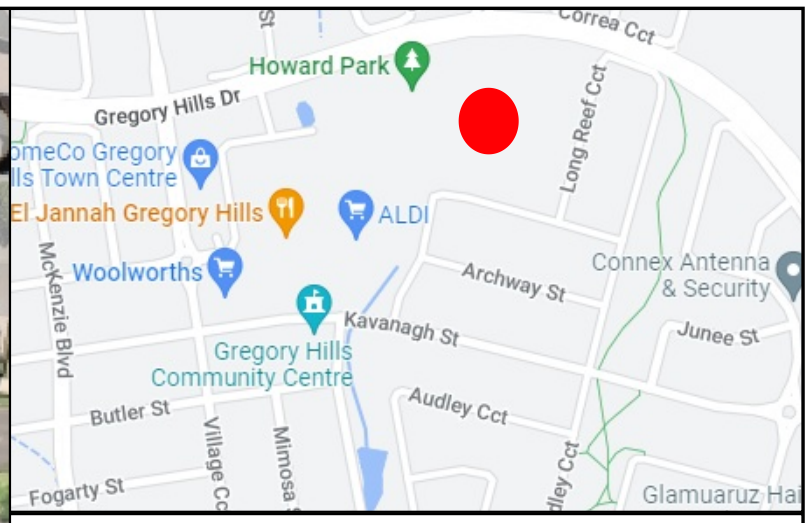

Porphyry

Appendix B

Drawings 1 and 2 – Test Location Plan
Site Photos
Borehole and Test Pit Logs

Legend

- Site Boundary
- Cored Borehole
- Cored Borehole (Well)
- Test Pit



Site Locality

GREGORY HILLS DRIVE

LONG REEF CIRCUIT

WALLARAH CIRCUIT

0 10 20 30 40 50 m

Douglas Partners Geotechnics / Environment / Groundwater	TITLE: **Test Location Plan - Main Structures Proposed School Development - GHPS Wallarah Cct and Long Reef Cct, Gregory Hills**	N GDA94 / MGA zone 56	OFFICE: Macarthur DRAWN BY: DN DATE: 13/07/2022
CLIENT: Jacobs Group Pty Ltd	PROJ. #: 213594.00	DRAWING No: 1	REVISION: 1 — SCALE: As Shown

Photo 1 - Looking northeast from central portion of site

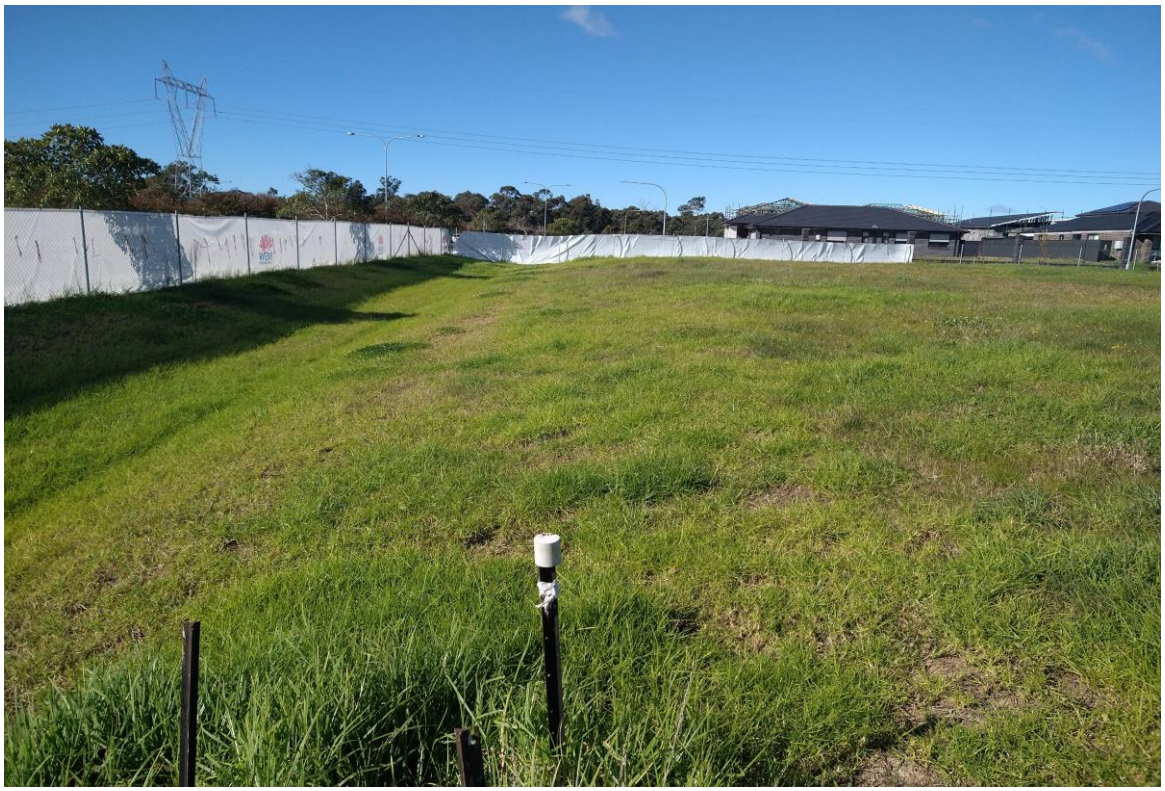


Photo 2 - Drainage Swale along northern buonrady of site

Douglas Partners Geotechnics / Environment / Groundwater	Site Photographs	PROJECT: 213594.00
	Proposed School	PLATE No: 1
	28 Wallarah Circuit, Gregory Hills	REV: A
	CLIENT: SINSW	DATE: Jul-22

Photo 3 - Looking south along eastern boundary

Photo 4 - Typical test pit conditions

Douglas Partners Geotechnics / Environment / Groundwater	Site Photographs	PROJECT: 213594.00
	Proposed School	PLATE No: 2
	28 Wallarah Circuit, Gregory Hills	REV: A
	CLIENT: SINSW	DATE: Jul-22

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 113.1 mAHD
EASTING: 295039.7
NORTHING: 6232863.1

PIT No: 1
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
113	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, dark brown, trace fine grained sand and rootlets, w<PL		D/E	0.1				
	0.5	FILL/Silty CLAY CI: medium plasticity, orange brown to pale grey, trace fine to medium grained sub-angular gravel, w<PL		D/E*	0.5				
112	1	Silty CLAY CI-CH: medium to high plasticity, pale grey mottled orange brown, with shale fragments, trace rootlets, w~PL, very stiff to hard, residual		D/E	1.0				
	1.2	SHALE: grey to dark grey, inferred very low to low strength, highly weathered, Bringelly Shale Below 1.5m: inferred low strength, highly to moderately weathered							
111	2								
	2.1	Pit discontinued at 2.1m - refusal							
110	3								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled, * Replicate sample BD1/220609 collected

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 114.2 mAHD
EASTING: 295089.5
NORTHING: 6232853.1

PIT No: 2
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
114	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, brown, trace rootlets, w<PL		D/E	0.1				
		FILL/Silty CLAY CL: low plasticity, dark brown to brown, w~PL		D/E	0.5				
	0.6	Silty CLAY CI-CH: medium to high plasticity, orange brown mottled pale grey, trace shale fragments, w<PL, very stiff to hard, residual							
113	0.8	SHALE: grey, inferred very low to low strength, highly weathered, Bringelly Shale							
	1								1
	1.7	Pit discontinued at 1.7m - refusal							
112	2								2
	3								3
111									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.0 mAHD
EASTING: 295142.4
NORTHING: 6232856.1

PIT No: 3
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
115	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, brown, trace rootlets, w<PL		D/E	0.1				
		FILL/Silty CLAY CI: medium plasticity, dark brown, w<PL							
	0.5	SHALE: pale grey and orange red brown, inferred very low strength, highly weathered, Bringelly Shale		D/E	0.5				
114	1	Below 1.0m: grey to dark grey, inferred very low to low strength, highly to moderately weathered							1
	1.5	Pit discontinued at 1.5m - refusal							
113	2								2
112	3								3

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.4 mAHD
EASTING: 295170.8
NORTHING: 6232841.1

PIT No: 4
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
115	0.15	FILL/TOPSOIL: Silty CLAY CI: medium plasticity, grey brown to brown, with fine to medium grained sub-angular to angular gravel, trace rootlets, w<PL		D/E	0.1				
		FILL/Silty CLAY CL: low plasticity, dark brown, trace fine grained sand, trace rootlets							
	0.5	Silty CLAY CI-CH: medium to high plasticity, orange brown and pale grey, trace fine grained sub-angular ironstone gravel, w~PL, very stiff to hard, residual		D/E	0.5				
	0.9	SHALE: grey to orange brown, iron stained in parts, inferred very low to low strength, highly weathered, Bringelly Shale		D/E	1.0				
114	1								1
	2	Below 2.0m: dark grey to grey, inferred low strength, highly to moderately weathered							2
113	2.5	Pit discontinued at 2.5m - refusal							
	3								3
112									

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 113.9 mAHD
EASTING: 295030.8
NORTHING: 6232814.6

PIT No: 5
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
113	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, brown, with fine to medium grained sub-angular to angular gravel, trace rootlets, w<PL		D/E	0.1				
	0.5	FILL/Silty CLAY CI: medium plasticity, orange brown, with fine to coarse grained sub-angular to angular gravel, w<PL							
	1.0	Silty CLAY CI-CH: medium to high plasticity, orange brown and pale grey, with shale fragments, w<PL, hard, residual		U_{50}	0.5				
				B/D/E	0.7				
		SHALE: grey and red brown, iron stained in parts, inferred very low to low strength, highly weathered, Bringelly Shale			1.0				
		Below 1.5m: inferred low strength, highly to moderately weathered		D	1.5				
112	1.9	Pit discontinued at 1.9m - refusal							
111									
110									

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 114.9 mAHD
EASTING: 295073.5
NORTHING: 6232785.1

PIT No: 6
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
114	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, brown, with fine to medium grained sub-angular to angular gravel, trace rootlets, w<PL		D/E	0.1				
	0.4	FILL/Silty CLAY CL: low plasticity, dark brown, brown and pale grey, with fine to coarse grained sub-angular to angular gravel, w<PL							
	0.6	FILL/Silty GRAVEL GM: dark grey, fine to coarse grained sub-angular to angular gravel, dry		D/E	0.5				
	1	SHALE: grey and red brown, iron stained in parts, inferred very low strength, highly weathered, Bringelly Shale		D	1.0				
113	2	Below 1.5m: inferred very low to low strength, highly to moderately weathered							
	2.5	Below 2.2m: dark grey to grey, minor iron staining, inferred low strength, moderately weathered							
112	3	Pit discontinued at 2.5m - refusal							
111									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.1 mAHD
EASTING: 295109.7
NORTHING: 6232805.9

PIT No: 7
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
115	0.2	FILL/TOPSOIL: Silty CLAY CI: medium plasticity, brown to grey brown, trace fine grained sand and fine to medium grained sub-angular to angular gravel, trace rootlets, w<PL		D/E	0.1				
	0.5	FILL/Silty CLAY CL: low plasticity, brown and pale grey, with fine to coarse grained sub-angular to angular gravel, trace sandstone and shale cobbles to 100mm, w<PL		D/E	0.4				
	0.9	Silty CLAY CI-CH: medium to high plasticity, grey, with red-brown iron stained shale fragments, w<PL, hard, residual		B E	0.5 0.8				
114	1.0	SHALE: grey to dark grey, inferred very low to low strength, highly to moderately weathered, Bringelly Shale			0.9				
		Pit discontinued at 1.0m - refusal							
113	2								
112	3								

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled, * Replicate sample BD5/220609 collected

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.4 mAHD
EASTING: 295087.9
NORTHING: 6232756.5

PIT No: 8
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
115	0.15	FILL/TOPSOIL: Silty CLAY CI: medium plasticity, brown to grey brown, with fine to medium grained sub-angular to angular gravel, trace shale fragments and rootlets, w<PL		D/E	0.1				
		FILL/Gravelly SAND SP: poorly graded, fine to medium grained, pale brown, fine to coarse grained sub-angular to angular gravel, with silt, trace shale and sandstone cobbles to 100mm At 0.5m: plastic sheeting debris		D/E*	0.5				
	0.6	Silty CLAY CI: medium plasticity, red-brown, trace fine to medium grained sub-angular gravel, w<PL, very stiff, residual							
	1	Below 1.0m: pale grey mottled red brown, becoming medium to high plasticity		D/E	1.0				1
114	1.4	SHALE: grey to brown, inferred low strength, highly to moderately weathered, Bringelly Shale		D	1.5				
	2	2.0 Pit discontinued at 2.0m - refusal							2
113	3								3
112									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled, * Replicate sample BD3/220609 collected

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 114.2 mAHD
EASTING: 295006.9
NORTHING: 6232740.1

PIT No: 9
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
114	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, brown, trace fine to medium grained sub-angular gravel, trace rootlets, w<PL		D/E	0.1				
		FILL/Silty CLAY CL: low plasticity, brown to red brown, trace fine to coarse grained sub-angular to angular gravel, trace cobbles up to 100mm		E	0.4				
	0.5	FILL/Silty CLAY CL-CI: low to medium plasticity, brown to grey brown, with fine to coarse grained sub-angular to angular gravel, trace fine grained sand and sandstone cobbles up to 150mm, w<PL		B	0.5				
	1			E*	1.0				1
113				D/E	1.5				
	1.6	Silty CLAY CI-CH: medium to high plasticity, red brown, with fine to medium grained sub-angular gravel, w<PL-w~PL, inferred stiff to very stiff, residual							
	2			D/E	2.0				2
112				D	2.5				
	3			D	3.0				3
	3.0	Pit discontinued at 3.0m - refusal							
111									

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled, * Replicate sample BD4/220609 collected

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 114.7 mAHD
EASTING: 295040.3
NORTHING: 6232714.9

PIT No: 10
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
114	0.3	FILL/TOPSOIL: Silty Gravelly CLAY: brown and grey brown, with shale cobbles up to 100mm, w<PL		D/E	0.1				
		FILL/Gravelly SAND SP: poorly graded, fine to medium grained, brown, fine to coarse grained sub-angular to angular gravel, with clay and silt, trace cobbles, dry		E	0.5				
	0.8	Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale grey, w<PL-w~PL, hard, residual		B	0.8				
	1			E	1.0				1
113		Below 1.5m: with shale fragments, grading to extremely weathered shale		D	1.5				
	2			D	2.0				2
112				D	2.5				
	3			D	3.0				3
	3.0	Pit discontinued at 3.0m - limit of investigation							
111									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.2 mAHD
EASTING: 295141
NORTHING: 6232819.3
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 213594.00
DATE: 6/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
115	0.15	FILL/TOPSOIL: Silty CLAY CL-CI, low to medium plasticity, brown to grey brown, with fine to medium grained, sub-angular gravel, trace rootlets, w~PL						Note: Unless otherwise stated, rock is fractured along smooth, planar, sub-horizontal bedding planes dipping at 0-10°	D/E			
	0.6	FILL/Silty CLAY CL: low plasticity, brown, trace fine grained gravel, high silt content							D/E			
114	1	SHALE: pale brown, inferred very low strength, highly weathered, Bringelly Shale							S			20,-,- refusal hammer bouncing
	1.5	Below 1.0m: grey, inferred very low to low strength, highly to moderately weathered						1.5-1.52m: Cs, 20mm silty clay				
113	2	SHALE: brown grey to dark grey, with intermittent iron stained clayey seams, highly to moderately weathered, very low to low strength, highly fractured to fractured						1.52-1.65m: Bx4, sh, pl, sm, cln 1.58-160m: Ds, gravel 20mm 1.67m: J, 70-90°, cu, sm, cln (1.62-1.72m) discontinuous 1.75m: B, 10°, un, sm, cln 1.85-1.88m: Cs, gravelly clay 25mm 1.91-1.93m: Cs, silty clay 20mm 2.10-2.11m: Cs, silty clay 15mm	C	100	44	PL(A) = 0.17 PL(A) = 0.06 PL(D) = 0.03 pp = 350
112	3	Below 3.08m: moderately weathered, low to medium strength, fractured to slightly fractured						2.2m: B, sh, pl, sm, clay co 10mm 2.52-2.53m: Cs, silty clay 10mm 2.53-2.54m: Cs, silty clay 10mm 2.59m: J, 60°, pl, sm, fe stn (2.55-2.64m) 2.75m: J, 70-80°, sm, (2.69-2.80m) partially he and discontinuous 2.87-2.95m: Cs, 0°, silty clay 80mm 2.98-3.01m: Cs, silty clay 30mm 3.05-3.07m: Bx2, 5-10°, pl, sm, clay co 5mm 3.68-3.70m: Cs, silty clay 20mm 3.76m: J, 40°, pl, sm, clay co 5mm 4.24-4.25m: Cs, silty clay 15mm 4.67-4.68m: Jx3, 10-15°, sm-ro, pl, partially he 1-3mm calcite 4.8m: B, sh, un, sm, clay co 5mm	C	100	84	PL(A) = 0.69 PL(D) = 0.9 PL(A) = 0.22 PL(D) = 0.17 PL(A) = 0.28 PL(D) = 0.16 PL(A) = 0.48 PL(D) = 0.29
111	4	Between 3.65-4.63m: <15% fine grained sandstone, indistinct bedding				13-07-22						
110	5 5.02	Below 4.78m: undulating boundary, grading to grey brown, highly weathered, very low to low strength SHALE: dark grey, fresh, low to medium strength, slightly fractured Below 5.35m: unbroken						4.93m: J, 15°, pl, sm, clay co 5mm 4.96-4.97m: Cs, silty clay 10mm 5.27-5.28m: Cs, 10°, silty clay 15mm 6.75m: J, 20°, un, sm-ro, cln	C	100	92	PL(A) = 2.2 PL(D) = 0.47
109	6 6.17	SANDSTONE: pale grey, fine grained, with <20% dark grey siltstone, fresh, medium to high strength, unbroken										
108	7 7.1	SHALE: grey to dark grey, fresh, medium to high strength, unbroken Between 7.23-7.25m: trace bioturbations										PL(A) = 1.05 PL(D) = 0.54
	7.65	Bore discontinued at 7.65m - limit of investigation										

RIG: Explora **DRILLER:** Groundtest **LOGGED:** DN **CASING:** HQ to 1.0m

TYPE OF BORING: SFA to 1.5m, NMLC coring to 7.65m

WATER OBSERVATIONS: Free groundwater measured at 3.8m depth

REMARKS: Location coordinates are in MGA94 Zone 56. Standpipe installed: 0.7m stickup, 0-3.65m casing; 0-4.0m spoil and backfill, 3.67-7.65m slotted screen; 4.0-4.5m bentonite; 4.5-7.65m gravel pack

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BORE: 101 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

1.50-6.00 m

BORE: 101 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

6.00-7.65 m

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.4 mAHD
EASTING: 295159.4
NORTHING: 6232815.5

PIT No: 102
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
115	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, grey brown, with fine grained sand and fine to medium grained sub-angular gravel, trace rootlets, w<PL		D/E*	0.1				
	0.4	FILL/Silty CLAY CL: low plasticity, red brown and brown, trace fine grained sub-angular gravel, w<PL		D/E	0.4				
	0.5	SHALE: grey to dark grey, inferred very low to low strength, highly to moderately weathered, Bringelly Shale							
		Pit discontinued at 0.5m - refusal							
114	1								
113	2								
112	3								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled, * Replicate sample BD2/220609 collected

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.6 mAHD
EASTING: 295135.3
NORTHING: 6232791.7

PIT No: 103
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
115	0.2	FILL/TOPSOIL: Silty CLAY CL: low plasticity, grey brown, with fine to medium grained sub-angular gravel, trace fine grained sand and rootlets, w<PL		D/E	0.1				
	0.5	FILL/Silty CLAY CL-CI: low to medium plasticity, brown, with fine to coarse grained sub-angular to angular gravel, trace sandstone and shale cobbles up to 50mm, w<PL		E	0.4				
	0.8	SHALE: grey and red brown, iron stained in parts, inferred very low to low strength, highly weathered, Bringelly Shale Below 0.7m: dark grey, inferred low strength, moderately weathered shale		D	0.5				
114	1	Pit discontinued at 0.8m - refusal							
113	2								
112	3								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 116.1 mAHD
EASTING: 295145.4
NORTHING: 6232757
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 213594.00
DATE: 6/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00	B - Bedding J - Joint S - Shear F - Fault				
116	0.2	FILL/TOPSOIL: Silty CLAY CL-CI, low to medium plasticity, brown, trace fine grained, sub-angular gravel and rootlets, w~PL						Note: Unless otherwise stated, rock is fractured along smooth, planar, sub-horizontal bedding planes dipping at 0-10°	D/E			
	0.8	FILL/Silty CLAY CL: low plasticity, brown, with fine grained sand and shale fragments, high silt content, w<PL							D/E			
115	1	SHALE: pale brown to brown, inferred very low to low strength, highly weathered, Bringelly Shale							D			
	1.2	SHALE: grey brown to dark grey, iron stained in parts, with <20% fine grained pale grey sandstone, moderately weathered, low to medium strength, highly fractured						1.22-1.23m: Cs, silty clay 15mm 1.25-1.28m: Bx3, sh, pl, sm, silty clay vn 1.35-1.36m: Cs, silty clay 10mm 1.46-1.48m: Cs, silty clay 25mm 1.91m: J, 80°, pl, sm, cln (1.82-2.00m) 2.08-2.18m: Cz, shale gravel and silty clay 100mm 2.60-2.72m: Ds, gravelly clay 120mm 2.88-2.89m: Cs, gravelly clay 15mm 3.13m: J, 20°, pl, sm, cln 3.35m: B, sh, vn, sm, cln 3.38-3.41m: Cs, silty clay 30mm 3.55m: J, 80-85°, ir, ro, calcite V 1mm (3.51-3.59m) 3.94-3.96m: Cs, sandy clay 20mm	C	100	64	PL(A) = 0.35 PL(D) = 0.11 PL(A) = 0.78 PL(D) = 0.26 PL(A) = 0.1
114	2	Below 1.63m: slightly fractured										
		Below 2.18m: slightly weathered, low strength, fractured										
113	3											
	3.51	SANDSTONE: fine grained, brown grey, trace dark grey siltstone laminations, iron stained in parts, slightly weathered, low to medium strength, fractured							C	100	93	PL(A) = 1.39 PL(D) = 0.07
112	4											
	4.24	SHALE: grey to dark grey, trace bioturbations, slightly weathered, medium strength, unbroken										PL(A) = 0.26 PL(D) = 0.22
	4.6	SANDSTONE: fine grained, pale grey, with <20% dark grey siltstone, fresh, medium to high strength, unbroken										
111	5							5.24m: J, 20°, pl, ro, cln				PL(A) = 0.68 PL(D) = 0.41
								5.77m: J, 40-80°, cu, ro, cln (5.75-5.81m)				
110	6							6.14m: B, sh, pl, ro, cln 6.26m: J, 70-90°, ir, ro, calcite V 1mm (6.16-6.35m)				PL(A) = 2.35 PL(D) = 0.18
	6.5	Bore discontinued at 6.5m - limit of investigation										
109	7											

RIG: Explora **DRILLER:** Groundtest **LOGGED:** DN **CASING:** HQ to 1.0m

TYPE OF BORING: SFA to 1.2m, NMLC coring to 6.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. Backfilled

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BORE: 104 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

1.20-6.00 m

BORE: 104 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

6.00-6.50 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.8 mAHD
EASTING: 295125.8
NORTHING: 6232750.7
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 213594.00
DATE: 8/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 0.05 0.10 0.50 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
115.8	0.2	FILL/TOPSOIL: Silty CLAY CL-CI, low to medium plasticity, brown, with fine grained, sub-angular gravel and rootlets, w<PL						Note: Unless otherwise stated, rock is fractured along smooth, planar, sub-horizontal bedding planes dipping at 0-10°	D/E			
	0.8	FILL/Silty CLAY CL: low plasticity, brown, with fine grained sand and shale fragments, high silt content, w<PL							D			
115	1	SHALE: pale brown, very low to low strength, highly weathered, Bringelly Shale							D S			13,-,- refusal hammer bouncing, no recovery
	1.35							1.2m: CORE LOSS: 150mm	C	70	46	PL(A) = 0.52
	1.68	SANDSTONE: fine grained, brown, with 30% dark grey siltstone laminations, moderately to slightly weathered, low to medium strength, slightly fractured						1.58m: J, 70°, pl, sm-ro, cln (1.53-1.64m) 1.6m: B, sh, pl, sm-ro, clay vn 1.64-1.68m: Ds 40mm 1.68-1.73m: Cs 50mm				pp = 190-200
114	2	SHALE: dark grey brown, moderately weathered, medium strength, slightly fractured										pp = 220-290
	2.2	Below 2.0m: pale grey and orange brown, extremely weathered						2.27-2.30m: Bx4, sh, pl, sm, fe, clay vn 2.32-2.34m: Ds 20mm 2.34-2.38m: Cs 40mm 2.47-2.48m: Jx2, 20°, pl, sm-ro, fe, clay vn 2.80-2.82m: Ds 20mm 2.82-2.84m: Cs 15mm 2.87-2.92m: Cs 15mm 3.02m: B, sh, un, sm, clay co 5mm 3.10-3.11m: Cs 10mm 3.14-3.17m: Cs 30mm 3.19-3.21m: Ds 20mm 3.27-3.29m: Cs, clay with gravel 20mm 3.31-3.34m: Ds 30mm 3.36-3.38m: Cs 20mm 3.41m: J, 60-80°, cu, sm, cln (3.38-3.49m) 3.43-3.46m: Bx3, sh, pl, clay vn 3.57m: B, sh, un, sm, clay co 5mm 3.89-3.94m: Bx3, sh, pl, m, fe, clay vn	C	100	30	PL(A) = 1.41 PL(D) = 0.47
113	3	SANDSTONE: fine grained, brown to pale grey, with 20% dark grey siltstone laminations, distinct subhorizontal bedding, highly weathered, very low to low strength, highly fractured										
	3.38	Between 2.45-3.11m: moderately to slightly weathered, medium to high strength, fractured to slightly fractured										PL(A) = 0.46 PL(D) = 0.39
112	4	SHALE: dark grey, with <10% pale grey, fine grained sandstone laminations, trace bioturbations, moderately weathered, medium strength, fractured										PL(A) = 0.47 PL(D) = 0.43
	4.75	SANDSTONE: fine grained, pale grey, with 20% dark grey siltstone laminations, distinct bedding at 0-10°, slightly weathered to fresh, medium to high strength, unbroken							C	100	98	
111	5							5.42m: Jx2, ir, ro, calcite V 1-2mm (5.35-5.48m)				PL(A) = 0.78 PL(D) = 0.06
110	6							6.21m: J, 50°, pl, ro, cln				
	6.57	Bore discontinued at 6.57m - limit of investigation										PL(A) = 1.74 PL(D) = 0.25
109	7											
108												

RIG: Explora **DRILLER:** Groundtest **LOGGED:** DN **CASING:** HQ to 1.0m

TYPE OF BORING: SFA to 1.2m, NMLC coring to 6.57m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. Backfilled

SAMPLING & IN SITU TESTING LEGEND

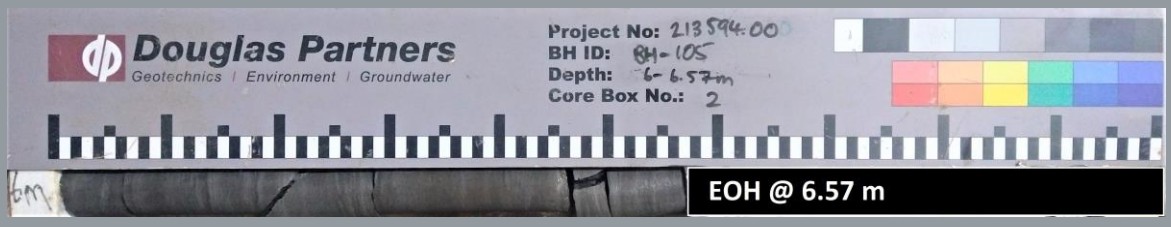
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 105 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

1.20-6.00 m

BORE: 105 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022



6.00-6.57 m

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 116.3 mAHD
EASTING: 295137.6
NORTHING: 6232718.8

PIT No: 106
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
116	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, brown to grey brown, with fine grained sand and fine to coarse grained sub-angular to angular gravel, trace rootlets, w<PL		D	0.1				
	0.4	FILL/Silty CLAY CI: medium plasticity, brown, with fine to medium grained sub-angular gravel, trace fine grained sand, w~PL							
		Silty CLAY CI: medium plasticity, pale grey and red-brown, with red-brown iron stained shale fragments, w<PL, hard, residual grading to extremely weathered shale		D	0.5				
	0.9	SHALE: grey to brown grey, iron stained in parts, inferred low strength, highly to moderately weathered, Bringelly Shale							
115	1.1	Pit discontinued at 1.1m - refusal							
114									
113									

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 116.3 mAHD
EASTING: 295132.8
NORTHING: 6232696.3
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 213594.00
DATE: 8/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
116	0.2	FILL/TOPSOIL: Silty CLAY CL-CI, low to medium plasticity, grey brown to brown, with fine to medium grained, sub-angular gravel, trace fine grained sand and rootlets, w<PL						Note: Unless otherwise stated, rock is fractured along smooth, planar, sub-horizontal bedding planes dipping at 0-10°	D/E			
	1.0	FILL/Silty CLAY CL: low plasticity, brown, trace fine to medium grained gravel and fine grained sand, high silt content, w<PL							D			
115	1.6	Silty CLAY CI-CH: medium to high plasticity, pale grey mottled red brown, w~PL, hard, residual Below 1.3m: with dark brown grey shale fragments, grading to extremely weathered shale							S			10,20,25/90mm refusal pp >550-600
114	2.86	SHALE: brown and dark brown, highly to moderately weathered, very low to low strength, fragmented to highly fractured Below 2.59: extremely weathered						1.66m: J, 60°, pl, sm, clay vn (1.62-1.70m) 1.70-1.74m: Cz 40mm 1.84m: Jx2, 80°, pl, sm, fe stn (1.75-1.93m) 1.87-1.89m: Cs 15mm 1.93-1.97m: Cs 30° 40mm 2.05m: Jx2, 80-90°, pl, sm, clay vn (2.00-2.13m) 2.11m: J, 50°, pl, sm, cln	C	100	0	pp = 420-490
113	3.55	SHALE: brown and dark brown, <10% fine grained sandstone, highly to moderately weathrered, very low to low strength, highly fractured to fractured						2.25-2.31m: Cs, sh, clay with gravel 60mm 2.38-2.44m: Cz 60mm 2.49-2.52m: Cs 30mm 2.52m: Jx2, 80°, pl, sm, cln (2.44-2.60m) discontinuous	C	100	41	PL(A) = 0.06 PL(A) = 0.02
112	4.61	SHALE: pale grey brown to brown, with carbonaceous flecks, abundant subvertical joints, possibly claystone, highly weathered, very low strength, highly fractured						2.59m: Cs 270mm, hard 2.91m: J, 20°, pl, sm-ro, cln 2.93m: J, 80°, ir, sm-ro, clay vn (2.86-3.00m) discontinuous 2.97-3.05m: Cs 90mm 3.07-3.13m: Cz, clay and gravels 60mm 3.18m: J, 80-90°, pl, sm, fe stn (3.08-3.28m) 3.31-3.32m: Cs 10mm 3.45-3.55m: Cs 100mm 3.57-3.93m: Jx12, 60-90°, ir, sm, fe clay vn 3.70-3.75m: Cs 50mm 3.93m: Cs 680mm, hard 4.28-4.31m: Jx2, 70°, pl, sm, fe clay co 10mm 4.61-4.64m: Ds 30mm 4.80-4.86m: Cs 60mm 4.95m: J, 85-90°, pl, sm, cln (4.60-5.30m) orthogonal 5.91m: J, 40°, pl, sm, fe stn 6.06-6.07m: Cs 10mm 6.07m: J, 50°, pl, sm, cln 6.12m: J, 60°, pl, sm, cln 6.62-6.72m: Jx3, 30-50°, pl, fe clay vn, partially he 6.75m: J, 70-80°, pl, sm, cln (6.71-6.80m)	C	100	75	pp = 410-450 pp = 150-260 PL(A) = 0.01 PL(A) = 0.01 PL(A) = 0.15 PL(A) = 0.2
111	5.61	Below 5.61m: highly to moderately weathered, very low to low strength, fractured										
110	6.85	Bore discontinued at 6.85m - limit of investigation										
109												

RIG: Explora **DRILLER:** Groundtest **LOGGED:** DN **CASING:** HQ to 1.0m

TYPE OF BORING: SFA to 1.6m, NMLC coring to 6.85m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. Backfilled

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BORE: 107 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

1.60-6.00 m

BORE: 107 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

6.00-6.85 m

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.8 mAHD
EASTING: 295112.8
NORTHING: 6232700

PIT No: 108
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
115	0.2	FILL/TOPSOIL: Silty CLAY CL: low plasticity, brown grey, trace fine to medium grained sub-angular gravel, trace rootlets, w<PL		D/E	0.1				
	0.4	FILL/Silty CLAY CL-CI: low to medium plasticity, brown, with fine grained sand, with fine to medium grained sub-angular gravel, w<PL		E	0.3				
	1	Silty CLAY CI-CH: medium to high plasticity, pale grey mottled red-brown, trace fine to medium grained sub-angular gravel, w<PL, very stiff to hard, residual grading to extremely weathered shale		D/E	0.5				
				D	1.0				
114	1.4	SHALE: grey and grey brown, iron stained in parts, inferred very low to low strength, highly to moderately weathered, Bringelly Shale							
	2 2.0	Pit discontinued at 2.0m - refusal							
113	3								
112									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.7 mAHD
EASTING: 295100.1
NORTHING: 6232708
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
115	0.2	FILL/TOPSOIL: Silty CLAY CL-CI, low to medium plasticity, brown to grey brown, with fine to medium grained, sub-angular gravel, trace fine grained sand and rootlets, w~PL						Note: Unless otherwise stated, rock is fractured along smooth, planar, sub-horizontal bedding planes dipping at 0-10°	D/E			
	0.8	FILL/Gravelly Silty SAND SP-SM: dark grey brown, fine grained sand, fine to medium grained, sub-angular gravel, w<PL							D/E			
	1	Silty CLAY CL-CI: low to medium plasticity, brown to pale brown, with fine to medium grained, sub-angular gravel, high silt content, w~PL, hard, residual							D			
									S			21,18,23 N = 41
114	2	Below 1.87m: brown to orange brown, with fine to medium grained, sub-angular gravel, firm to stiff						1.5m: CORE LOSS: 690mm	C	59	0	pp = 90-110 pp >550-600 PL(A) = 0.06 PL(D) = 0.05
	2.19	SHALE: brown, iron stained in parts, with intermittent clayey seams, highly to moderately weathered, very low to low strength, fragmented						2.19-2.21m: Cs 20mm 2.22-2.29m: Cz 70mm 2.29-2.35m: Ds 60mm 2.38-2.40m: Cs 20mm 2.41m: CORE LOSS: 110mm				
113	2.52							2.52-2.65m: Cz 130mm (possibly drilling induced) 2.65-2.67m: Cs 20mm 2.67-2.74m: Cz 70mm (possibly drilling induced)	C	91	11	
	3	Below 3.06m: fragmented to highly fractured										pp = 200-470 PL(A) = 0.03
112	3.65							2.74-2.76m: Cs 20mm 2.76-2.80m: Cz 40mm (possibly drilling induced) 2.89-2.92m: Cs 25mm 2.93-2.94m: Cs 10mm 2.95m: Bx2, sh pl, sm, clay vn 2.96-3.00m: Cz 40mm (possibly handling induced) 3.00-3.06m: Cs clay with gravel 60mm 3.20-3.31m: Cs clay with gravel 110mm	C	93	0	PL(A) = 0.27
	4											
111	5					13-07-22						
	5.33	SHALE: brown, iron stained in parts, recovered as gravel up to 6m depth, moderately weathered, low to medium strength, highly fractured to fractured						3.38-3.40m: Bx2, sh, pl, sm, fe clay co 5mm 3.47-3.49m: Cs 20mm 3.52-3.58m: Cs 60mm 3.65m: CORE LOSS: 100mm 3.81-3.84m: Ds 30mm 3.84-3.92m: Jx2, 40-70°, ir, sm, clay vn 3.88-3.90m: Ds 20mm 3.96-3.97m: Cs 10mm 4.04m: J, 20°, pl, sm, clay vn 4.07-4.22m: Jx4, 20-70°, ir, sm, clay vn, discontinuous 5.17m: CORE LOSS: 160mm	C	92	33	PL(A) = 0.27
110	6											
		Between 6.52-6.60m: fine grained sandstone band										
109		Below 6.86m: grey to brown grey										PL(A) = 0.32
	7											
	7.2	Bore discontinued at 7.2m - limit of investigation						5.57-5.59m: Cs 20mm 5.61-5.65m: Cs 40mm 5.76-5.80m: Ds 40mm 6.05m: J, 20°, pl, sm, cln 6.32m: J, 70-80°, pl, sm, cln (6.26-6.39m)				
108												

RIG: Explora **DRILLER:** Groundtest **LOGGED:** DN **CASING:** HQ to 1.0m

TYPE OF BORING: SFA to 1.5m, NMLC coring to 7.2m

WATER OBSERVATIONS: Free groundwater measured at 5.0m depth

REMARKS: Location coordinates are in MGA94 Zone 56. Standpipe installed: 0.8m stickup, 0-4.2m casing; 0-3.5m spoil and backfill, 4.20-7.20m slotted screen; 3.5-4.0m bentonite; 4.0-7.2m gravel pack

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.7 mAHD
EASTING: 295100.1
NORTHING: 6232708
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
107	9							6.32-640m: Cz 80mm 6.33m: J, 60°, pl, sm, cln (6.30-6.36m) 6.48m: J, 20°, pl, sm, clay co 5mm 6.63m: J, 70-90°, ir, sm-ro, fe stn (6.57-6.59m) discontinuous 6.64m: J, 50°, pl, sm, clay vn 6.78-6.82m: Cz 40mm 6.84-6.86m: Ds 20mm 7.05m: J, 80-90°, pl, sm, clay vn (6.89-7.20m) 7.12m: Jx2, 60-90°, cu, sm, cln (7.05-7.17m)				
106	10											
105	11											
104	12											
103	13											
102	14											
101	15											
100												

RIG: Explora **DRILLER:** Groundtest **LOGGED:** DN **CASING:** HQ to 1.0m

TYPE OF BORING: SFA to 1.5m, NMLC coring to 7.2m

WATER OBSERVATIONS: Free groundwater measured at 5.0m depth

REMARKS: Location coordinates are in MGA94 Zone 56. Standpipe installed: 0.8m stickup, 0-4.2m casing; 0-3.5m spoil and backfill, 4.20-7.20m slotted screen; 3.5-4.0m bentonite; 4.0-7.2m gravel pack

SAMPLING & IN SITU TESTING LEGEND

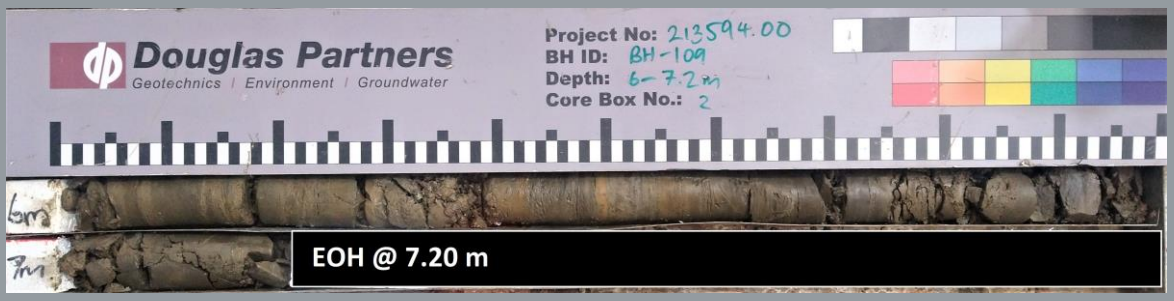
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 109 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

1.50-6.00 m

BORE: 109 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022



6.00-7.20 m

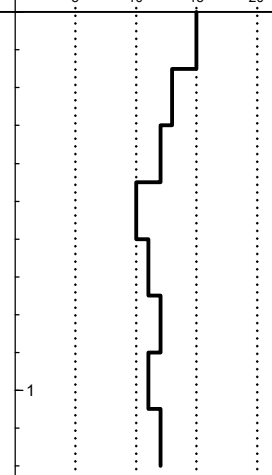
TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 114.8 mAHD
EASTING: 295051
NORTHING: 6232719.2

PIT No: 110
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
114	0.2	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, brown, with fine to medium grained sub-angular gravel, trace rootlets, w<PL		D	0.1				
	0.4	FILL/Silty CLAY CL: low plasticity, brown, with fine to coarse grained sub-angular to angular gravel, trace rootlets, w<PL							
	1	Silty CLAY CI-CH: medium to high plasticity, red-brown mottled pale grey, w<PL-w~PL, very stiff, residual		D	0.5				
				D	1.0				
113		Below 1.5m: with shale fragments, grading to extremely weathered shale		D	1.5				
	2			D	2.0				
112				D	2.5				
	3	3.0 Pit discontinued at 3.0m - limit of investigation							
111									



RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.8 mAHD
EASTING: 295104
NORTHING: 6232731.5

PIT No: 111
PROJECT No: 213594.00
DATE: 9/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
115	0.15	FILL/TOPSOIL: Silty CLAY CL-CI: low to medium plasticity, brown to grey brown, with fine grained sand and fine to medium grained sub-angular gravel, trace rootlets, w<PL		D	0.1				
		FILL/Gravelly SAND SP: pooly graded, fine to medium grained, brown grey, fine to coarse grained sub-angular to angular gravel, with silt, trace clay, sandstone and shale cobbles up to 60mm, w<PL		D	0.5				
	0.6	Silty CLAY CI-CH: medium to high plasticity, red-brown, trace fine to medium grained sub-angular gravel , w<PL, hard, residual			0.7				
	1			U_{50}	0.85				1
				D	1.0				
	1.4	SHALE: grey brown to orange red brown, iron stained, inferred very low to low strength, highly weathered, Bringelly Shale		D	1.5				
114	1.7	Pit discontinued at 1.7m - refusal							
	2								2
113	3								3
112									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6t excavator - 450mm bucket

LOGGED: DN

SURVEY DATUM: MGA94 Zone 56

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Backfilled

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.0 mAHD
EASTING: 295059.9
NORTHING: 6232742.3
DIP/AZIMUTH: 90°/--

BORE No: 112
PROJECT No: 213594.00
DATE: 8/6/2022
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
115	0.2	FILL/TOPSOIL: Silty CLAY CL-CI, low to medium plasticity, brown to grey brown, trace fine to medium grained gravel and rootlets, w<PL							D/E			
		FILL/Silty CLAY CL: low plasticity, brown, with fine to medium grained, sub-angular gravel, high silt content, w<PL						Note: Unless otherwise stated, rock is fractured along smooth, planar, sub-horizontal bedding planes dipping at 0-10°	D			
114	1 1.0	Silty CLAY CI-CH: medium to high plasticity, orange red brown mottled pale grey, with fine to medium grained, sub-angular ironstone gravel, w<PL, hard, residual							D			
		Below 1.8m: orange brown, increase in shale and sandstone fragments, grading to extremely weathered sandstone							S			10,16,21 N = 37
113	2 2.4	SANDSTONE: pale brown, fine to medium grained, inferred very low to low strength, highly weathered										
	2.69	SANDSTONE: fine to medium grained, pale brown grey, moderately weathered, very low to low strength, highly fractured to fractured						2.5m: CORE LOSS: 190mm 2.75-2.78m: Ds 30mm 2.84m: B, sh, pl,ro, clayey sand co 10mm 3.09-3.17m: Bx3, pl, ro, fe, sandy clay co 5-10mm 3.26-3.29m: Ds, gravelly sandy clay 30mm 3.37-3.38m: Cs 10mm 3.66m: J, 10-40°, un, ro, cln	C	91	50	PL(A) = 0.04 PL(A) = 0.31
112	3	Below 3.3m: low to medium strength, fractured						4.10-4.13m: Cs 30mm 4.21m: J, 60-90°, cu, ro (4.12-4.30m) fe, clay vn 4.25m: J, 70-90°, ir, ro (4.22-4.29m) partially ca vn, he and discontinuous				PL(A) = 2.73
111	4	Below 4.53m: moderately weathered, low to medium strength, fractured						4.37m: J, 60-70°, pl, ro, cln (4.32-4.43m) ti 4.41-4.51m: Cz 100mm 4.51-4.53m: Cs 15mm 4.56m: J, 20°, pl, ro, cln 4.62-4.67m: Ds 50mm 4.63m: J, 50-60°, pl, ro, cln (4.58-4.67m) 4.76-4.83m: Ds 70mm 4.89m: B, sh, pl, ro, fe, sandy clay co 5mm 5.37-5.44m: Jx2, 30°, pl, sm, cln 5.53m: J, 40°, pl, sm, cln 5.58m: J, 70-80°, ir, ro, cln (5.52-5.65m) 5.65m: J, 10°, un, ro, fe, clay vn 5.73m: J, 40°, pl, ro, fe stn 5.78m: J, 50°, pl, ro, fe stn 5.91m: J, 40°, pl, ro, fe stn 7.05m: J, 10°, pl, sm, clay vn 7.25m: J, 30°, pl, sm, clay co 5mm				PL(A) = 0.15 PL(A) = 0.28
110	5 5.16	SHALE: dark grey and dark brown, with <20% pale brown grey, fine to medium grained sandstone, disturbed to indistinct sub-horizonal bedding, moderately to slightly weathered, low to medium strength, fractured to slightly fractured							C	100	65	
109	6											PL(A) = 0.36
108	7 7.7	Bore discontinued at 7.7m - limit of investigation										PL(A) = 0.24

RIG: Explora **DRILLER:** Groundtest **LOGGED:** DN **CASING:** HQ to 1.0m

TYPE OF BORING: SFA to 1.5m, NMLC coring to 7.2m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. Backfilled

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Schools
LOCATION: Long Reef Circuit, Gregory Hills

SURFACE LEVEL: 115.0 mAHD
EASTING: 295059.9
NORTHING: 6232742.3
DIP/AZIMUTH: 90°/--

BORE No: 112
PROJECT No: 213594.00
DATE: 8/6/2022
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
107								7.35-7.36m: Cs 10mm				
106	9											
105	10											
104	11											
103	12											
102	13											
101	14											
100	15											

RIG: Explora **DRILLER:** Groundtest **LOGGED:** DN **CASING:** HQ to 1.0m

TYPE OF BORING: SFA to 1.5m, NMLC coring to 7.2m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Location coordinates are in MGA94 Zone 56. Backfilled

SAMPLING & IN SITU TESTING LEGEND

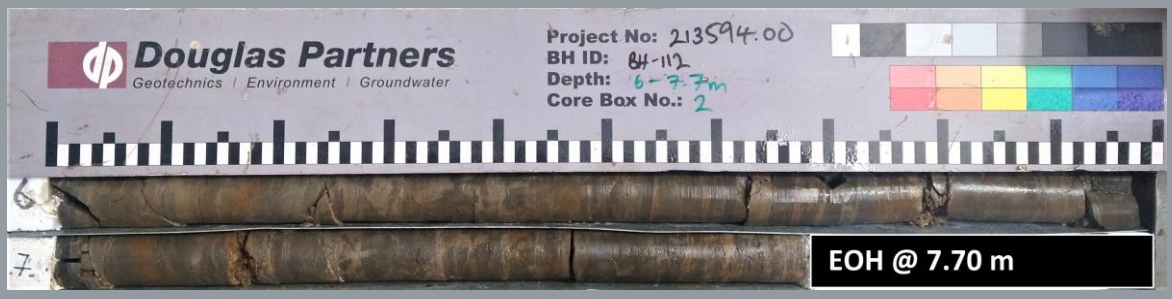
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BORE: 112 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022

2.50-6.00 m

BORE: 112 PROJECT: SCHOOL-GREGORY HILLS JUNE 2022



6.00-7.70 m

Appendix C

Results of Laboratory Testing
Summary of Salinity Results

Material Test Report

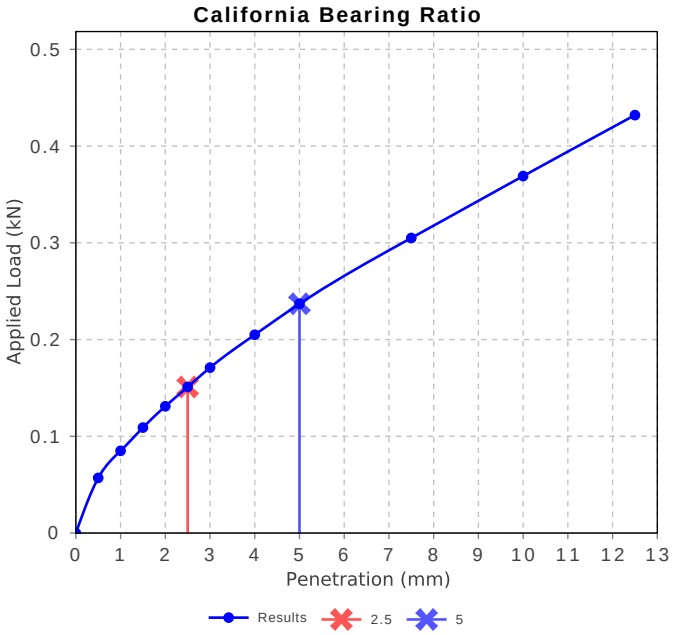
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: Tim.white@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Simon Rosam
dp-simon
Laboratory Accreditation Number: 828

Report Number: **213594.00-2**
Issue Number: 1
Date Issued: 08/07/2022
Client: School Infrastructure NSW
c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact: Marisa Sidoti
Project Number: 213594.00
Project Name: Proposed Schools
Project Location: Long Reef Circuit, Gregory Hills NSW
Work Request: 8191
Sample Number: MA-8191A
Date Sampled: 09/06/2022
Dates Tested: 20/06/2022 - 05/07/2022
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **7 , Depth: 0.5 - 0.9m**
Material: silty CLAY, grey

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**1.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.77		
Optimum Moisture Content (%)	17.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.67		
Field Moisture Content (%)	14.2		
Moisture Content at Placement (%)	17.1		
Moisture Content Top 30mm (%)	25.0		
Moisture Content Rest of Sample (%)	18.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	166.7		
Swell (%)	6.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: Tim.white@douglaspartners.com.au

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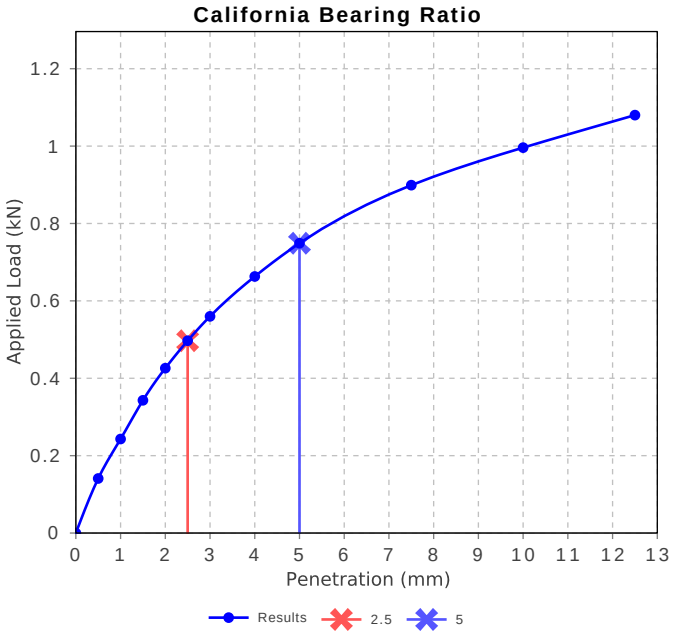
Approved Signatory: Simon Rosam
dp-simon
Laboratory Accreditation Number: 828

Report Number: **213594.00-2**
Issue Number: 1
Date Issued: 08/07/2022
Client: School Infrastructure NSW
c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact: Marisa Sidoti
Project Number: 213594.00
Project Name: Proposed Schools
Project Location: Long Reef Circuit, Gregory Hills NSW
Work Request: 8191
Sample Number: MA-8191B
Date Sampled: 09/06/2022
Dates Tested: 20/06/2022 - 05/07/2022
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **9 , Depth: 0.5 - 1.0m**
Material: Fill: silty CLAY, brown to grey brown

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**4.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.82		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.81		
Field Moisture Content (%)	15.2		
Moisture Content at Placement (%)	15.3		
Moisture Content Top 30mm (%)	20.3		
Moisture Content Rest of Sample (%)	18.9		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	188.1		
Swell (%)	0.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

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Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: Tim.white@douglaspartners.com.au

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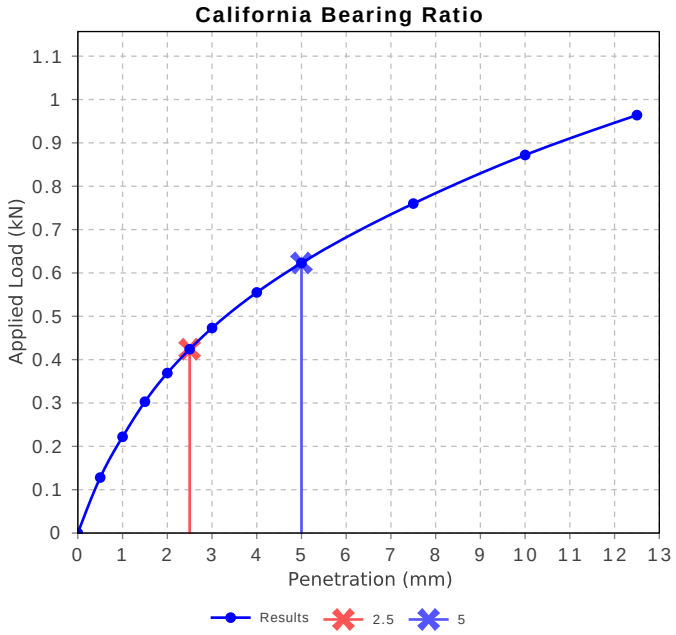
Approved Signatory: Simon Rosam
dp-simon
Laboratory Accreditation Number: 828

Report Number: **213594.00-2**
Issue Number: 1
Date Issued: 08/07/2022
Client: School Infrastructure NSW
c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact: Marisa Sidoti
Project Number: 213594.00
Project Name: Proposed Schools
Project Location: Long Reef Circuit, Gregory Hills NSW
Work Request: 8191
Sample Number: MA-8191C
Date Sampled: 09/06/2022
Dates Tested: 20/06/2022 - 05/07/2022
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **10 , Depth: 0.8 - 1.0m**
Material: silty CLAY, red brown mottled pale grey

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.73		
Optimum Moisture Content (%)	18.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.70		
Field Moisture Content (%)	14.6		
Moisture Content at Placement (%)	18.5		
Moisture Content Top 30mm (%)	22.1		
Moisture Content Rest of Sample (%)	21.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	168.0		
Swell (%)	1.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0.0		



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
clean lab
Laboratory Accreditation Number: 828

Report Number: **213594.00-1**
Issue Number: 1
Date Issued: 07/07/2022
Client: School Infrastructure NSW
c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact: Marisa Sidoti
Project Number: 213594.00
Project Name: Proposed Schools
Project Location: Long Reef Circuit, Gregory Hills NSW
Work Request: 8197
Sample Number: MA-8197A
Date Sampled: 09/06/2022
Dates Tested: 21/06/2022 - 06/07/2022
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **4 (0.5 m)**
Material: silty CLAY: orange brown and pale grey

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	51		
Plastic Limit (%)	20		
Plasticity Index (%)	**31**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	13.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	20.7

Material Test Report

Douglas Partners
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Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Report Number:	**213594.00-1**
Issue Number:	1
Date Issued:	07/07/2022
Client:	School Infrastructure NSW
	c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact:	Marisa Sidoti
Project Number:	213594.00
Project Name:	Proposed Schools
Project Location:	Long Reef Circuit, Gregory Hills NSW
Work Request:	8197
Sample Number:	MA-8197B
Date Sampled:	09/06/2022
Dates Tested:	21/06/2022 - 06/07/2022
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Sample Location:	**7 (0.5 - 0.7 m)**
Material:	silty CLAY: grey

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Approved Signatory: Nilusha Arachchi
clean lab
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	42		
Plastic Limit (%)	20		
Plasticity Index (%)	**22**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	11.0		
Cracking Crumbling Curling	None		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	11.0

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Report Number:	**213594.00-1**
Issue Number:	1
Date Issued:	07/07/2022
Client:	School Infrastructure NSW
	c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact:	Marisa Sidoti
Project Number:	213594.00
Project Name:	Proposed Schools
Project Location:	Long Reef Circuit, Gregory Hills NSW
Work Request:	8197
Sample Number:	MA-8197C
Date Sampled:	09/06/2022
Dates Tested:	21/06/2022 - 06/07/2022
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Sample Location:	**7 (0.8 m)**
Material:	silty CLAY: grey

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Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	57		
Plastic Limit (%)	21		
Plasticity Index (%)	**36**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	12.5		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	14.5

Material Test Report

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Report Number:	**213594.00-1**
Issue Number:	1
Date Issued:	07/07/2022
Client:	School Infrastructure NSW c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact:	Marisa Sidoti
Project Number:	213594.00
Project Name:	Proposed Schools
Project Location:	Long Reef Circuit, Gregory Hills NSW
Work Request:	8197
Sample Number:	MA-8197D
Date Sampled:	09/06/2022
Dates Tested:	21/06/2022 - 05/07/2022
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**5 (0.5 - 0.7 m)**
Material:	silty CLAY, orange brown and pale grey

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	59		
Plastic Limit (%)	21		
Plasticity Index (%)	**38**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	13.0		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	18.1

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Approved Signatory: Nilusha Arachchi
clean lab
Laboratory Accreditation Number: 828

Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Report Number:	**213594.00-1**
Issue Number:	1
Date Issued:	07/07/2022
Client:	School Infrastructure NSW
	c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact:	Marisa Sidoti
Project Number:	213594.00
Project Name:	Proposed Schools
Project Location:	Long Reef Circuit, Gregory Hills NSW
Work Request:	8197
Sample Number:	MA-8197E
Date Sampled:	09/06/2022
Dates Tested:	21/06/2022 - 06/07/2022
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Sample Location:	**5 (0.5 - 0.1 m)**
Material:	silty CLAY, orange brown and pale grey

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Approved Signatory: Nilusha Arachchi
clean lab
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	67		
Plastic Limit (%)	21		
Plasticity Index (%)	**46**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	13.5		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	17.6

Material Test Report

Douglas Partners
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Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Report Number:	**213594.00-1**
Issue Number:	1
Date Issued:	07/07/2022
Client:	School Infrastructure NSW
	c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact:	Marisa Sidoti
Project Number:	213594.00
Project Name:	Proposed Schools
Project Location:	Long Reef Circuit, Gregory Hills NSW
Work Request:	8197
Sample Number:	MA-8197F
Date Sampled:	09/06/2022
Dates Tested:	21/06/2022 - 06/07/2022
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Sample Location:	**8 (1.0 m)**
Material:	silty CLAY, pale grey mottled red brown

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Approved Signatory: Nilusha Arachchi
clean lab
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	62		
Plastic Limit (%)	22		
Plasticity Index (%)	**40**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	15.5		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	17.3

Material Test Report

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Report Number:	**213594.00-1**
Issue Number:	1
Date Issued:	07/07/2022
Client:	School Infrastructure NSW c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact:	Marisa Sidoti
Project Number:	213594.00
Project Name:	Proposed Schools
Project Location:	Long Reef Circuit, Gregory Hills NSW
Work Request:	8197
Sample Number:	MA-8197AC
Date Sampled:	09/07/2022
Dates Tested:	21/06/2022 - 06/07/2022
Sample Location:	**107 (1.0 - 1.39 m)**
Material:	silty CLAY, pale grey mottled red brown

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
clean lab
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	55		
Plastic Limit (%)	18		
Plasticity Index (%)	**37**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	13.5		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	14.1

Material Test Report

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Report Number:	**213594.00-1**
Issue Number:	1
Date Issued:	07/07/2022
Client:	School Infrastructure NSW c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact:	Marisa Sidoti
Project Number:	213594.00
Project Name:	Proposed Schools
Project Location:	Long Reef Circuit, Gregory Hills NSW
Work Request:	8197
Sample Number:	MA-8197AD
Date Sampled:	09/07/2022
Dates Tested:	21/06/2022 - 06/07/2022
Sample Location:	**10 (0.8 -1.0 m)**
Material:	silty CLAY, red brown mottled pale grey

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
clean lab
Laboratory Accreditation Number: 828

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	53		
Plastic Limit (%)	19		
Plasticity Index (%)	**34**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	13.0		
Cracking Crumbling Curling	Curling		

Moisture Content (AS 1289 2.1.1)	
Moisture Content (%)	16.0

Material Test Report

Report Number: **213594.00-1**
Issue Number: 1
Date Issued: 07/07/2022
Client: School Infrastructure NSW
c/ Jacobs Group (Australia) Pty Ltd, South Brisbane QLD 4101
Contact: Marisa Sidoti
Project Number: 213594.00
Project Name: Proposed Schools
Project Location: Long Reef Circuit, Gregory Hills NSW
Work Request: 8197
Dates Tested: 21/06/2022 - 28/06/2022
Location: Long Reef Circuit, Gregory Hills

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Email: meregal.henakaa@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Nilusha Arachchi
clean lab
Laboratory Accreditation Number: 828

Determination of pH of Soil (In-House) DP MAC1

Sample Number	Location	Depth (m)	Material	pH Value
MA-8197G	1	0.5	Soil	6.0
MA-8197H	2	0.5	Soil	7.3
MA-8197I	4	0.1	Soil	7.0
MA-8197J	4	0.5	Soil	7.1
MA-8197K	4	1.0	Soil	6.9
MA-8197L	6	0.5	Soil	5.8
MA-8197M	5	0.5 -1.0	Soil	5.3
MA-8197N	103	0.5	Soil	5.8
MA-8197O	111	0.1	Soil	8.9
MA-8197P	111	0.5	Soil	8.9
MA-8197Q	111	1.0	Soil	6.1
MA-8197R	111	1.5	Soil	5.8
MA-8197S	106	0.5	Soil	5.3
MA-8197T	108	0.5	Soil	4.9
MA-8197U	9	0.1	Soil	8.7
MA-8197V	9	0.5 - 1.0	Soil	8.4
MA-8197W	9	1.5	Soil	7.4
MA-8197X	9	2.0	Soil	6.3
MA-8197Y	9	2.5	Soil	6.6
MA-8197Z	9	3.0	Soil	6.4
MA-8197AA	110	0.5	Soil	5.1
MA-8197AB	104	0.5	Soil	5.9

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Determination of EC of Soil (In-House) DP MAC2

Sample Number	Location	Depth (m)	Material	EC Value (µS/cm)
MA-8197G	1	0.5	Soil	103.90
MA-8197H	2	0.5	Soil	273.50
MA-8197I	4	0.1	Soil	62.90
MA-8197J	4	0.5	Soil	330.50
MA-8197K	4	1.0	Soil	206.30
MA-8197L	6	0.5	Soil	274.20
MA-8197M	5	0.5 -1.0	Soil	169.20
MA-8197N	103	0.5	Soil	233.90
MA-8197O	111	0.1	Soil	260.80
MA-8197P	111	0.5	Soil	252.10
MA-8197Q	111	1.0	Soil	156.30
MA-8197R	111	1.5	Soil	164.40
MA-8197S	106	0.5	Soil	250.30
MA-8197T	108	0.5	Soil	474.60
MA-8197U	9	0.1	Soil	226.60
MA-8197V	9	0.5 - 1.0	Soil	335.50
MA-8197W	9	1.5	Soil	271.90
MA-8197X	9	2.0	Soil	199.90
MA-8197Y	9	2.5	Soil	61.60
MA-8197Z	9	3.0	Soil	89.40
MA-8197AA	110	0.5	Soil	418.20
MA-8197AB	104	0.5	Soil	536.10

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 298423

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Eric Riggle
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details

Your Reference	**213594.00,*Proposed Gregory Hills Sch via Long Ree**
Number of Samples	6 Soil
Date samples received	20/06/2022
Date completed instructions received	20/06/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	27/06/2022
Date of Issue	27/06/2022

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		298423-1	298423-2	298423-3	298423-4	298423-5
Your Reference	UNITS	BH-101	BH-101	BH-101	BH-112	BH-112
Depth		0.5	1.5	2.5	0.5	1.5
Date Sampled		09/06/2022	09/06/2022	09/06/2022	09/06/2022	09/06/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Date analysed	-	24/06/2022	24/06/2022	24/06/2022	24/06/2022	24/06/2022
Chloride, Cl 1:5 soil:water	mg/kg	160	42	40	300	270
Sulphate, SO4 1:5 soil:water	mg/kg	250	24	10	360	290

Misc Inorg - Soil		
Our Reference		298423-6
Your Reference	UNITS	BH-112
Depth		2.8
Date Sampled		09/06/2022
Type of sample		Soil
Date prepared	-	24/06/2022
Date analysed	-	24/06/2022
Chloride, Cl 1:5 soil:water	mg/kg	22
Sulphate, SO4 1:5 soil:water	mg/kg	20

Method ID	Methodology Summary
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			24/06/2022	1	24/06/2022	24/06/2022		24/06/2022	[NT]
Date analysed	-			24/06/2022	1	24/06/2022	24/06/2022		24/06/2022	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	160	160	0	93	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	250	230	8	88	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Table C1: Summary Table - Laboratory Tests and Assessments

Test	Sample Depth	pH	Chloride Concentration	Sulphate Concentration	Resistivity	Soil Condition	Sample Aggressivity Class					Exchangeable Sodium (Na) Concentration	Cation Exchange Capacity	Sodicity	Sodicity Class	Soil Texture Group	Textural Factor (M)	$EC_{1:5}$	EC_e	Sample Salinity Class
					By inversion of EC1:5		Aggr. to Concrete - from sample pH	Aggr. to Concrete - from Sulphate conc.	Aggr. to Steel - from sample pH	Aggr. to Steel - from Chloride conc.	Aggr. to Steel - from sample Resistivity			[Na/CEC]		(for detailed soil logs see Report Appendix)		[Lab.]	[M x $EC_{1:5}$]	(Based on sample ECe)
	(m bgl)	(pH units)	(mg/kg)	(mg/kg)	Ω.cm	[AS2159-2009]	[AS2159-2009]					(meq/100g)	(meq/100g)	(%)	[after DLWC]	[after DLWC]	[after DLWC]	(microS/cm)	(deciS/m)	[Richards 1954]
1	0.5	6			10390	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Loam	10	103.9	1.0	Non-Saline
2	0.4 - 0.5	7.2				B	Non-Aggressive		Non-Aggressive			1	17	6	Sodic					
2	0.5	7.3			27350	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Sand	17	273.5	4.6	Moderately Saline
4	0.1	7			6290	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Sand	17	62.9	1.1	Non-Saline
4	0.5	7.1			33050	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Heavy clay	6	330.5	2.0	Non-Saline
4	1	6.9			20630	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Clay loam	9	206.3	1.9	Non-Saline
5	0.5 - 1.0	5.3			16920	B	Mild		Non-Aggressive		Non-Aggressive					Medium clay	7	169.2	1.2	Non-Saline
6	0.5	5.8			27420	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Sandy loam	14	274.2	3.8	Slightly Saline
9	0.1	8.7			22660	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Light clay	8.5	226.6	1.9	Non-Saline
9	0.5 - 1.0	8.4			33550	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Light medium clay	8	335.5	2.7	Slightly Saline
9	1.5	7.4			27190	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Light medium clay	8	271.9	2.2	Slightly Saline
9	2	6.3			19990	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Clay loam	9	199.9	1.8	Non-Saline
9	2.5	6.6			6160	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Light clay	8.5	61.6	0.5	Non-Saline
9	3	6.4			8940	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Heavy clay	6	89.4	0.5	Non-Saline
10	0 - 0.1	9.1				B	Non-Aggressive		Non-Aggressive			3	21	14	Sodic					
101	1		160	250		B		Non-Aggressive		Non-Aggressive										
101	1.5		42	24		B		Non-Aggressive		Non-Aggressive										
101	2.5		40	10		B		Non-Aggressive		Non-Aggressive										
103	0 - 0.1	7.9				B	Non-Aggressive		Non-Aggressive			1.4	23	6	Sodic					
103	0.5	5.8			23390	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Clay loam	9	233.9	2.1	Slightly Saline
104	0.5	5.9			53610	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Heavy clay	6	536.1	3.2	Slightly Saline
106	0.5	5.3			25030	B	Mild		Non-Aggressive		Non-Aggressive					Clay loam	9	250.3	2.3	Slightly Saline
108	0.5	4.9			47460	B	Mild		Non-Aggressive		Non-Aggressive					Loam	10	474.6	4.7	Moderately Saline
110	0.5	5.1			41820	B	Mild		Non-Aggressive		Non-Aggressive					Light clay	8.5	418.2	3.6	Slightly Saline
111	0.1	8.9			26080	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Medium clay	7	260.8	1.8	Non-Saline
111	0.5	8.9			25210	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Medium clay	7	252.1	1.8	Non-Saline
111	1	6.1			15630	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Heavy clay	6	156.3	0.9	Non-Saline
111	1.5	5.8			16440	B	Non-Aggressive		Non-Aggressive		Non-Aggressive					Light clay	8.5	164.4	1.4	Non-Saline
112	0.5		300	360		B		Non-Aggressive		Non-Aggressive										
112	1.5		270	290		B		Non-Aggressive		Non-Aggressive										
112	2.8		22	20		B		Non-Aggressive		Non-Aggressive										