Douglas PARTNERS

GROUNDED EXPERTISE

Report on Geotechnical, Salinity and Acid Sulfate Soils Assessment

Proposed Liverpool Boys and Girls High School Upgrade Project

Forbes Street, Liverpool NSW

Prepared for Meinhardt Australia Pty Ltd

Project 92370.03

6 March 2025

Douglas Partners Pty Ltd
ABN 75 053 980 117
douglaspartners.com.au
18 Waler Crescent, Smeaton Grange, NSW 2567
(02) 4647 0075

Document History

Details

Project No.	92370.03
Document Title	Report on Geotechnical, Salinity and Acid Sulfate Soils Assessment
Site Address	Forbes Street, Liverpool NSW
Report Prepared For	Meinhardt Australia Pty Ltd
Filename	92370.03.R.001.Rev6

Status and Review

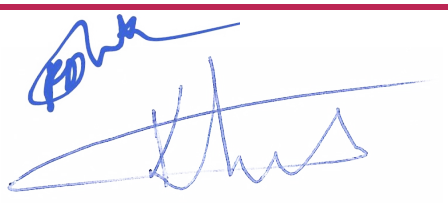
Status	Prepared by	Reviewed by	Date issued
Revision 0	Konrad Schultz	Michael J Thom	25/11/2019
Revision 1	Konrad Schultz	Michael J Thom	27/11/2019
Revision 2	Konrad Schultz	Michael J Thom	10/12/2019
Revision 3	Konrad Schultz	Michael J Thom	17/12/2019
Revision 4	Roshan Bhetwal	Konrad Schultz	14/01/2025
Revision 5	Roshan Bhetwal	Konrad Schultz	03/02/2025
Revision 6	Roshan Bhetwal	Konrad Schultz	07/03/2025

Distribution of Copies

Status	Issued to
Revision 0	Mr Richard Bharata, School Infrastructure NSW
Revision 1	Mr Richard Bharata, School Infrastructure NSW
Revision 2	Mr Richard Bharata, School Infrastructure NSW
Revision 3	Mr Richard Bharata, School Infrastructure NSW
Revision 4	Mr Tom Guo, Meinhardt Australia Pty Ltd
Revision 5	Mr Tom Guo, Meinhardt Australia Pty Ltd
Revision 6	Mr Tom Guo, Meinhardt Australia Pty Ltd

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.

Signature	Date
Author	6 March 2025
Reviewer	6 March 2025



FS604853

Douglas Partners acknowledges Australia's First Peoples as the Traditional Owners of the Land and Sea on which we operate. We pay our respects to Elders past and present and to all Aboriginal and Torres Strait Islander peoples across the many communities in which we live, visit and work. We recognise and respect their ongoing cultural and spiritual connection to Country.

Douglas PARTNERS | GROUNDED EXPERTISE

Executive Summary

A geotechnical investigation was carried out for the proposed redevelopment of the Liverpool Boys and Girls High Schools at Forbes Street, Liverpool. The investigation included the drilling of nine cored boreholes and seven augured boreholes.

The interpreted subsurface profile determined in the investigation was variable. In the north east of the site there was a variable depth of shallow fill and topsoil then residual silty clay over shale and laminite. In the south and east, there is alluvial clay over shale. The rock generally increases in strength with depth.

For excavations, retaining walls will be required to support the overburden soil and weaker layers of rock. For relatively highly loaded footings, it is recommended that all footings be extended to uniform shale or laminite. A combination of pad footings and piers are likely to be required.

The results of the investigation suggest that redevelopment of the site should be feasible from a geotechnical perspective, and design and construction is likely to be possible using conventional techniques.

Douglas PARTNERS | GROUNDED EXPERTISE

Table of Contents

Report on Geotechnical, Salinity and Acid Sulfate Soils Assessment Proposed Liverpool Boys and Girls High School Upgrade Project Forbes Street, Liverpool NSW

1. Introduction

This geotechnical investigation report has been prepared by Douglas Partners Pty Ltd (Douglas) on behalf the NSW Department of Education (the Applicant) to assess the geotechnical conditions of the site. The investigation was commissioned by email instructing to proceed dated 10 December 2024 from Tom Guo of Meinhardt Australia Pty Ltd and was undertaken in accordance with Douglas Partners Pty Ltd (Douglas) proposal 92370.03 dated 17 Oct 2024.

This report has been prepared to provide information on the anticipated subsurface conditions (based on the investigation) for documentation and the conceptual design of the structures including the foundations, retaining structures and floor slabs and to assess excavation conditions on the site.

It is understood that the proposed upgrade will include:

[redacted]

- Construction and operation of a six-storey school building, including school hall and gymnasium;
- Associated parking and building services;
- Tree removal;
- Associated landscaping and play spaces;
- Augmentation of service infrastructure; and
- Associated off-site infrastructure works to support the school, including (but not limited to) services, kiss and drop point and pedestrian crossings.

The investigation comprised eighteen boreholes followed by 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.

The investigation was carried out in conjunction with investigation for Gulyangarri Public School site located in the north eastern corner of the existing Liverpool Boys and Girls High School site. The results of the investigation for the Liverpool Primary School site have been reported separately, however relevant information from the boreholes near the common boundary has been included in this report.

This report must be read in conjunction with all appendices including the notes provided in Appendix A.

2. Site Description and Regional Geology

The site is located at 18 Forbes Street, Liverpool, within the Liverpool Local Government Area (LGA). The site is legally described as Lot 1 DP1137425 and has a total area of approximately 74,973m2.

The site comprises a broadly rectangular portion of land which currently contains the existing Liverpool Boys High School, Liverpool Girls High School, and the Gulyangarri Public School, which commenced operations in January 2024 and is located to the east of the wider site.

The site's western portion contains Liverpool Boys High School and Liverpool Girls High School. Liverpool Girls High School in the site's southwest comprises three, two-storey buildings. Liverpool Boys High School in the site's northwest, comprises approximately four, two-storey buildings, with adjacent at-grade carparking and various sports courts.

The new Liverpool High School is proposed to be relocated to along the western corner of the overall site. The redeveloped Liverpool Boys and Girls High Schools site will be 'L' shaped with maximum plan dimensions of some 260 m by 210 m. It will be bounded to the west by a road reserve, the south by Liverpool Hospital and road reserve the east by the proposed new primary school, and the north the proposed new primary school and a road reserve. The approximate extents of the proposed new boundaries are shown on Drawing 1 in Appendix A.

The site slopes gently towards the south east with the ground surface levels falling from the corner of Forbes and Lachlan Street at about RL 13 m relative to the Australian Height Datum (AHD) to about RL 9 m AHD at the south eastern corner.

At the time of the investigation, the subject site was an operational high school with the western portion occupied by low rise multi storey predominantly brick school building, paved areas and gardens with some mature trees. Most of the eastern portion of the site was grassed playing fields with some amenities building near the northern and southern boundaries.

Reference to the Penrith 1:100 000 Geology Map for Penrith indicates that the western portion of the site is probably underlain by Bringelly Shale of Triassic age. Bringelly Shale typically comprises siltstone, fine grained sandstone and laminite with some shale bands. The eastern portion is shown on the map as being underlain by more recent alluvium comprising clayey quartzose sand and sand laid down in the floodplain of the nearby Georges River. The geological mapping is shown in Figure 1 (next page). The detailed logging of the boreholes confirms the mapping with the western area of the site underlain by a relatively shallow depth of filling and silty clay and then weathered siltstone to the full depth of testing. The boreholes in the eastern area of the site encountered extensive alluvial deposits over Bringelly Shale.

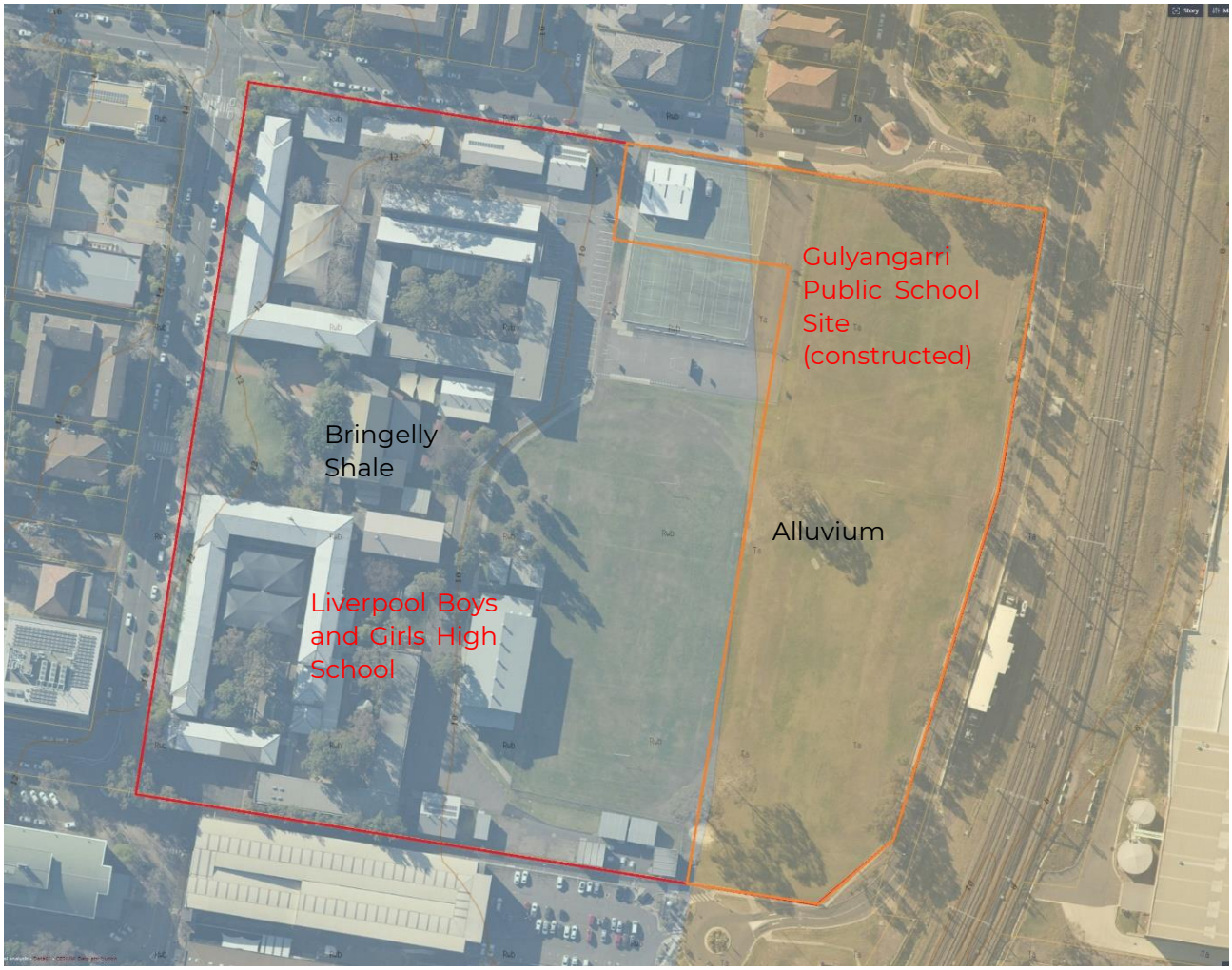


Figure 1: Extract from the Penrith 1:100 000 Geology Map and the approximate site boundary. The locations of the tests are shown in Drawing 1 in Appendix A.

3. Statement of Significance

The results of the geotechnical investigation indicate that the proposed development of the site is considered be feasible from a geotechnical perspective provided the recommendations in the report and good engineering practice are adopted for the design and construction.

4. Deliverable

The Table 1 (next page) summarizes the deliverable requirements.

Table 1: Deliverable

Item	Requirement	Relevant Report Section
1	Statement of Significance	3
2	Previous Field Work Methods and Results	5
3	Laboratory Testing Results	6
4	Site Conditions	8.1
5	Site Classification	8.2
6	Slope Stability	8.3
7	Excavation Conditions	8.4.1
8	Vibration	8.4.2
9	Dilapidation Surveys	8.4.3
10	Disposal of Excavation Material	8.4.4
11	Excavation Support	8.4.5
12	Batter Slopes and Vertical Rock Faces	8.4.5.1
13	Retaining Walls	8.4.5.2
14	Rock Wedge Design	8.4.5.3
15	Passive Resistance	8.4.5.4
16	Ground Anchors	8.4.5.5
17	Groundwater	8.4.5.6
18	Site Preparation and Earthworks	8.5
19	Reuse of Excavated Materials	8.5.1
20	Engineered Fill	8.5.2
21	Geotechnical Inspection and Testing	8.5.3
22	Foundation	8.6
23	Pavement and Floor Slabs on Ground	8.7
24	Seismic Site Class	8.8
25	Salinity Management Plan	8.9
26	Preliminary Acid Sulfate Management Plan	8.10

5. Previous Field Work

5.1 Field Work Methods

The previous field investigation for the development comprised sixteen boreholes (1 - 3, 7 - 9, 12 - 14, 17,19, 20, 22, 23, 25 and 26) drilled in an approximate grid pattern across the site to depths in the range 3.0 – 15.0 m below existing surface levels. Following locating of the underground services and pre-coring of existing concrete slabs, nine boreholes (1, 7, 8, 12, 14, 19, 20, 25 and 26) were drilled using a combination of spiral flight augers and rotary drilling in the near surface soils and rotary core drilling in the bedrock. Standard penetration tests (SPT) were conducted at regular depth intervals in the soils down to bedrock level to provide information on the engineering properties of the strata. The SPT also recovers partially disturbed samples which can be utilised for engineering testing.

On reaching the level of the bedrock, rotary core drilling commenced using NMLC sized core barrels to obtain 50 mm diameter samples of the bedrock strata. The boreholes were continued to a depth of about 3 m into rock and were generally terminated in medium strength rock.

Seven boreholes (2, 3, 9, 13, 17, 22, and 23) were drilled using a 6 t excavator fitted with a power auger attachment turning 300 mm diameter continuous spiral flight augers.

Upon completion of the investigation, fourteen of the boreholes were backfilled with spoil material obtained from the boreholes whilst two (Bores 1 and 25) were converted into standpipe piezometers to facilitate measuring of groundwater levels in the longer term. Slotted PVC tubing (50 mm diameter) was inserted into the bore with the annulus between the borehole wall, and the slotted casing filled with coarse sand and then capped to prevent inflow of surface water into the piezometer. The piezometers were finished with a gatic cover to minimize the risk of unauthorized usage.

The location of the bores is given on Drawing 1 in Appendix A, together with selected photographs of area in which augered boreholes were drilled. The locations (to MGA94 Zone 56) and surface levels (to AHD) at each borehole location were determined by surveying using a differential GPS with a nominal accuracy of 0.1 m.

5.2 Field Work 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. Sections summarising the boreholes are presented in Drawings 2 -4 Appendix A. The location of the Sections is shown on Drawing 1.

The bores encountered variable conditions over the site. In the north western portion of the site the typical succession of strata comprised pavement, topsoil and filling up to 0.8 m in depth overlying residual silty clay the shale and laminite. In the eastern and southern portions of the site, the pavement, topsoil and filling were underlain by layers of alluvial clay and sand then shale and laminite, which typically increased in strength with depth. The depth of overburden soil typically increased towards the south eastern corner.

A summary of the levels at which each of the strata was encountered in the cored boreholes is provided in Table 2 (next page). These indicate some variation across the site which is typical for sites underlain by Bringelly Shale.

Table 2: Summary of Strata in Cored Boreholes

Strata Description	RL (m AHD) at Top of Strata								
	1	7	8	12	14	19	20	25	26
FILL/ PAVEMENT/ TOPSOIL	12.4	12.5	9.8	11.9	9.3	9.9	9.4	10.7	9.6
ALLUVIAL SOIL	-	-	9.1	-	8.8	9.5	8.7	10.0	9.1
RESIDUAL SOIL	11.6	11.8	-	11.2		-	-	-	-
SHALE: up to very low strength	-	8.9	0.3	9.3	-0.1	0.1	-	-	-0.8
SHALE: low to medium strength	8.15	7.7	-	8.8		-0.1		-	-2.2
SHALE: medium strength or higher strength	6.44	-	-0.2	6.8	-0.7	-0.6	-2.1	0.5	-3.3
Borehole Discontinued	5	5.5	-3.29	4.9	-3.7	-3.1	-5.6	-2.11	-4.96

No free groundwater was encountered whilst augering through the near surface soils in most of the boreholes 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. In Borehole 25 free groundwater was observed at a depth of 8 m and in Borehole 20 drilling fluids were lost at a depth of 1.6 m.

The results of water level measurements in the three standpipe piezometers are summarised in Table 3 (below).

Table 3: Results of Water Level Measurements

Borehole	Ground Surface RL (m AHD)	Depth to Water (20/11/19) (m)	RL of Water Level (m AHD)
1	12.4	6.0	6.4
25	10.7	7.8	2.9

6. Laboratory Testing

6.1 Laboratory Methods

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 (next page).

6.2 Laboratory Results

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

Borehole	Depth (m)	Material	Field Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
1	0.5	Fill	19.7	-	-	-	-
	1.0 (SPT)	Clay	21.5	94	19	75	17
	2.5 (SPT)	Clay	7.0	-	-	-	-
2	1.0	Fill	19.1	-	-	-	-
	2.5	Clay	21.0	-	-	-	-
3	0.5	Clay	22.1	-	-	-	-
	2.5	Clay	17.8	-	-	-	-
7	0.3	Fill	18.7	-	-	-	-
9	3.0	Clay	17.1	-	-	-	-
12	0.5	Fill	13.8	-	-	-	-
	1.0 (SPT)	Clay	19.9	66	19	47	15.0
	2.5 (SPT)	Clay	16.9	-	-	-	-
13	0.5	Fill	22.2	46	16	30	14.5
	3.0	Sand	20.0	-	-	-	-
14	0.5	Clay	17.4	-	-	-	-
	3.0	Sand	12.6	-	-	-	-
17	0.5	Fill	24.9	-	-	-	-
	1.0	Clay	17.9	62	18	44	16.5
	3.0	Clay	6.5	-	-	-	-
20	2.5 (SPT)	Sand	20.2	-	-	-	-
	6.9 (SPT)	Sand	16.9	-	-	-	-
	3.0	Sand	6.3	-	-	-	-
22	1.0	Clay	21.4	68	20	48	18.5
	3.0	Clay	15.7	-	-	-	-
23	3.0	Clay	14.5	-	-	-	-
25	1.0 (SPT)	Clay	16.5	-	-	-	-
	25(SPT)	Clay	18.3	-	-	-	-
26	26 (SPT)	Clay	15.6	-	-	-	-

California bearing ratio (CBR) tests were carried out on two composite samples of the 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 a surcharge loading of 4.5 kg. The detailed results are given in the report sheets and are summarised in Table 5 (below).

Table 5: Results of CBR and Standard Compaction Testing

Composite	Depth (m)	Material	Field Moisture Content (%)	Optimum Moisture Content (%)	Standard Maximum Dry Density (t/m³)	Swell (%)	CBR (%)
1	0.5 – 1.5	Clay	21.1	23.0	1.61	1.0	3.0
2	0.5 – 1.5	Clay	22.3	22.5	1.64	1.0	3.5

Selected samples from four boreholes were tested in the field to determine the pH and electrical conductivity, chloride content and sulfate content. The detailed results are given in the report sheets and are summarised in Table 6 (below).

Table 6: Results of Aggressivity Testing

Borehole	Depth (m)	Material	pH	Electrical Conductivity (µS/cm)	Chloride Content (mg/kg)	Sulfate Content (mg/kg)
7	0.5	Clay	5.4	60	25	59
	2.5	Clay	6.1	22	<10	10
26	1.0	Clay	5.2	230	120	300

The results, with reference to AS2159: 2009 Piling Design and Installation, suggest that for the clay above the water table is non aggressive to mildly aggressive for concrete and steel piles. In sand and below the water table, the soil is mildly aggressive to moderately aggressive for concrete and steel piles.

Screening tests were also carried out on the soil samples by Envirolab Services Pty Ltd (Envirolab) to provide indications of actual acid sulfate soil (AASS) and potential acid sulfate soil (PASS). The natural field pH of each soil sample was measured after the addition of distilled water (pH_F), then the pH (pH_{FOX}) was measured following the addition of hydrogen peroxide and oxidisation for at least one hour. The results for the screening tests are summarised in Table 7 (below).

Table 7: Summary of ASS and PASS Screening Test Results

Borehole	Depth (m)	Material	Natural pH_F	Oxidised pH_{FOX}	Change in pH	Reaction
26	1.0	Clay	5.3	3.9	1.4	Slight
	5.5	Clayey Sand	6.6	5.2	1.4	Slight
	10.0	Clayey Sand	8.4	7.5	0.9	Slight

Note: yellow highlight potential for exceedance of action criteria

The screening test results were assessed for the possible presence of AASS or PASS using the indicators specified in the ASSMAC Guidelines:

- $pH_F \leq 4$ indicates oxidation has occurred in the past and that AASS are likely to be present;
- $4 < pH_F < 5.5$ indicates the soil is acidic. This may be as a result of limited oxidation of sulphides but may also be as a consequence of the presence of organic acids or naturally acidic soil.
- $pH_{FOX} < 3$, plus a strong reaction with peroxide, plus a pH_{FOX} value of at least one pH unit below pH_F, strongly indicates a PASS. The higher the reaction, the lower the drop between pH_F and pH_{FOX}, and the lower the pH_{FOX} value, the higher the potential for PASS.
- $3 < pH_{FOX} < 4$ is less positive that the sample is PASS.
- $4 < pH_{FOX} < 5$ is neither positive nor negative, as some sulfides may be present in small quantities.
- $pH_{FOX} > 5$ and little or no drop from pH_F to pH_{FOX} indicate little net acid generating ability.

No samples provided positive indicators of AASS however most of the samples provided slightly positive indicators of PASS however given the elevation of the site and the soil types, the pH change may be due to the oxidation of organic materials rather than sulfides.

7. Proposed Development

The proposed development is outlined in Section 1. 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 2000 kN to 4000 kN could occur.

The extent of bulk excavations is not known at this stage, although given the gently sloping site topography excavation depths of the order of 3 m (RL 10.7 m) may be required. Whilst no basements are proposed, preliminary commentary has been provided on excavation and excavation support.

8. Comments

8.1 Site Conditions

The results of the investigation indicate that the existing school development on the north western portion of the site is generally underlain by 2 – 4 m of filling and silty clay overlying very low strength to low strength shale which continued to depths of about 5 m below existing surface level. Below that depth the boreholes (except Borehole 7) intersected low strength to medium strength shale typically increasing in strength with depth. In the southern and eastern portions of the site, fill and alluvium was encountered overlying shale and laminite. The depth of fill was generally less than 1 m with the alluvial sand and clay increasing in depth to 10 m in the southeast at Borehole 20.

The top of the bedrock surface encountered in the boreholes was sloping down from RL 9.3 m AHD in Borehole 12 to RL -2.1 m AHD in Borehole 20.

The descriptions given above are simplified and the conditions on the site vary with the depth of weathering and the degree of fracturing being somewhat different in the individual bores.

Groundwater levels measured in the standpipes also sloped downwards from the north western corner at RL 6.4 m in Borehole 1 to RL 2.9 m in Borehole 25.

8.2 Site Classification

The results of field work indicate that the site is underlain by fill at all test locations up to 1 m in depth, overlying residual clay and alluvial sand and clay soils then weathered shale. As there is uncontrolled fill on the site greater than 0.4 m in depth and there may be mature trees within proposed building footprints, the overall site will be classified as class 'P' when assessed in accordance with the "uncontrolled fill" and "abnormal moisture condition" provisions of AS 2870:2011 Residential Slabs and Footings.

Notwithstanding this classification, the laboratory testing indicates that the clays at the site are of generally high reactivity and likely to be highly susceptible to shrink-swell movements in response to variations in soil moisture content. Based on the soil depth, and the results of laboratory testing, the natural soil profile, prior to cut and fill activities, would generally be consistent with at least a Class 'H1' (highly reactive) site.

If the uncontrolled filling is removed beneath proposed structures and replaced with non-reactive material as controlled structural filling, it may be feasible to re-classify the site.

Several options are available for managing the effects of the reactivity of the soil including:

- Designing slabs to cope with the pressures associated with uplift
- Design grounds slabs as suspended and included void formers on edges affected by the mounding effects of soil moisture variations
- Remove 1 m of clay soil and replace with non-reactive granular soil (ripped sandstone or similar) as a slab subgrade.

8.3 Slope Stability

The site is gently sloping with an average grade of about 1 in 40. 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.

8.4 Excavations

8.4.1 Excavation Conditions

It is understood that bulk excavation level for all three building footprint is 10.7 m; the results of the investigation indicate that bulk excavation could be through filling and clay. It is anticipated that bulk excavation of the clays could be readily achieved using conventional earthmoving equipment.

Whilst the eastern boundary of the site is near the main south rail line, the site is separated from the line by a roadway and it is considered extremely unlikely that any bulk excavation near the eastern boundary will result in Transport for NSW infrastructure being with the zone of influence of the excavation.

8.4.2 Vibrations

During excavation, it will be necessary to use appropriate methods and equipment to keep ground vibrations at adjacent buildings and structures within acceptable limits. The level of acceptable vibration is dependent on various factors including the type of structure, its structural condition, the frequency range of vibrations produced by the construction equipment, the natural frequency of the structure and the vibration transmitting medium.

Ground vibration can be strongly perceptible to humans at levels above 2.5 mm/s peak particle velocity (PPVi). This is generally much lower than the vibration levels required to cause structural damage to buildings. The Australian Standard AS2670.2:1990 "Evaluation of human exposure to whole-body vibrations – continuous and shock induced vibrations in buildings (1-80 Hz)" indicates an acceptable day time limit of 8 mm/s PPVi for human comfort.

Based on previous experience in the area and with reference to AS2670, it is suggested that a maximum PPVi of 8 mm/s (applicable at the foundation level of existing buildings) be adopted at this site for both architectural and human comfort considerations, although this vibration limit may need to be reduced if there are sensitive buildings or equipment in the area.

8.4.3 Dilapidation Surveys

Dilapidation surveys should be carried out on adjacent buildings, pavements and infrastructure that may be affected by any excavation prior to commencement of the works. The surveys should document any existing defects so that claims for damage due to construction related activities can be accurately assessed.

8.4.4 Disposal of Excavated Material

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the Waste Classification Guidelines (EPA, 2014). It is understood that contamination status and waste classification of the site soils is being carried out by others.

8.4.5 Excavation Support

Vertical excavations within the filling, soils and extremely low to low strength rock will require both temporary and permanent lateral support during and after excavation. Excavations in shale and laminite (including medium and high strength shale) will also require support due to the risk of adverse joints in the shale forming potentially unstable wedges. The shoring walls will need to be designed to cater for earth pressures and should also consider potential rock wedge failure mechanisms.

Provision will need to be to be made for support any existing buildings proposed to be kept in the redevelopment that are within the zone of influence of the excavation. To limit lateral and vertical soil movement, this may require the design of anchored contiguous pile walls or underpinning of the existing building foundations. Detailed investigation will probably be required once conceptual plans are prepared and potential affected structures are identified.

8.4.5.1 Batter Slopes and Vertical Rock Faces

Suggested temporary and permanent batter slopes for unsupported excavations up to a maximum height of 4 m are shown in Table 8 (below).

Table 8: Recommended Batter Slopes for Exposed Material

Material	Temporary	Permanent
Stiff to hard clay, extremely weathered shale and compacted filling	1H:1V	2H:1V
Shale and Laminite: very low to low strength	0.75H:1V*	1H:1V*
Shale and Laminite: medium or greater strength	Vertical*	0.25H:1V*

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

Further analysis will be required where batters greater than 4 m in height are proposed or where surcharge loads will be applied near the crest. The indicative batter slopes in rock in Table 8 are largely dependent on joint orientation and would be subject to verification after an inspection by a qualified engineering geologist during the excavation process. Depending upon the conditions encountered during the excavation and the prevailing weather it may also be necessary to pin and shotcrete the temporary batters to prevent fretting and local slumping failures.

As shale cut faces are likely to fret and have blocks loosen over time when exposed to weather, maintenance of long-term batters should include provision periodic cleaning of debris which may block any toe drains. This will require the acceptance of periodic maintenance by the site owner and operator. Alternatively, a 50 mm thick shotcrete lining could be applied to minimise the need for any long term maintenance. Where the slopes are to be vegetated to prevent erosion, a maximum final batter slope of 3(H):1(V) is recommended.

8.4.5.2 Retaining Walls

Where batter slopes cannot be used, shoring walls will be required to support the filling, soils and shale. Soldier pile with infill panel walls could be used to provide temporary retaining support to soils and weathered rock. The soldier piles are usually spaced at approximately 2 - 2.5 m centres, however more closely spaced piles may be required to reduce wall movements, or prevent collapse of infill materials, particularly where pavements, structures or services are located in close proximity to the excavation. Shotcrete infill panels are then installed between the soldier piles as the excavation proceeds, usually in 1.5 – 2.4 m drops but subject to the pile spacing and material exposed.

Shoring piles should be founded in rock at least 1 m below the bulk excavation level, or deeper if required for passive resistance.

It is suggested that the design of cantilevered shoring systems and retaining walls (with one row of anchors) be based on a triangular earth pressure distribution using the earth pressure coefficients provided in Table 9 (next page). ‘Active’ earth pressure coefficient (Ka) values may be used where some wall movement is acceptable, and ‘at rest’ earth pressure (Ko) values should be used where the wall movement needs to be restricted (such as near movement sensitive existing structures).

Table 9: Suggested Shoring and Retaining Wall Design Parameters

Material	Unit Weight (kN/m³)	Effective Cohesion c' (kPa)	Effective Friction Angle (Degrees)	Active Earth Pressure Coefficient Ka		At Rest Earth Pressure Coefficient Ko	Passive Earth Pressure Coefficient Kp	
				Temp.	Perm.		Temp.	Perm.
Stiff to hard clay, extremely weathered shale and compacted filling	20	2	25	0.3	0.4	0.6	4	3
Shale and Laminite: very low to low strength	22	10	30	0.25	0.3	0.35	1000 kPa	400 kPa
Shale and Laminite: medium or greater strength	24	20	30	0	10 kPa uniform	10 kPa uniform	3000 kPa	1500 kPa

The design of the shoring should allow for all surcharge loads, including building footings, inclined slopes behind the wall, traffic and construction related activities.

Depending on design flood levels and depths of excavation, shoring walls may be required to be designed for hydrostatic pressures unless drainage of the ground behind impermeable walls can be provided. Drainage could comprise 150 mm wide strip drains pinned to the face at 1 m centres behind the shotcrete in-fill panels. The base of the strip drains should extend out from the shoring wall to allow any seepage to flow into a perimeter toe drain which is connected to the stormwater drainage system.

8.4.5.3 **Rock Wedge Design**

The design of shoring support will also need to consider the possibility that 45 degree joints in the rock will daylight near the base of the shoring wall leading to wedges of rock which need to be supported by the temporary and permanent retaining structures.

The approximation of the anchor force required to support a 45 degree wedge should based on an anchor inclination of 10 degrees below horizontal, an average bulk weight of 22 kN/m³, and friction angle of 25 degrees and cohesion of 0 kPa along the failure plane. Given that there is a very low probability that a joint would run the full length and height of the excavation it suggested that this aspect of the design may be carried out for a factor of safety of greater than 1.5.

8.4.5.4 **Passive Resistance**

Passive resistance for piles founded in rock below the base of the bulk excavation (including allowance for services and/or footings) may be based on the ultimate passive restraint value provided in Table 9. This ultimate value represents the pressure mobilised at high displacements and therefore it will be necessary to incorporate a factor of safety of at least 2 to limit wall movement. The top 0.5 m of the socket should be ignored due to possible disturbance and over-excavation.

8.4.5.5 **Ground Anchors**

The design of temporary and permanent ground anchors/rock bolts for the support of excavations and/or shoring systems may be carried out using the maximum bond stresses given in Table 10 (below).

Table 10: Recommended Bond Stresses for Rock Anchor Design

Material Description	Maximum Allowable Bond Stress (kPa)	Maximum Ultimate Bond Stress (kPa)
Stiff to hard clay, extremely weathered shale and compacted filling	25	50
Shale and Laminite: very low to low strength	75	150
Shale and Laminite: Medium or greater strength	300	600

The parameters given in Table 10 assume that the drilled holes are clean and adequately flushed. The anchors should be bonded behind a line drawn up at 45 degrees from the base of the shoring, and "lift-off" tests should be carried out to confirm the anchor capacities. It is suggested that ground anchors should be proof loaded to 125% of the design working load and locked-off at no higher than 80% of the working load.

8.4.5.6 **Groundwater**

Monitoring of the groundwater levels during the investigation has indicated that the groundwater is at a depth of at least 6 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. During construction and following rainfall there may be some seepage of perched water through soil and along some bedding planes or highly fractured zones and it will therefore be necessary to make provision for pumping seepage water out of excavations.

During construction and in the long term, it is anticipated that seepage into excavations could be controlled by perimeter and subfloor drainage connected to a sump-and-pump system and, if proposed in the final design, drained basements may be considered for this site. Generally, water collected from dewatering operations should be suitable for disposal by pumping to stormwater drains subject to confirmation testing of groundwater quality and approval from the local council.

It is possible that seepage into excavations including basements, if proposed, may give rise to precipitation of red brown iron oxide residue from the groundwater and therefore perimeter and subfloor drains should be designed for easy access to allow for inspection, maintenance and periodic cleaning.

It is not possible to provide an estimate of the seepage quantity that may be expected within the excavations, and possible basements, based on the available data. This would require large scale packer/permeability testing of the rock and pumping tests over a period of several weeks together with further analysis which would probably include numerical modelling. A more usual approach is

to monitor the seepage rates during the excavation to confirm and/or re-assess the proposed sump and pump system capacity over the longer term.

8.5 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, organic topsoil and uncontrolled fill. The organic topsoil could be separately stockpiled for use in landscaping or removed off site. Existing fill may be suitable for reuse as controlled fill;
- 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.

8.5.1 Reuse of Excavated Materials

Generally, the majority of natural soils and filling encountered during the investigation will be suitable for reuse as engineered filling 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.

8.5.2 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.

8.5.3 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.

8.6 Foundations

For lightly loaded or settlement insensitive structures, shallow pad, strip or raft footing founding within very stiff natural clay or control fill may be feasible for this site. However, given that the expected typical loadings for the main structures may be in the order of 4000 kN, footings founding within uniform rock are recommended to limit both total and differential settlements; bored piles founded on shale or laminite should be feasible. To the east and south of the site, deeper piled foundations are likely to be required. For bored piers, allowance should also be made for seepage inflows and removal of water during construction. Casing will probably be required to support sand and water charged layers in the bores. Alternatively CFA piles may be feasible for use in areas of the site underlain by alluvium.

Footings may be designed using the values given in Table 11 (below). For bored piles, shaft adhesion values for uplift (tension) may be taken as being equal to 70% of the values for compression.

Table 11: Recommended Design Parameters for Foundation Design

Founding Stratum	Maximum Allowable Pressure (Serviceability)		Maximum Ultimate Pressure (Ultimate)		Young's Modulus, E (MPa)
	End Bearing (kPa)	Shaft Adhesion* (Compression) (kPa)	End Bearing (kPa)	Shaft Adhesion* (Compression) (kPa)	
Shale and Laminite: very low to low strength	700	50	3000	100	80
Shale and Laminite: Medium or greater strength	3500	350	30000	800	1000

Note: * shaft adhesion for piles only

Foundations proportioned using the allowable bearing pressure in Table 11 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 11.

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

8.7 Pavements and Floor Slabs on Ground

The prepared subgrade could be expected to provide adequate support for the pavements and floor slabs. Floor slabs should not bear on uncontrolled filling in the long term. Allowance should be made for differential movement between any slab-on-grade and the structure founded on rock. Based on the results of laboratory testing and field observations, pavement and floor slab design could be based on:

- a CBR of 3% for the clay and controlled filling; and
- a CBR of 7% for shale of at least very low strength.

Subfloor drainage should be provided connected to a pump system (if installed) or stormwater drainage. Allowance should be made for water-proofing any permanent excavations such as basements, if proposed, and, if the excavations extend below the likely range of ground water level or design flood levels, uplift due to water pressure on any tanked floor or support.

8.8 Seismic Site Class

The site stratigraphy typically comprises pavements, filling or topsoil underlain by stiff to hard silty clays and/or medium dense to dense sand overlying bedrock at depths less than 15 m. Therefore, the sub-soil class for the site, when assessed in accordance with AS 1170.4 – 2007 (Ref 4), is considered a shallow soil site and a classification of Class C_e is suggested.

If the building structures are founded on rock and separate from interaction with soil greater than 3 m in depth, and other structures, an alternate classification Class B_e may be appropriate.

8.9 Salinity Management Plan

Soil salinity is often assessed with respect to electrical conductivity of a 1:5 soil:water extract (EC 1:5). This value can be converted to ECe (electrical conductivity of a saturated extract) by multiplication with a factor dependent on soil texture ranging from 6 to 17 according to soil type. Richards (1954) and Hazelton and Murphy (1992) classify soil salinity on the basis of ECe and describe the implications of the salinity classes on agriculture as outlined in Table 12 (below).

Table 12: Soil Salinity Classification

Class	ECe (dS/m)	Implication
Non-Saline	<2	Salinity effects mostly negligible
Slightly Saline	2 – 4	Yields of sensitive crops affected
Moderately Saline	4 – 8	Yields of many crops affected
Very Saline	8 – 16	Only tolerant crops yield satisfactorily
Highly Saline	>16	Only a few very tolerant crops yield satisfactorily

Note: this classification scheme is based on agricultural sensitivity. At this point in time no structure-based classification system exists

The current salinity and aggressivity testing indicates that materials within the site are non-saline to moderately saline, with parameters associated with aggressivity indicating that the materials underlying the site are non-aggressive to mildly aggressive to concrete and non-aggressive to moderately aggressive to steel (AS 2159, 2009).

As there is potential for salts to be mobile, a "worst case" scenario was adopted to determine salinity and aggressivity classifications. This was achieved by comparing the worst-case salinity and aggressivity to concrete and steel classifications

Based on the worst-case scenario, the adopted aggressivity to concrete and steel, and salinity classifications are summarised in Table 13 (below).

Table 13: Aggressivity and Salinity Classification Summary

Exposure classification for concrete (AS 3600)	Exposure classification for concrete piles (AS 2159)	Exposure classification for steel piles (AS 2159)	Salinity classification (Richards 1954)
A2	Mild	Moderate	Moderately Saline

The classifications given in Table 13 must be taken into account by the designer when determining durability and corrosion requirements as per AS 3600:2018 *"Concrete Structures"* (AS 3600, 2018), AS 2159:2009 *"Piling Design and Installation"* (AS 2159, 2009) and *"Precast concrete pipes" (AS 4058, 2007)* for:

- Concrete foundations and concrete structure (AS 3600).
- Concrete piles (AS 2159).
- Corrosion allowances for steel (as per AS 2159).
- Precast concrete pipes (as per AS 4058).

The above should be complementary to standard building practices.

8.10 Acid Sulfate Soil Management Plan (ASSMP)

The results of testing indicate some potential acid sulfate soils may be present at depth in the south western corner of the site which is underlain by deep alluvium. If encountered, management strategies could include the following:

- minimisation of disturbance;
- neutralisation;
- hydraulic separation;
- strategic reburial.

As most of the excavation for the current development will be in the north west of the site which is underlain by residual soil, no detailed ASSMP is proposed at this stage.

It is suggested the issue is revisited as the design proceeds and the exact extent and depth of the work are known, particularly in the east and southern areas of the site.

9. Conclusion

Provided that the recommendation provided in Section 7 are followed, the proposed development of the site is considered to be feasible from a geotechnical perspective. Additional investigation might be required as the detailed design progresses and any relevant geotechnical comments or recommendations arising from this work will be required to be incorporated into the design.

The planning, design and construction should be carried out in accordance with good engineering practice

10. Mitigation Measures

Table 14 (below) provides the summary of possible geotechnical risks (during design, construction, and operation stage) and mitigation measures.

Table14: Geotechnical Risks and Mitigation Measures

Project Stage: Design (D) Construction (C) Operation(o)	Geotechnical Risk	Mitigation Measures	Relevant Section of Report
D/C	Encounter variable ground conditions.	• Carry out geotechnical inspection • Additional geotechnical testing (boreholes, CPT etc.) might be required.	8.1, 8.5.3
D/C	Encounter unsuitable founding material.	• Carry out geotechnical inspection of each footing. • If required, carry out additional testing.	8.6, 8.5.3
D/C	Presence of uncontrolled fill.	• Remove and replace as controlled fill (if required).	8.5
D/C	Collapse of excavation.	• Carry out geotechnical inspection of batters and excavations. • Use appropriate parameters for shoring design and batter slopes.	8.4.5, 8.5.3
D/C	Damage to adjacent structures and services.	• Carry out dilapidation surveys. • Use appropriate plants to minimise vibrations. • Use appropriate shoring/batter (if required) during excavation.	8.4.2, 8.4.3, 8.4.5
D/C	Encounter 'collapsing' conditions during piling.	• Piles will need to be cased to bedrock. • Alternatively, CFA piling technique can be used.	8.6
D/C	Intercept groundwater	• For bored piles, water will need to be pumped out or a tremie pipe can be used to pour the concrete.	8.4.5.6, 8.6

Project Stage: Design (D) Construction (C) Operation(o)	Geotechnical Risk	Mitigation Measures	Relevant Section of Report
	during piling or into excavation.	• Alternatively, CFA piling technique can be used.	
C	Encounter acid sulfate soils	Following measures could be adopted: • Minimise disturbance • Neutralisation • Hydraulic separation • Reburial	8.10
D/C	Excessive vibration due to plants.	• Use appropriate equipment and methods.	8.4.2
D/C/O	Aggressive and saline conditions	• Exposure classification provided in Table 13 should be taken into account during the design, construction and operation stages.	8.9

11. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for this project at Forbes Street, Liverpool NSW in line with Douglas' proposal dated 17 Oct 2024 and acceptance received from Tom Guo of Meinhardt Australia Pty Ltd This report is provided for the exclusive use of Meinhardt Australia Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site 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 Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas 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 Douglas' field testing has been completed.

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

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

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. Douglas 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.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope of 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 fill 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 fill may contain contaminants and hazardous building materials.

Appendix A

About This Report

Results of Field Work

Site Photographs

Drawings 1 to 4

About this Report

Douglas Partners

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 rily rep

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

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

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 e 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 Methods

Douglas Partners

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 o undisturbed samples) is o relat vely lo 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 eac 150 mm of, say, 4, 6 and 7 as:

4,6,7
=13

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

15, 30/

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

Dynamic Cone Penetrometer Te
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.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

The soil group symbol classifications are given as follows based on two major soil divisions:

Coarse-grained soils

Fine-grained soils

aj				rip	
				up Sy	Typ
COARSE-GRAINED SOILS	ore han 65% by dry mass, (excluding that large tha 63 mm) is greater than 0.075 mm		More than 50% of coarse grains are greater than 2.36 mm		Well graded gravels and gravel-sand mixtures, little or no
				GP	Poorly graded gravels and gravel-sand mixtures, little or no
		RAVEL SOILS			ilty g ls, g
				GC	Clay gravels, gravel-sand-clay mixtures.
			More than 50% of coarse grains are less than 2.36 mm	SW	Well graded sands and gravelly sands, little or no fines.
				SP	Poorly graded sands and gravelly sands, little or no fines.
		SANDY SOILS		SM	Silty sand, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.

* For coarse grained soils where the fines content is between 5% and 12%, the soil shall be given a dual classification eg GP-GM.

FINE-GRAINED SOILS	35% by dry mass, (excluding tha arg 63 mm) is less than 0.075 mm	iquid Limit less tha 35%		Inorga ts, ery ds, r, ilty layey sands
				Inorganic clays of low to medium p ity, g lly lays, sandy clays, silty clays, lean clays.
				rg d org ilty lay p ity
		35% 0%		Inorganic clays of low to medium p ity, g lly lays, sandy clays, silty clays, lea clays
		Liquid Limit greater than 50%		Inorganic silts, m silts, elastic silts.
				org lay high p ity, lay
				rg lay high p ity
				highly org

Soil Types

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

Type	cle size (m)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
San	0.075 - 2.36
Silt	0.002 - 0.075
lay	

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

Type	ticle size (m)
Coarse gravel	19 - 63
Medium gra	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6

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 particula particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

	Proportion of sand gravel	mp
And	Specify	Clay (60%) and Sand (40%)
Adje	>30%	Sandy Clay
With	15 – 30%	Clay with sand
		lay,

In coarse grained soils (>65% coarse)
- with clays or silts

	Proportio of fines	mp
And	Specify	Sand (70%) and Clay (30%)
Adje	>12%	Clayey Sand
With	5 - 12%	Sand with clay
		d, lay

In coarse grained soils (>65% coarse)
- with coarser fraction

	Proportion of coarse fraction	mp
And	Specify	Sand (60%) and Gravel (40%)
Adje	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
		and, tra g

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ wit the word order indicating the dominant first and the proportio
tog

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:

ript		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	
Friable	Fr	

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 (P) ity t e g

Relative Density	Abbreviation	Density Index (%)
Very lo	V	<15
Loose	L	15-35
Medium	MD	35-65
Dense	D	65-85
ry		

Soil Origin

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

Residual soil - derived from -situ weathe ing of the underlying rock;

Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;

Alluvial so l – deposited by streams and ivers;

Estuarine soil – deposited in coastal estuaries;

Marine soil deposited in a marine environment;

Lacustrine soil deposited in freshwater lakes;

Aeolian soil – carried and deposited by wind;

Colluvial soil – soil and rock debris transported down slopes by gravity;

Topsoil – mantle of surface soil, often with high levels of organic material.

Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

Dry (D)	Non-cohesive and free-running.
Moist (M)	Soil feels cool, darkened in colour.
	Soil tends to stick together.
	Sand forms weak ball but breaks easily.
Wet (W)	Soil feels cool, darkened in colour.
	Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

'Moist, dry of plastic limit' or 'w <PL' (i.e. hard and friable or powdery)

'Moist, near plastic limit' or 'w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).

'Moist, wet of plastic limit' or 'w >PL' (i.e. soils usually weakened and free water forms on the hands when hand ing)

'Wet' or 'w ≈LL' (i.e. near the liquid limit).

'Wet' or 'w >LL' (i.e. wet of the liquid limit).

Rock Strength

Rock strength is defined by the Unconfined Compressive Strength and it 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 Point Load Strength Index $Is_{(50)}$ is commonly used to provide an estimate of the rock strength and site specific correlations should be developed to allow UCS values to be determined. The point load strength test procedure is described by Australian Standard AS4133.4.1-2007. The terms used to describe rock strength are as follows:

Strength Term	Abbreviation	Unconfined Compressive ng	Point Load Index $Is_{(50)}$ MPa
Very	V	0.6 -	0.03 - 0.1
Low	L	2 - 6	0.1 - 0.3
Med	M	6 20	0.3 - 1 0
High	H	20 - 60	1 - 3
Very high	VH	0 - 200	- 10
Extremely high	EH	>200	>10

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

Degree of Weathering

he degree o wea he ing o roc is classified as follows

Term	Abbreviation	Description
esidu l S	S	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longe le, been significantly transported.
ely		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible
Highly weathered	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the exten that the colour of the original rock is not recognisable. ock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately d	MW	The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, change of strength from fresh rock.
Slightly weathered	SW	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh	FR	No signs of decomposi ing
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in p

Rock Descriptions

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 occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fr	Core lengths of 300 mm or longe
	ery

Rock Quality Designation

q lity ing Q lity sig n (QD) x,

Q % cumulative length of 'sound' core sections > 100 ng
ng ing

where 'sound' rock is assessed to be rock of low strength or stronger. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. d ing s) n p
tog Q

Stratification Spacing

ary ing ay sp ing ing p ing

Term	ep of Stratific
Thinly lami	< 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
ery kly	

Symbols & Abbreviations

Douglas Partners

Introduction

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

Dr ing or Excavat

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

W r

▷	Water seep
—	Water level

S mpling 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
La	Laminatio
Pt	Parting
S	Sheared Zone
	Ve

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
	very roug

Other

fg	fragme ted
bnd	band
qtz	quartz

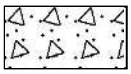
Symbols & Abbreviations

Sy

General


Asphalt


Road base


Concrete


Filling

Soils


Topsoil

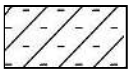

Peat


Clay

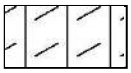

Silty clay

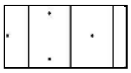

Sandy clay

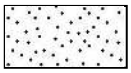

Gravelly clay


Shaly clay

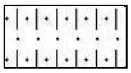

Silt


Clayey silt


Sandy silt

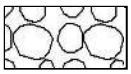

Sand

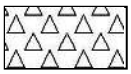

Clayey sand


Silty sand


Gravel

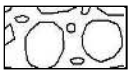

Sandy gravel


Cobbles, boulders

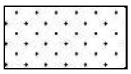

Talus

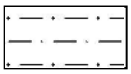
Sedimentary Rocks

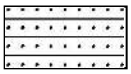

Boulder conglomerate

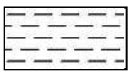

Conglomerate


Conglomeratic sandstone

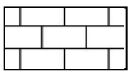

Sandstone


Siltstone

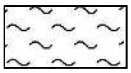

Laminite

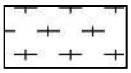

Mudstone, claystone, shale

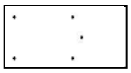

Coal


Limestone

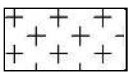
Metamorphic Rocks

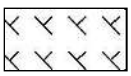

Slate, phyllite, schist

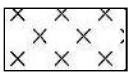

Gneiss

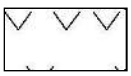

Quartzite

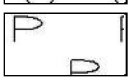
Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 12.4 mAHD
EASTING: 308755
NORTHING: 6245170
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 92370.00
DATE: 1/10/2019
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				
12	0.05	ASPHALT						Note: Unless otherwise stated, rock is fractured along sub-horizontal, rough, planar, iron stained or clean bedding planes	D			
		FILL/Silty CLAY CI: medium plasticity, brown, with gravel, w<PL, appears to be typically stiff							D			
	0.8	Silty CLAY CH: high plasticity, grey, red and brown, w~PL, very stiff, residual							D			
11	1								S			7,9,13 N = 22
	2	- with very low strength, highly weathered shale bands below 2.0m										
10									S			25/100mm,-,- refusal
	3											
9	4								S			19,25/100mm,- refusal
	4.25	SHALE: red, grey and brown, laminated, low to medium strength, highly weathered, highly fractured, Bringelly Shale						4.27m: Cs 40mm 4.43m: B, sh, pl, ro, clay inf 10mm 4.6m: Cs 60mm 4.73m: J, sv, cu, ro, clay co 40mm 4.83m: J, 80°, cu, ro, clay co 170mm 5m: Cs 30mm 5.03m: J, sv, ir, ro, fe stn 130mm 5.54m: J, sv, cu, ro, fe stn 200mm 5.61m: J, sv, cu, ro, fe stn 130mm 5.68m: CORE LOSS: 60mm 5.81m: CORE LOSS: 150mm 6.18m: fg zone 30mm 6.28m: J, sv, cu, ro, fe stn 100mm 6.38m: Cs 20mm 6.51m: J, 45°. cu, ro, fe stn 6.83m: J, 45°, cu, ro, clay co 6.92m: J, 45°, cu, ro, cln, fg 7.08m: fg zone 20mm 7.3m: fg zone 30mm	C	97	0	PL(A) = 0.42
8	5											
7	5.74	- becoming grey and brown, moderately weathered below 5.74m				20-11-19			C	91		PL(A) = 0.29
	5.96											
6	6								C	91	0	PL(A) = 0.46
	7											
5	7.4	- becoming high strength, fresh stained below 7.10m									30	PL(A) = 1.34
4	8	Bore discontinued at 7.4m - limit of investigation										
3	9											

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** SE/JHB **CASING:** HW to 2.5m; HQ to 4.25m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 4.25m, then NMLC coring to 7.4m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Well installed: 0 - 0.1 gatic cover; 0.1 - 4.25m backfill; 4.25 - 4.4m bentonite; 4.4 - 7.4m gravel; 0 - 4.4m casing; 4.4 - 7.4m screen

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 1 DEPTH: 4.25 – 7.40m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 7.40 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 11.0 mAHD
EASTING: 308793
NORTHING: 6245154
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 92370.00
DATE: 2/10/2019
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)
11	0.05	ASPHALT							
		FILL/Silty CLAY CI: medium plasticity, brown, w<PL, appears to be typically hard							
	0.5	Silty CLAY CH: high plasticity, brown and red, w~PL, hard, residual		D	0.5				
10	1			D	1.0				1
		- becoming grey and red below 1.5m		D	1.5		pp = 500		
9	2			D	2.0		pp = 400		2
		- with trace ironstone gravel below 2.7m		D	2.5		pp = 600		
8	3								3
	3.0	Bore discontinued at 3.0m - limit of investigation		D	3.0		pp = 400		
7	4								4
6	5								5
5	6								6
4	7								7
3	8								8
2	9								9

RIG: Hyundai 60CR-9 6 tonne excavator **DRILLER:** Quake Excavations **LOGGED:** JHB **CASING:** N/A
TYPE OF BORING: 300mm diameter SFA
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Location coordinates are in MGA94 Zone 56.

☐ 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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.9 mAHD
EASTING: 308841
NORTHING: 6245146
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 92370.00
DATE: 2/10/2019
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)
	0.05	ASPHALT							
	0.4	GRAVEL GW: well graded, black, with sand, moist, appears to be typically dense (roadbase)							
		Silty CLAY CH: high plasticity, brown, red and grey, stiff to very stiff, alluvial		D	0.5				
		- becoming grey and red below 1.0m		D	1.0				
				D	1.5		pp = 200		
				D	2.0		pp = 200		
		- with trace ironstone gravel below 2.5m		D	2.5		pp = 300		
	3.0	Bore discontinued at 3.0m		D	3.0		pp = 300		
		- limit of investigation							

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

RIG: Hyundai 60CR-9 6 tonne excavator **DRILLER:** Quake Excavations **LOGGED:** JHB **CASING:** N/A

TYPE OF BORING: 300mm diameter SFA

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ 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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.7 mAHD
EASTING: 308858
NORTHING: 6245150
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 92370.00
DATE: 2/10/2019
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
	0.35	FILL/TOPSOIL: Silty CLAY, low plasticity, dark brown, with rootlets, w~PL						Note: Unless otherwise stated, rock is fractured along sub-horizontal, rough, planar, iron stained or clean joints or bedding planes	D			
	0.65	FILL/Silty CLAY CI: medium plasticity, dark brown, trace building rubble (brick), w~PL, appears to be typically stiff to very stiff							D			
									D			
	1	Silty CLAY CH: high plasticity, grey, red and brown, w~PL, alluvial							S/A	100		3,3,4 N = 7
	2											
									S/A	100		5,8,11 N = 19
	3	- trace ironstone gravel below 2.85m										
	4								S/A	100		4,8,13 N = 21
	5											
	6								/A	100		8,9,13 N = 22
		- with sand below 6.5m										
	7											
	7.2	Clayey SAND SC: well graded, fine grained, sub-rounded, grey brown, medium dense, alluvial							S/A	100		7,12,10 N = 22
	8											
	9								S/A	100		9,9,11 N = 20
		- with sub-rounded gravel below 9.6m										

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** SE/JHB **CASING:** HW to 2.5m; HQ to 10.0m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.07m, then NMLC coring to 13.08m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

SAMPLING & IN SITU TESTING LEGEND

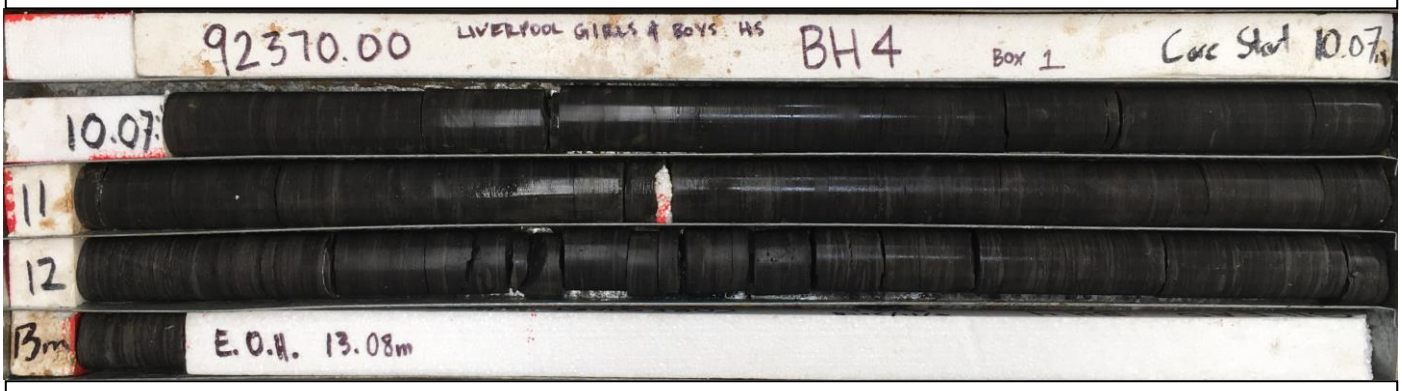
A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample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

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 4 DEPTH: 10.07 – 13.08m PROJECT: 92370.00 OCTOBER 2019



End of Bore at 13.08 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.7 mAHD
EASTING: 308858
NORTHING: 6245150
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 92370.00
DATE: 2/10/2019
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
	10.07	LAMINITE: grey, laminated siltstone and quartz lithic sandstone, medium strength, fresh, fractured, Bringelly Shale							S/A	100		25/70mm,-,- refusal
												PL(A) = 0.36
-1	11								C	100		
-2											98	
	12											PL(A) = 0.8
								12.19m: J, sh, pl, ca inf 1mm	C	100		
-3								12.29m: J, sv, cu, ro, ca co				PL(A) = 0.93
								12.34m: J, sv, cu, ro, ca co				PL(A) = 1.49
	13							12.45m: J, h, pl, ro				
	13.08	Bore discontinued at 13.08m - limit of investigation						12.59m: B, h, pl, ca inf				
								12.69m: J, h, pl, ro, ca co				
-4								12.83m: J, h, ir, ro, ca co				
								12.97m: J, h, un, ro, ca co				
	14											
-5												
	15											
-6												
	16											
-7												
	17											
-8												
	18											
-9												
	19											
-10												

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** SE/JHB **CASING:** HW to 2.5m; HQ to 10.0m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.07m, then NMLC coring to 13.08m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 12.5 mAHD
EASTING: 308741
NORTHING: 6245119
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 92370.00
DATE: 1/10/2019
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				
12	0.2	CONCRETE						Note: Unless otherwise stated, rock is fractured along sub-horizonalt, rough, planar, iron stained or clean bedding planes	D			
	0.5	FILL/SAND SW: well graded, brown, with organics and gravel, moist, appears to be typically medium dense (ripped sandstone)							D			
	0.7	FILL/CLAY CI: medium plasticity, brown mottled red, with gravel, trace building rubble (bricks), w~PL, appears to be typically stiff							D			
11	1	Silty CLAY CH: high plasticity, grey mottled red brown, w<PL, stiff, residual							S/A	100		2,5,6 N = 11
		trace ironstone gravel below 1.33m										
10	2	becoming pale grey mottled orange, extremely weathered shale with very low strength, highly weathered shale bands below 2.0m							S/A	100		25/50mm,-,- refusal
9	3											
	3.6	MIXTURE OF CLAY AND SHALE: CLAY CI, medium plasticity, brown, hard, extremely weathered shale AND SHALE, red and brown, 40%, laminated, medium strength, highly weathered, fractured, Bringelly Shale							C	94	0	PL(A) = 0.13
8	4											
	4.79	SHALE: grey and brown, laminated, low to medium strength, highly weathered, fractured, Bringelly Shale						4.83m: B, sh, pl, ro, clay inf 10mm 4.91m: J, 45°, cu, ro, clay co 4.92m: J, sv, cu, ro, clay co 150mm 5.07m: J, sv, un, ro, clay co 140mm 5.4m: B, sh, pl, ro, clay inf 10mm 5.41m: J, sv, pl, ro, fe stn 350mm 5.61m: fg zone 20mm 5.69m: fg zone 70mm 5.84m: Cs 20mm 5.87m: J, sv, un, ro, fe stn 200mm 6.11m: J, 45°, cu, ro, clay co 6.17m: Cs 20mm 6.55m: J, sv, cu, vr, fe stn 60mm 6.65m: B, sh, pl, ro, cln, fg 10mm 6.93m: J, 45°, cu, ro, fe stn 6.95m: J, 45°, cu, ro, fe stn			0	PL(A) = 0.42
7	5											
6	6								C	100	15	PL(A) = 0.26
	7	Bore discontinued at 7.0m - limit of investigation										
5	7.0											
8	8											
4	9											
3												

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** SE/JHB **CASING:** HW to 2.5m; HQ to 2.85m

TYPE OF BORING: SFA to 2.85m, then NMLC coring to 7.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 7 DEPTH: 3.60 – 7.00m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 7.00 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.8 mAHD
EASTING: 308829
NORTHING: 6245124
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 92370.00
DATE: 9/10/2019
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
9	0.03	ASPHALT						Note: Unless otherwise stated, rock is fractured along sub-horizontal, rough or smooth, planar, clean bedding planes	D			
	0.4	FILL/Sandy GRAVEL GW: well graded, grey, moist, appears to be typically dense (roadbase)							D			
	0.7	FILL/CLAY CH: high plasticity, brown, w>PL, appears to be typically firm to stiff							D			
1		Silty CLAY CH: high plasticity, grey, red and brown, w~PL, stiff, alluvial							S			2,3,6 N = 9
8												
2												
		- with sand, becoming very stiff below 2.5m							S			5,8,10 N = 18
7												
3												
6												
4									S			8,12,15 N = 27
5												
5												
		- becoming stiff below 5.5m							S			5,6,8 N = 14
4												
6												
3												
7	7.0	Clayey SAND SP: poorly graded, medium grained, grey, wet, medium dense, alluvial							S			5,4,7 N = 11
2												
8												
1									S			10,8,13 N = 21
9												
	9.5	LAMINITE: (*see next page*)										
0	10.0											

RIG: Scout IV **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m; HQ to 10.0m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.0m, then NMLC coring to 13.09m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 8 DEPTH: 10.00 – 13.09m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 13.09 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.8 mAHD
EASTING: 308829
NORTHING: 6245124
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 92370.00
DATE: 9/10/2019
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
-1	11	LAMINITE: grey, laminated siltstone and fine-grained, quartz-lithic sandstone, medium to high strength, fresh, slightly fractured, Bringelly Shale										PL(A) = 0.94
								11.15m: J, 45°, cu, ro, cln	C	100	100	PL(A) = 1.52
-2	12											PL(A) = 1.26
-3	13							12.56m: J, 45°, cu, ro, cln				
	13.09	Bore discontinued at 13.09m - limit of investigation										
-4	14											
-5	15											
-6	16											
-7	17											
-8	18											
-9	19											
-10												

RIG: Scout IV **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m; HQ to 10.0m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.0m, then NMLC coring to 13.09m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.6 mAHD
EASTING: 308852
NORTHING: 6245116
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 92370.00
DATE: 1/10/2019
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)
	0.2	FILL/TOPSOIL: Clayey SILT ML, low plasticity, dark brown, moist							
		FILL/Silty CLAY CI: medium plasticity, grey and brown, w>PL, appears to be typically soft to very stiff		D	0.5				
	0.9	SILTY CLAY CH: high plasticity, red, grey and brown, w~PL, very stiff, alluvial		D	1.0				
				D	1.5		pp = 300		
				D	2.0		pp = 500		
		- becoming grey and brown, with sand below 2.3m		D	2.5		pp = 200-300		
		- trace ironstone gravel below 2.6m							
	3.0	Bore discontinued at 3.0m		D	3.0		pp = 400		
		- limit of investigation							

RIG: Hyundai 60CR-9 6 tonne excavator **DRILLER:** Quake Excavations **LOGGED:** JHB **CASING:** N/A

TYPE OF BORING: 300mm diameter SFA

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ 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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 11.9 mAHD
EASTING: 308714
NORTHING: 6245037
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 92370.00
DATE: 10/10/2019
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
11	0.13	CONCRETE						Note: Unless otherwise stated, rock is fractured along sub-horizontal, planar, rough or smooth, iron stained or clean joints or bedding planes				
		FILL/Silty CLAY CI: medium plasticity, brown and red, w<PL, appears to be typically very stiff							D			
	0.7	Silty CLAY CH: high plasticity, grey, red and brown, with very low strength, highly weathered shale bands, w~PL, very stiff, residual							S			6,7,15 N = 22
10	1											
	2											
	2.6	SHALE: brown, red and grey, laminated, low strength, highly weathered, fractured, Bringelly Shale							S			14,37/150mm,- refusal
9	3							2.8m: Cs, 290mm				
								3.1m: J, 45°, cu, ro, stn, fe				
								3.15m: Cs, 40mm				
								3.24m: Cs, 20mm				PL(A) = 0.13
								3.35m: Cs, 50mm				
								3.47m: Cs, 20mm				
8	4							3.52m: Cs, 20mm			33	
								3.77m: B, sh, pl, ro, co, cly	C	100		
								3.9m: B, sh, pl, ro, co, cly				PL(A) = 0.12
								3.95m: Cs, 20mm				
7	5							4.19m: J, sv, ir, ro, stn, fe, 120mm				
	5.11	LAMINITE: grey and brown, laminated siltstone and fine-grained, quartz-lithic sandstone, medium strength, moderately weathered, slightly fractured, Bringelly Shale						4.43m: J, sv, cu, ro, stn, fe, 60nn				
								4.79m: J, sv, cu, ro, stn, fe, 80mm				PL(A) = 0.42
								4.95m: Cs, 50mm				
6	6							5.44m: J, sv, un, ro, cln, 120mm	C	100		
								5.84m: B, sh, pl, ro, co, cly			90	
								6.11m: B, sh, pl, ro, cln, fg, 10mm				PL(A) = 0.33
5	7	- becoming high strength, slightly weathered below 6.77m										PL(A) = 1.51
	7.0	Bore discontinued at 7.0m - limit of investigation										
4	8											
3	9											
2												

RIG: Bobcat **DRILLER:** Rockwell **LOGGED:** JHB **CASING:** HW to 2.5m

TYPE OF BORING: SFA to 2.8m, then NMLC coring to 6.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 12 DEPTH: 2.80 – 7.00 m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 7.00 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.9 mAHD
EASTING: 308791
NORTHING: 6245039
DIP/AZIMUTH: 90°/--

BORE No: 13
PROJECT No: 92370.00
DATE: 2/10/2019
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)
	0.2	FILL/TOPSOIL: Silty CLAY CI, medium plasticity, brown, moist							
	0.7	FILL/Silty CLAY CI: medium plasticity, brown, w~PL, appears to be typically stiff		D	0.5				
	1	Silty CLAY CH: high plasticity, brown, grey and red, w~PL, very stiff, alluvial		D	1.0				
				D	1.5		pp = 500		
	2	- becoming brown and grey, with sand below 2.1m		D	2.0		pp = 400		
	2.4	SAND SP: poorly graded, medium grained, grey and brown, with clay, moist, appears to be typically medium dense, alluvial		D	2.5				
	3	Bore discontinued at 3.0m - limit of investigation		D	3.0				

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

RIG: Hyundai 60CR-9 6 tonne excavator **DRILLER:** Quake Excavations **LOGGED:** JHB **CASING:** N/A

TYPE OF BORING: 300mm diameter SFA

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ 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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.3 mAHD
EASTING: 308851
NORTHING: 6245072
DIP/AZIMUTH: 90°/--

BORE No: 14
PROJECT No: 92370.00
DATE: 10/10/2019
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
9.3	0.2	FILL/TOPSOIL: Silty CLAY CL: low plasticity, brown, w<PL										
	0.5	FILL/Sandy CLAY CL: low plasticity, brown and black, with ash, w>PL, appears to be typically stiff							D			
8	1	Silty CLAY CH: high plasticity, red, brown and grey, w~PL, very stiff, alluvial							D			
									D			
7	2								D			
	2.6	- becoming grey and brown, trace sand below 2.4m							D			
		SAND SP: poorly graded, medium grained, white and brown, moist, medium dense, alluvial						Note: Unless otherwise stated, rock is fractured along sub-horizontal, rough or smooth, planar, clean bedding planes	D			
6	3								S			6,8,10 N = 18
5	4								S			8,11,13 N = 24
4	5											
		- becoming dense below 5.5m							S			13,23,21 N = 44
3	6											
	6.8	CLAY CH: high plasticity, grey, w>PL, very stiff, alluvial										
2	7.2	SAND SP: poorly graded, medium grained, brown and red-brown, moist, dense, alluvial							S			12,17,17 N = 34
	8											
1	8.7	Gravelly CLAY CI: medium plasticity, brown, w>PL, appears to be very stiff, alluvial							S			8,20,23 N = 43
0	9											
	9.4	LAMINITE: (*see next page*)										
	10.0											

RIG: Scout IV **DRILLER:** Groundtest **LOGGED:** SE/JHB **CASING:** HW to 4.0m; HQ to 10.0m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.0m, then NMLC coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 14 DEPTH: 10.00 – 13.00m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 13.00 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.3 mAHD
EASTING: 308851
NORTHING: 6245072
DIP/AZIMUTH: 90°/--

BORE No: 14
PROJECT No: 92370.00
DATE: 10/10/2019
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
-1	11	LAMINITE: grey, laminated, siltstone and fine grained quartz lithic sandstone, medium strength, moderately weathered, slightly fractured, Bringelly Shale (*continued*) becoming high strength, fresh below 10.48m						10.01m: J, 45°, cu, ro, cln 10.3m: J, 60°, cu, ro, cln 100mm 10.32m: J, 60°, cu, ro, cln 100mm 10.45m: J, 48°, cu, ro, cln 10.77m: J, 48°, cu, ro, cln 11.31m: J, 48°, cu, ro, cln 11.51m: J, 48°, cu, ro, cln	C	100	79	PL(A) = 0.6 PL(A) = 1.16 PL(A) = 1.3
-2	12											
-3	13											
	13.0	Bore discontinued at 13.0m - limit of investigation										
-4	14											
-5	15											
-6	16											
-7	17											
-8	18											
-9	19											
-10												

RIG: Scout IV **DRILLER:** Groundtest **LOGGED:** SE/JHB **CASING:** HW to 4.0m; HQ to 10.0m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.0m, then NMLC coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.3 mAHD
EASTING: 308866
NORTHING: 6245030
DIP/AZIMUTH: 90°/--

BORE No: 17
PROJECT No: 92370.00
DATE: 1/10/2019
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)
	0.3	FILL/TOPSOIL: Clayey SILT ML, low plasticity, dark brown, moist		D	0.2				
		FILL/Silty CLAY CI: medium plasticity, brown and grey, trace sand, w~PL, appears to be typically soft to stiff		D	0.5				
	0.8	- becoming grey, w<PL below 0.4m							
	1	Silty CLAY CH: high plasticity, grey and red, w~PL, very stiff, alluvial		D	1.0				
				D	1.5		pp = 600		
	2			D	2.0		pp = 500		
				D	2.5		pp = 400-500		
	2.8	- trace ironstone gravel below 2.7m							
	3	Clayey SAND SP: poorly graded, medium grained, grey and brown, moist, appears to be typically medium dense, alluvial		D	3.0		pp = 400-500		
		Bore discontinued at 3.0m - limit of investigation							

RIG: Hyundai 60CR-9 6 tonne excavator **DRILLER:** Quake Excavations **LOGGED:** JHB **CASING:** N/A

TYPE OF BORING: 300mm diameter SFA

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ 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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.9 mAHD
EASTING: 308780
NORTHING: 6245010
DIP/AZIMUTH: 90°/--

BORE No: 19
PROJECT No: 92370.00
DATE: 9/10/2019
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
	0.04	ASPHALT							D			
	0.4	FILL/Sandy GRAVEL GW: well graded, grey, moist, appears to be typically dense (roadbase)							D			
	0.7	Sandy CLAY CH: high plasticity, brown, with gravel, w~PL, appears to be typically very stiff						Note: Unless otherwise stated, rock is fractured along sub-horizontal, planar, rough or smooth, iron stained or clean joints or bedding planes	D			
	1	Silty CLAY CI: medium plasticity, red and brown, w<PL, very stiff, alluvial							S			5,9,12 N = 21
		becoming brown, red and grey below 1.2m										
	2	- with sand, becoming hard below 2.5m							S			10,16,22 N = 38
	3											
	3.7	SAND SP: poorly graded, medium grained, brown, trace clay, moist, dense, alluvial										
	4								S			12,15,16 N = 31
	5											
									S			10,20,24 N = 44
	6											
	7								S			11,20,19 N = 39
	8											
		- with gravel below 8.6m							S			8,9,6 N = 15
	9											
	9.8	LAMINITE: (*see next page*)										
	10.0											

RIG: Scout IV **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m; HQ to 10.0m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.0m, then NMLC coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 19 DEPTH: 10.00 – 13.00m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 13.00 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.9 mAHD
EASTING: 308780
NORTHING: 6245010
DIP/AZIMUTH: 90°/--

BORE No: 19
PROJECT No: 92370.00
DATE: 9/10/2019
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
-1	11	LAMINITE: grey, laminated siltstone and fine-grained, quartz-lithic sandstone, low strength, highly weathered, highly fractured, Bringelly Shale (*continued*) - becoming high strength, fresh, fractured below 10.51m						10.09m: J, 45°, un, ro, cln 10.3m: B, sh, pl, ro, inf, cly, 10mm				PL(A) = 0.17
-2	12							11.33m: B, sh, pl, ro, inf, cly, 10mm 11.64m: J, sv, pl, ro, cln, 50mm	C	100	69	PL(A) = 1.07 PL(A) = 2.73
-3	13 13.0	Bore discontinued at 13.0m - limit of investigation										
-4	14											
-5	15											
-6	16											
-7	17											
-8	18											
-9	19											
-10												

RIG: Scout IV **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 2.5m; HQ to 10.0m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.0m, then NMLC coring to 13.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.4 mAHD
EASTING: 308858
NORTHING: 6244989
DIP/AZIMUTH: 90°/--

BORE No: 20
PROJECT No: 92370.00
DATE: 30/9/2019
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
	0.0	TOPSOIL/Silty CLAY CL: low plasticity, brown, w<PL						Note: Unless otherwise stated, rock is fractured along sub-horizontal, planar, rough or smooth, clean bedding planes	D			
	0.3	FILL/Silty CLAY CI: medium plasticity, brown, red and grey, w~PL, appears to be typically stiff							D			
	0.7	Silty CLAY CH: high plasticity, brown, grey and red, w<PL, very stiff, alluvial							D			
									S			8,12,12 N = 24
	2.5	Clayey SAND SP: poorly graded, medium grained, grey and brown, moist, dense, alluvial							S			9,17,24 N = 41
	3.46	SAND SP: poorly graded, medium grained, pale brown, moist, dense, alluvial							S			18,18,18 N = 36
									S			6,14,14 N = 28
	7.6	Silty CLAY CI: medium plasticity, grey and brown, w~PL, very stiff, alluvial										
	8.5	SAND SP: poorly graded, medium grained, pale grey, moist, dense, alluvial							S			10,23,25 N = 48

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 1.0m; HQ to 12.3m

TYPE OF BORING: SFA to 1.0m, rotary drilling to 12.3m; then NMLC coring to 15.0m

WATER OBSERVATIONS: 100% waster loss at 1.6m

REMARKS: Location coordinates are in MGA94 Zone 56.

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 20 DEPTH: 12.30 – 13.00m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 13.00 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.4 mAHD
EASTING: 308858
NORTHING: 6244989
DIP/AZIMUTH: 90°/--

BORE No: 20
PROJECT No: 92370.00
DATE: 30/9/2019
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
		SAND SP: poorly graded, medium grained, pale grey, moist, dense, alluvial *(continued)*							S			3,2,0 N = 2
	11	- with silt and organics and becoming very loose below 10.0m										
	11.5	LAMINITE: grey, laminated siltstone and fine-grained, quartz-lithic sandstone, high strength, fresh, fractured, Bringelly Shale							S			30/100mm,-,- refusal
	12											
	13	-becoming unbroken below 12.92m							C	100	87	PL(A) = 2.09 PL(A) = 1.86
	14											
		-becoming very high strength below 14.5m										PL(A) = 3.24
	15 15.0	Bore discontinued at 15.0m - limit of investigation										
	16											
	17											
	18											
	19											

RIG: Bobcat **DRILLER:** Groundtest **LOGGED:** JHB **CASING:** HW to 1.0m; HQ to 12.3m

TYPE OF BORING: SFA to 1.0m, rotary drilling to 12.3m; then NMLC coring to 15.0m

WATER OBSERVATIONS: 100% waster loss at 1.6m

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.7 mAHD
EASTING: 308792
NORTHING: 6244961
DIP/AZIMUTH: 90°/--

BORE No: 22
PROJECT No: 92370.00
DATE: 2/10/2019
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 100mm)
	0.05	ASPHALT							
	0.2	FILL/Sandy GRAVEL GW: well graded, sub-angular, pale grey, dry, appears to be typically dense (roadbase)		D	0.5				
	0.7	FILL/Silty CLAY CI: medium plasticity, brown, trace sand, w<PL, appears to be typically very stiff							
	1	Silty CLAY CH: high plasticity, grey, red and brown, w<PL, hard, alluvial		D	1.0		pp = 500		
				D	1.5		pp = 500		
	2			D	2.0		pp = 500		
				D	2.5		pp >600		
	3			D	3.0		pp = 400-500		
	3.0	Bore discontinued at 3.0m - limit of investigation							

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Hyundai 60CR-9 6 tonne excavator **DRILLER:** Quake Excavations **LOGGED:** JHB **CASING:** N/A
TYPE OF BORING: 300mm diameter SFA
WATER OBSERVATIONS: No free groundwater observed whilst augering
REMARKS: Location coordinates are in MGA94 Zone 56.

☐ 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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.4 mAHD
EASTING: 308843
NORTHING: 6244945
DIP/AZIMUTH: 90°/--

BORE No: 23
PROJECT No: 92370.00
DATE: 1/10/2019
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)
	0.2	FILL/TOPSOIL: Clayey SILT ML, low plasticity, dark brown, moist							
		FILL/Silty CLAY CI: medium plasticity, red, grey and brown, w<PL, appears to be stiff to hard		D	0.5				
	1.0	Silty CLAY CH: high plasticity, red and grey, w~PL, hard, alluvial		D	1.0				
				D	1.5		pp >600		
				D	2.0		pp = 400-500		
				D	2.5		pp = 400-500		
		- becoming grey and brown, with sand below 2.8m							
	3.0	Bore discontinued at 3.0m - limit of investigation		D	3.0		pp = 500		

RIG: Hyundai 60CR-9 6 tonne excavator **DRILLER:** Quake Excavations **LOGGED:** JHB **CASING:** N/A

TYPE OF BORING: 300mm diameter SFA

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ 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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 10.7 mAHD
EASTING: 308687
NORTHING: 6244932
DIP/AZIMUTH: 90°/--

BORE No: 25
PROJECT No: 92370.00
DATE: 9/10/2019
SHEET 1 OF 2

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
	0.05	ASPHALT						Note: Unless otherwise stated, rock is fractured along sub-horizontal, rough or smooth, planar, iron stained or clean bedding planes				
	0.4	FILL/Sandy GRAVEL GW: well graded, grey, dry, appears to be typically dense										
	0.7	FILL/Silty CLAY CL: low plasticity, brown and grey, w<PL, appears to be typically stiff							D			
	1	Silty CLAY CH: high plasticity, brown, w<PL, very stiff, alluvial							S			5,8,10 N = 18
	2	- becoming grey, brown and red, trace ironstone gravel below 2.0m							S			5,10,13 N = 23
	3	- with sand below 3.5m							S			5,11,19 N = 30
	4.9	Clayey SAND SP: poorly graded, medium grained, grey and brown, moist, dense, alluvial							S			5,15,17 N = 32
	7.0	CLAY CH: high plasticity, grey and brown, trace silt and sand, w~PL, stiff, alluvial				09-10-2019			S			2,5,8 N = 13
	8.0	Clayey SAND SP: poorly graded, medium grained, brown and grey, wet, medium dense, alluvial							S			2,7,11 N = 18
	10.0											

RIG: Bobcat **DRILLER:** Rockwell **LOGGED:** SE/JHB **CASING:** HW to 10.23m

TYPE OF BORING: SFA to 10.23m, then NMLC coring to 12.81

WATER OBSERVATIONS: Free groundwater observed at 8.0m whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Well installed: 0 - 0.1 gatic cover; 0.1 - 9.31m backfill; 9.31 - 9.81m bentonite; 7.35 - 12.81m gravel;
0 - 9.31m casing; 9.31 - 12.81 screen

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 25 DEPTH: 10.23 – 12.81m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 12.81 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 10.7 mAHD
EASTING: 308687
NORTHING: 6244932
DIP/AZIMUTH: 90°/--

BORE No: 25
PROJECT No: 92370.00
DATE: 9/10/2019
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
		Clayey SAND SP: (*continued*)							S			24,30/80mm,- refusal
	10.23 10.29	LAMINITE: grey and brown, laminated, siltstone and fine grained quartz lithic sandstone, medium strength, moderately weathered, fractured, Bringelly Shale - becoming high strength, fresh below 10.45m						10.23m: CORE LOSS: 60mm 10.43m: B. sh, pl, ro, fe stn, fg 10mm	C	95	0 61	
	12.81	Bore discontinued at 12.81m - limit of investigation							C	100		

RIG: Bobcat **DRILLER:** Rockwell **LOGGED:** SE/JHB **CASING:** HW to 10.23m

TYPE OF BORING: SFA to 10.23m, then NMLC coring to 12.81

WATER OBSERVATIONS: Free groundwater observed at 8.0m whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Well installed: 0 - 0.1 gatic cover; 0.1 - 9.31m backfill; 9.31 - 9.81m bentonite; 7.35 - 12.81m gravel;
0 - 9.81m casing; 9.81 - 12.81 screen

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: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.6 mAHD
EASTING: 308815
NORTHING: 6244918
DIP/AZIMUTH: 90°/--

BORE No: 26
PROJECT No: 92370.00
DATE: 4/10/2019
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
9	0.1	FILL/GRAVEL GW: well graded, grey, with sand, dry, appears to be typically dense						Note: Unless otherwise stated, rock is fractured along sub-horizontal, rough or smooth, clean joints or bedding planes	D			
	0.5	FILL/Silty CLAY CI: medium plasticity, grey mottled red brown, w>PL, stiff, alluvial							D			
8	1	Silty CLAY CH: high plasticity, grey mottled red brown, w>PL, stiff, alluvial - becoming w~PL below 0.7m							S/A	100		3,4,5 N = 9
7	2								D			
		- with ironstone gravel and becoming very stiff below 2.5m							S/A	100		6,12,15 N = 27
6	3											
5	4								S/A	100		9,19,22 N = 41
	4.3	- with sand below 4.2m Clayey SAND SC: poorly graded, fine grained, sub-rounded, pale grey mottled orange, dense, alluvial										
4	5								S/A	100		7,20,27 N = 47
3	6											
2	7	- becoming well graded, medium grained, brown, with gravel, medium dense below 7.2m							S/A	100		9,15,17 N = 32
1	8	- with sub-rounded gravel below 8.0m							S/A	100		8,10,14 N = 24
0	9											
	10.0											

RIG: Scout IV **DRILLER:** Groundtest **LOGGED:** SE/JHB **CASING:** HW to 2.5m; HQ to 10.43m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.43m, then NMLC coring to 14.56

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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

DOUGLAS PARTNERS PTY LTD

SCHOOL INFRASTRUCTURE NSW
LIVERPOOL GIRLS & BOYS HIGH SCHOOL

BORE: 26 DEPTH: 11.5 – 14.56m PROJECT: 92370.00 OCTOBER 2019

End of Bore at 14.56 m

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Liverpool Boys & Girls High School
LOCATION: Forbes Street, Liverpool, NSW

SURFACE LEVEL: 9.6 mAHD
EASTING: 308815
NORTHING: 6244918
DIP/AZIMUTH: 90°/--

BORE No: 26
PROJECT No: 92370.00
DATE: 4/10/2019
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
		Clayey SAND SC: (*continued*)										
	10.2	Silty CLAY CI: medium plasticity, pale grey mottled brown and orange, w>PL, very stiff, alluvial							S/A	100		6,10,30/130mm refusal
	10.43	LAMINITE: grey, laminated siltstone and fine-grained, quartz-lithic sandstone, low strength, highly weathered, highly fractured, Bringelly Shale										
-1	11											
-2	12	-becoming medium to high strength, slightly weathered, fractured, below 12.09m						11.5m: Ds clay inf fg 260mm 11.86m: J, sv, cu, clay co 80mm 11.97m: J, sv, cu, clay co 70mm 12.04m: J, sv, cu, clay inf 35mm 12.07m: Ds 15mm 12.51m: B, h, pl, clay co, fg 12.52m: J, sv, ro, clay co 20mm 12.7m: J, sv, un 220mm 12.89m: Ds 50mm 13.49m: Ds, clay inf 20mm 13.59m: B, sh, fg 5mm			0	PL(A) = 0.12
-3	13								C	100	89	PL(A) = 0.55 PL(A) = 0.87 PL(A) = 0.8
-4	14										89	PL(A) = 0.5 PL(A) = 1.48 PL(A) = 1.24
-5	14.56	Bore discontinued at 14.56m - limit of investigation										
-6	15											
-7	16											
-8	17											
-9	18											
-10	19											

RIG: Scout IV **DRILLER:** Groundtest **LOGGED:** SE/JHB **CASING:** HW to 2.5m; HQ to 10.43m

TYPE OF BORING: SFA to 2.5m, rotary drilling to 10.43m, then NMLC coring to 14.56

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

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

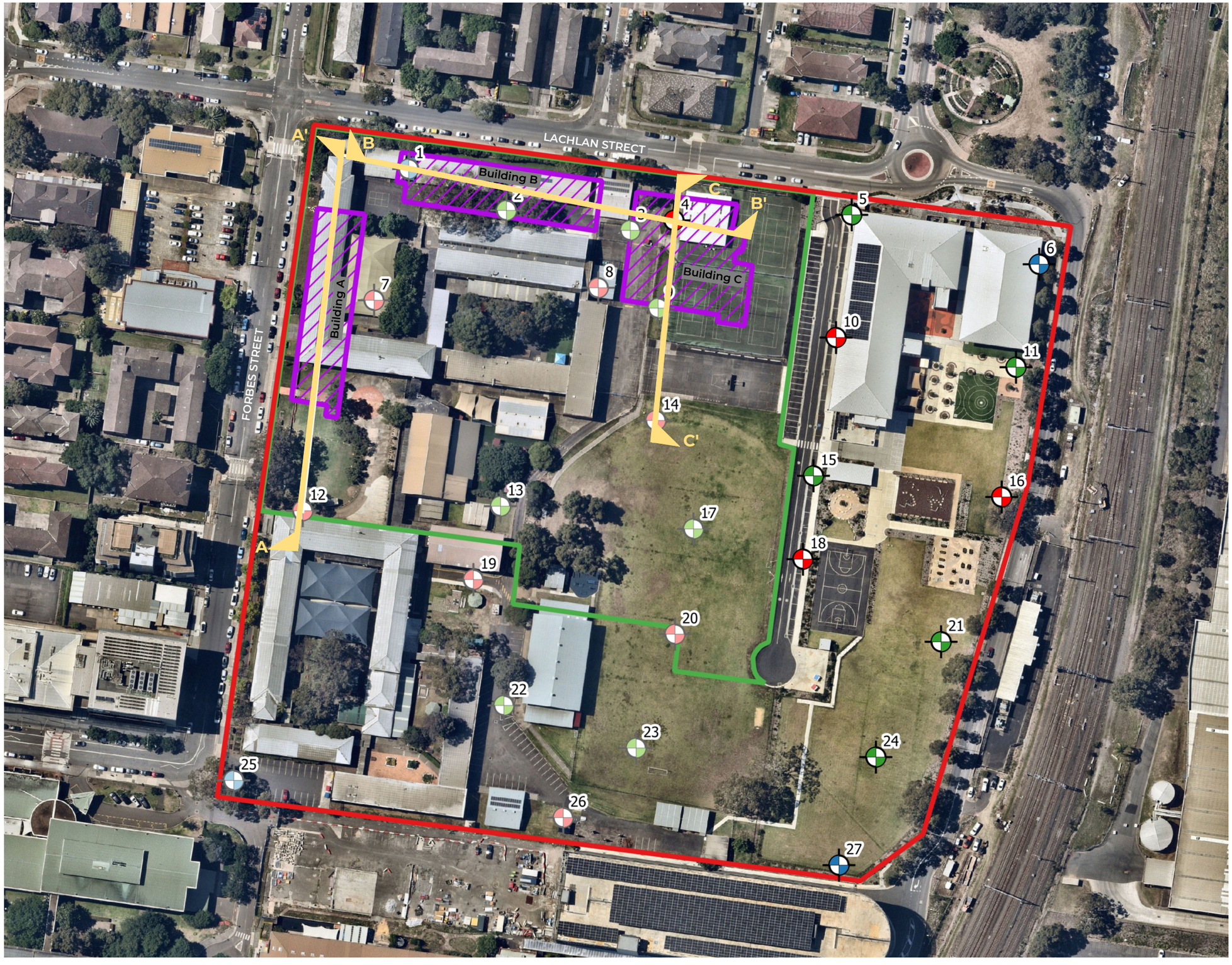
Photo 1 - Borehole 13

Photo 2 - Borehole 15

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: School Infrastructure NSW		Site Photographs	PROJECT No: 92370.00	
	OFFICE: Macarthur	PREPARED BY: JHB	Liverpool Boys and Girls High Schools	PLATE No: 1	
	SCALE: NTS	DATE: Oct 2019	Forbs Street, Liverpool	REVISION: 0	

Photo 3 - Borehole 21

Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: School Infrastructure NSW		Site Photographs	PROJECT No: 92370.00	
	OFFICE: Macarthur	PREPARED BY: JHB	Liverpool Boys and Girls High Schools	PLATE No: 2	
	SCALE: NTS	DATE: Oct 2019	Forbs Street, Liverpool	REVISION: 0	



Location Plan

LEGEND:-

- Augered Borehole Location
- Cored Borehole Location
- Standpipe Piezometer Location
- Approximate Liverpool School Site Boundary
- Approximate Liverpool High School Site Boundary
- Proposed Buildings

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0		08/01/2025	JST

: ZONE 56
COORDINATE REFERENCE SYSTEM: MGA2020

Douglas PARTNERS
OFFICE: MACARTHUR
18 Waler Crescent Smeaton Grange, NSW 2567

NOTE:
- Base image from MetroMap (Dated 06.10.2024)
- Site locality image from street-directory. Not to scale.

CLIENT: **Meinhardt Australia Pty Ltd**

SCALE: 0 10 20 30 40 50
SCALE 1:1,500 (A3)

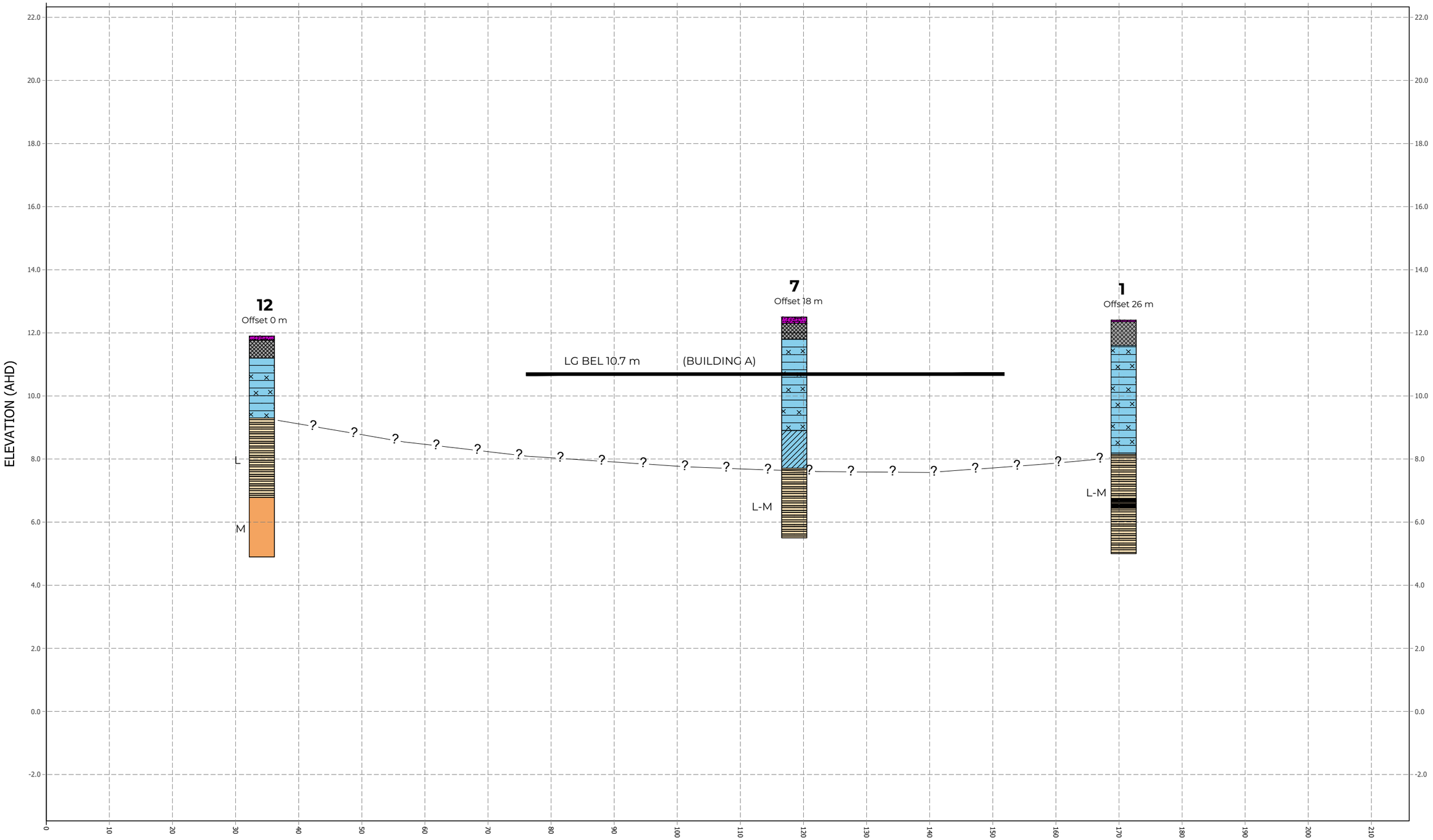
PROJECT NAME: **Proposed High School Redevelopment**

PROJECT ADDRESS: **Forbes Street, Liverpool**

DRAWING TITLE: **SITE AND TEST LOCATION PLAN**

PROJECT No: **92370.03**
DRAWING No: **1**
REVISION: **0**

P:\Macarthur Projects\92370.03\92370.03.D.001.Rev0.dwg



LEGEND

- ASPHALTIC CONCRETE
- CONCRETE
- Laminite
- CLAY
- NO CORE
- Shale
- Silty CLAY
- FILL

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0		08/01/2025	JST

: ZONE 56
COORDINATE REFERENCE SYSTEM: GDA 94

Douglas PARTNERS
OFFICE: MACARTHUR
18 Waler Crescent Smeaton Grange, NSW 2567

NOTE:

CLIENT: **Meinhardt Australia Pty Ltd**

SCALE: 0 4 8 12 16 20
SCALE 1:600 (A3)
VERTICAL EXAGGERATION: 5

PROJECT NAME: **Proposed High School Redevelopment**

PROJECT ADDRESS: **Forbes Street, Liverpool**

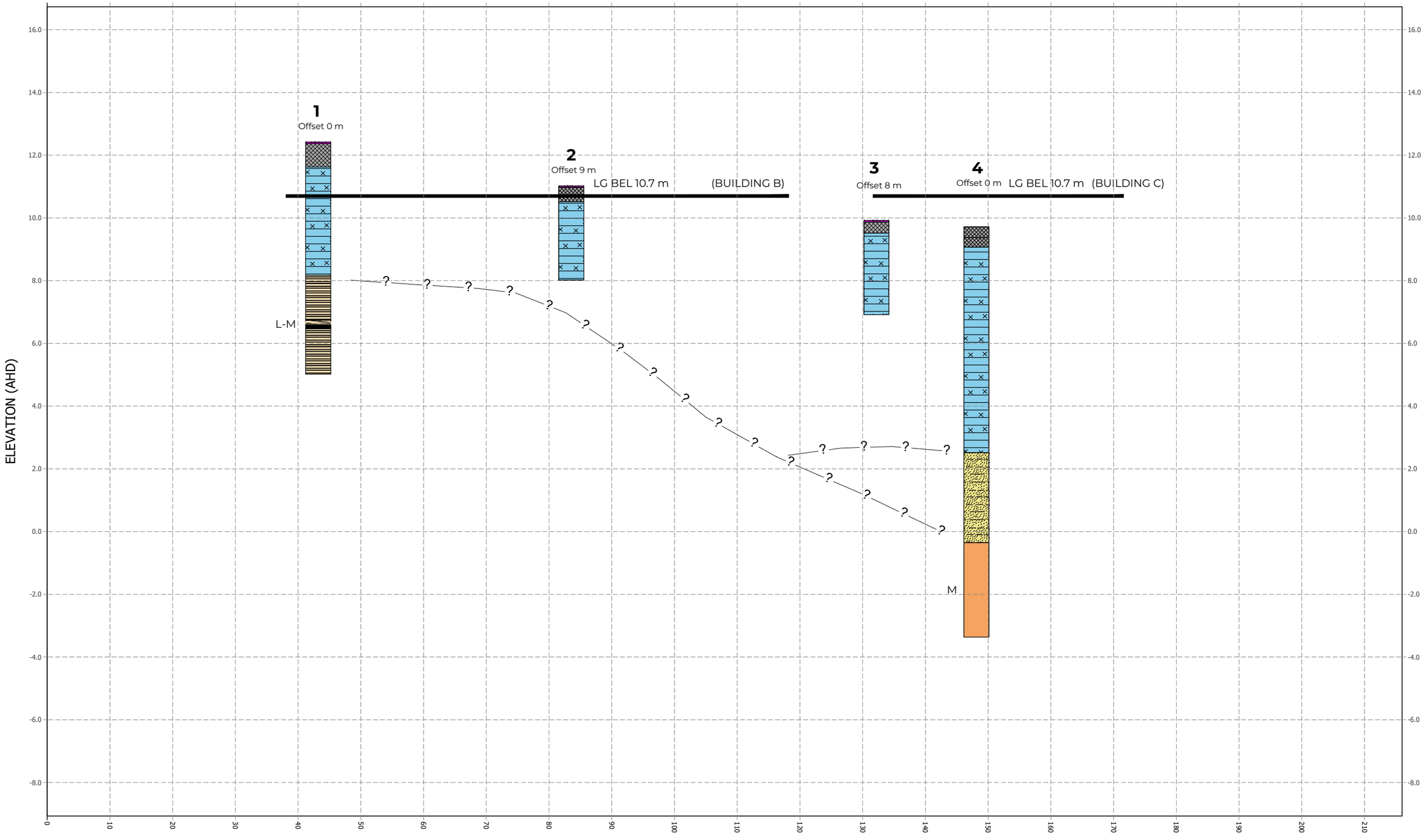
DRAWING TITLE: **CROSS SECTION A-A'**

PROJECT No: **92370.03**

DRAWING No: **2**

REVISION: **0**

P:\Macarthur Projects\92370.03\92370.03.D.002.Rev0.dwg



LEGEND

- ASPHALTIC CONCRETE
- CONCRETE
- Laminite
- CLAY
- NO CORE
- Shale
- Silty CLAY
- FILL

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0		08/01/2025	JST

: ZONE 56
COORDINATE REFERENCE SYSTEM: GDA 94

Douglas PARTNERS
OFFICE: MACARTHUR
18 Waler Crescent Smeaton Grange, NSW 2567

NOTE:

CLIENT: **Meinhardt Australia Pty Ltd**

SCALE: 0 4 8 12 16 20
SCALE 1:600 (A3)
VERTICAL EXAGGERATION: 5

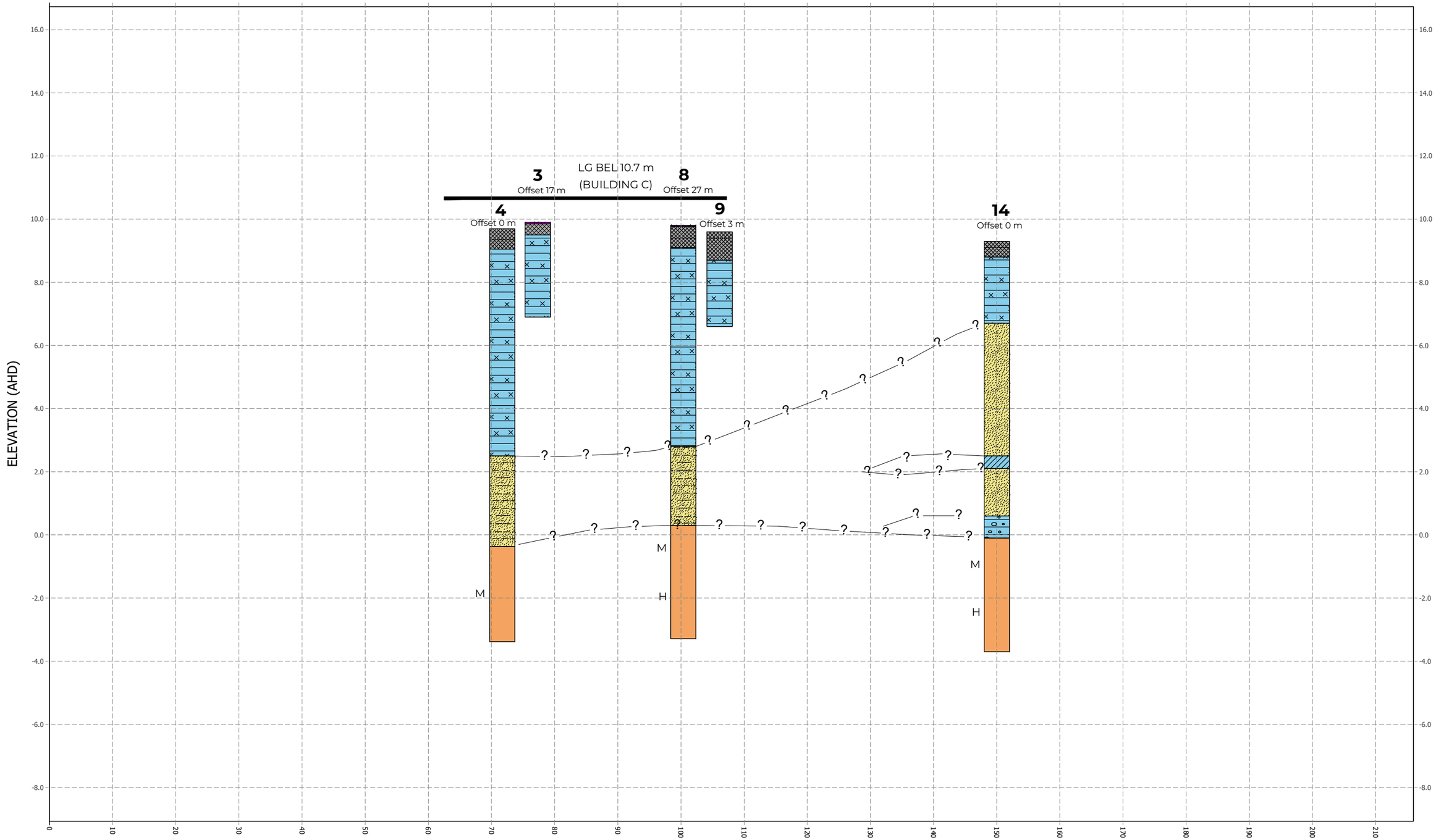
PROJECT NAME: **Proposed High School Redevelopment**

PROJECT ADDRESS: **Forbes Street, Liverpool**

DRAWING TITLE: **CROSS SECTION B-B'**

PROJECT No: **92370.03**
DRAWING No: **3**
REVISION: **0**

P:\Macarthur Projects\92370.03\92370.03.D.002.Rev0.dwg



LEGEND

- ASPHALTIC CONCRETE
- CONCRETE
- Laminite
- CLAY
- NO CORE
- SAND
- Silty CLAY
- FILL
- Clayey SAND

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0		08/01/2025	JST

: ZONE 56
COORDINATE REFERENCE SYSTEM: GDA 94

Douglas PARTNERS

OFFICE: MACARTHUR
18 Waler Crescent Smeaton Grange, NSW 2567

NOTE:

CLIENT: **Meinhardt Australia Pty Ltd**

SCALE: 0 4 8 12 16 20
SCALE 1:600 (A3)
VERTICAL EXAGGERATION: 5

PROJECT NAME: **Proposed High School Redevelopment**

PROJECT ADDRESS: **Forbes Street, Liverpool**

DRAWING TITLE: **CROSS SECTION C-C'**

PROJECT No: **92370.03**

DRAWING No: **4**

REVISION: **0**

P:\Macarthur Projects\92370.03\92370.03.D.002.Rev0.dwg

Appendix B

Results of Laboratory Testing

Material Test Report

Report Number: **92370.00-2**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Name ammended, added missing data and corrected depth*
Date Issued: 21/11/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Boys & Girls High School
Project Location: Forbes Street, Liverpool
Work Request: 1524
Dates Tested: 21/10/2019 - 21/10/2019

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: ramon.arancibia@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA WORLD RECOGNISED ACCREDITATION

Approved Signatory: Ramon Arancibia
Assistant Laboratory Manager
NATA Accredited Laboratory Number: 828

Moisture Content AS 1289 2.1.1

Sample Number	Sample Location	Moisture Content (%)	Material
MA-1524C	1 (0.5 - 0.5m)	19.7 %	FILLING - brown silty clay
MA-1524D	1 (2.5 -2.95m)	7.0 %	SITLY CLAY - grey, red and brown
MA-1524E	2 (1.0 - 1.0m)	19.1 %	FILLING - brown silty clay
MA-1524F	2 (2.5 - 2.5m)	21.0 %	SILTY CLAY - brown and red
MA-1524G	3 (0.5 - 0.5m)	22.1 %	SILTY CLAY - brown and grey
MA-1524H	3 (2.5 - 2.5m)	17.8 %	SILTY CLAY - brown and red
MA-1524I	4 (0.3 - 0.3m)	20.2 %	FILLING - brown silty clay
MA-1524J	4 (2.5 - 2.5m)	17.4 %	SILTY CLAY - grey, red and brown
MA-1524K	5 (1.0 - 1.0m)	31.5 %	SILTY CLAY - grey , red and brown
MA-1524L	5 (3.0 - 3.0m)	21.3 %	SILTY CLAY - red and grey
MA-1524M	6 (2.5 - 2.95m)	10.9 %	SILTY CLAY - red and orange
MA-1524N	7 (0.3 - 0.3m)	18.7 %	FILL/SAND - brown
MA-1524O	9 (1.0-1.0m)	23.0 %	SILTY CLAY - grey, red and brown
MA-1524P	9 (3.0 - 3.0m)	17.1 %	SILTY CLAY - grey and brown
MA-1524Q	10 (1.0 - 1.0m)	27.2 %	SILTY CLAY - grey , red and brown
MA-1524R	11 (3.0 - 3.0m)	12.7 %	SILTY CLAY - pale brown and grey
MA-1524S	12 (0.5 - 0.5m)	13.8 %	Fill/Silty CLAY - brown and red
MA-1524T	12 (2.5 - 2.8m)	16.9 %	SILTY CLAY - grey , red and brown
MA-1524U	13 (3.0 - 3.0m)	20.0 %	SAND - grey and brown
MA-1524V	14 (0.5 - 0.5m)	17.4 %	SILTY CLAY - grey , red and brown
MA-1524W	14 (3.0 - 3.0m)	12.6 %	SAND - white and brown
MA-1524X	15 (0.5 - 0.5m)	3.4 %	FILL/Silty CLAY - pale grey
MA-1524Y	15 (2.5 -2.5m)	12.7 %	SILTY CLAY - grey , red and brown
MA-1524Z	16 (2.5 - 2.95m)	11.9 %	SILTY CLAY - grey , red and brown
MA-1524AA	17 (0.5 - 0.5m)	24.9 %	FILL/Silty CLAY - red
MA-1524AB	17 (3.0 - 3.0m)	6.5 %	SILTY CLAY - grey , red and brown
MA-1524AC	18 (2.5 - 2.95m)	9.1 %	SILTY CLAY - grey , red and brown
MA-1524AD	20 (2.5 - 2.95m)	20.2 %	Clayey SAND - grey and brown
MA-1524AE	20 (6.9 - 7.35m)	16.9 %	SAND - grey and brown
MA-1524AF	21 (0.5 - 0.5m)	23.1 %	Silty CLAY - brown
MA-1524AG	21 (3.0- 3.0m)	6.3 %	Clayey SAND - grey and brown
MA-1524AH	22 (3.0 - 3.0m)	15.7 %	SILTY CLAY - grey , red and brown
MA-1524AI	23 (3.0 - 3.0m)	14.5 %	SILTY CLAY - grey and brown
MA-1524AJ	24 (0.2 - 0.2m)	13.7 %	FILL/Silty CLAY - brown and grey
MA-1524AK	24 (3.0 - 3.0m)	18.1 %	SILTY CLAY - grey , red and brown

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
Fax: (02) 4646 1886
Email: john.purcell@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

J.T. Purcell

Approved Signatory: John Purcell
Lab technician
NATA Accredited Laboratory Number: 828

Report Number: **92370.00-1**
Issue Number: 1
Date Issued: 25/10/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Girls & Boys High School
Project Location: Forbes Street, Liverpool
Work Request: 1502
Sample Number: MA-1502A
Date Sampled: 01/10/2019
Dates Tested: 17/10/2019 - 22/10/2019
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Remarks: Field moisture content = 21.5%
Sample Location: **BH 1 (1.0m - 1.45m)**
Material: SILTY CLAY - grey, red & brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	94		
Plastic Limit (%)	19		
Plasticity Index (%)	**75**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	17.0		
Cracking Crumbling Curling	Curling		

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
Fax: (02) 4646 1886
Email: john.purcell@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

J.T. Purcell

Approved Signatory: John Purcell
Lab technician
NATA Accredited Laboratory Number: 828

Report Number: **92370.00-1**
Issue Number: 1
Date Issued: 25/10/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Girls & Boys High School
Project Location: Forbes Street, Liverpool
Work Request: 1502
Sample Number: MA-1502E
Date Sampled: 10/10/2019
Dates Tested: 17/10/2019 - 24/10/2019
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Remarks: Field moisture content = 19.9%
Sample Location: **BH 12 (1.0m - 1.45m)**
Material: SILTY CLAY - grey, red & brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	66		
Plastic Limit (%)	19		
Plasticity Index (%)	**47**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	15.0		
Cracking Crumbling Curling	Curling		

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
Fax: (02) 4646 1886
Email: john.purcell@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

J.T. Purcell

Approved Signatory: John Purcell
Lab technician
NATA Accredited Laboratory Number: 828

Report Number: **92370.00-1**
Issue Number: 1
Date Issued: 25/10/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Girls & Boys High School
Project Location: Forbes Street, Liverpool
Work Request: 1502
Sample Number: MA-1502F
Date Sampled: 02/10/2019
Dates Tested: 17/10/2019 - 22/10/2019
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Remarks: Field moisture content = 22.2%
Sample Location: **BH 13 (0.5m)**
Material: FILL - brown silty clay fill

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	46		
Plastic Limit (%)	16		
Plasticity Index (%)	**30**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	14.5		
Cracking Crumbling Curling	Curling		

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
Fax: (02) 4646 1886
Email: john.purcell@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

J.T. Purcell

Approved Signatory: John Purcell
Lab technician
NATA Accredited Laboratory Number: 828

Report Number: **92370.00-1**
Issue Number: 1
Date Issued: 25/10/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Girls & Boys High School
Project Location: Forbes Street, Liverpool
Work Request: 1502
Sample Number: MA-1502H
Date Sampled: 01/10/2019
Dates Tested: 17/10/2019 - 24/10/2019
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Remarks: Field moisture content = 17.9%
Sample Location: **BH 17 (1.0m)**
Material: SILTY CLAY - grey & red silty clay

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 (%)	18		
Plasticity Index (%)	**44**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	16.5		
Cracking Crumbling Curling	Curling		

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
Fax: (02) 4646 1886
Email: john.purcell@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

J.T. Purcell

Approved Signatory: John Purcell
Lab technician
NATA Accredited Laboratory Number: 828

Report Number: **92370.00-1**
Issue Number: 1
Date Issued: 25/10/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Girls & Boys High School
Project Location: Forbes Street, Liverpool
Work Request: 1502
Sample Number: MA-1502I
Date Sampled: 02/10/2019
Dates Tested: 17/10/2019 - 21/10/2019
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Remarks: Field moisture content = 21.4%
Sample Location: **BH 22 (1.0m)**
Material: SILTY CLAY - grey, red & brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Air Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	68		
Plastic Limit (%)	20		
Plasticity Index (%)	**48**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	18.5		
Cracking Crumbling Curling	Curling		

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
Fax: (02) 4646 1886
Email: john.purcell@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

NATA
WORLD RECOGNISED ACCREDITATION

J.T. Purcell

Approved Signatory: John Purcell
Lab technician
NATA Accredited Laboratory Number: 828

Report Number: **92370.00-1**
Issue Number: 1
Date Issued: 25/10/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Girls & Boys High School
Project Location: Forbes Street, Liverpool
Work Request: 1502
Sample Number: MA-1502J
Date Sampled: 01/10/2019
Dates Tested: 17/10/2019 - 24/10/2019
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Remarks: Field moisture content = 22.1%
Sample Location: **BH 24 (1.0m)**
Material: SILTY CLAY - brown silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	68		
Plastic Limit (%)	20		
Plasticity Index (%)	**48**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	16.0		
Cracking Crumbling Curling	Curling		

Material Test Report

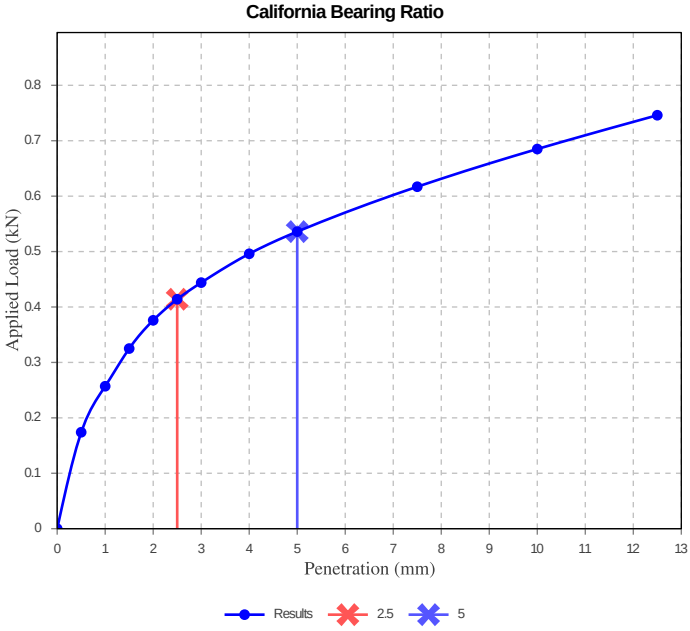
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: ramon.arancibia@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ramon Arancibia
Assistant Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **92370.00-2**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Name ammended, added missing data and corrected depth*
Date Issued: 21/11/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Boys & Girls High School
Project Location: Forbes Street, Liverpool
Work Request: 1524
Sample Number: MA-1524A
Date Sampled: 21/10/2019
Dates Tested: 21/10/2019 - 01/11/2019
Sample Location: **Composite 1 - BH11.15,16,18,21,24,27 (0.5 - 1.5m)**
Material: SILTY CLAY - grey red and brown

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)	1.62		
Optimum Moisture Content (%)	23.0		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.61		
Field Moisture Content (%)	21.1		
Moisture Content at Placement (%)	23.2		
Moisture Content Top 30mm (%)	27.4		
Moisture Content Rest of Sample (%)	24.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	48		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			



Material Test Report

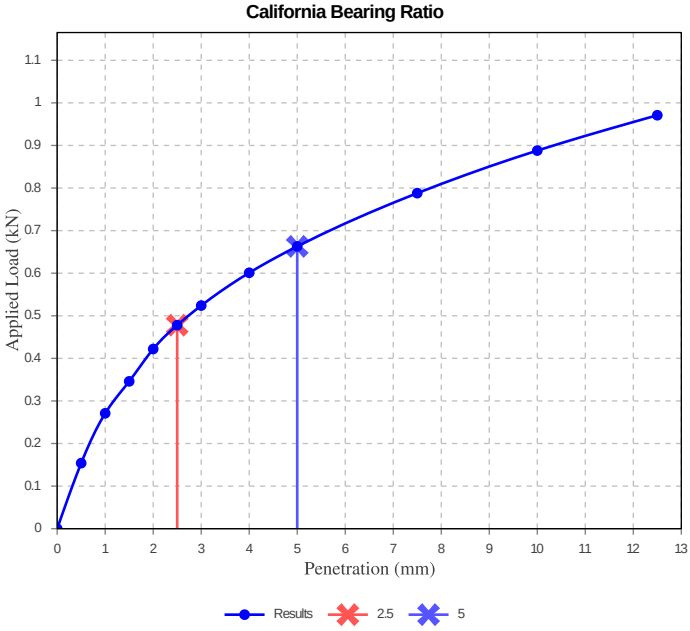
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: ramon.arancibia@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ramon Arancibia
Assistant Laboratory Manager
NATA Accredited Laboratory Number: 828

Report Number: **92370.00-2**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *Name ammended, added missing data and corrected depth*
Date Issued: 21/11/2019
Client: School Infrastructure NSW
Level 8, SYDNEY NSW 2000
Contact: Jester Magpayo
Project Number: 92370.00
Project Name: Liverpool Boys & Girls High School
Project Location: Forbes Street, Liverpool
Work Request: 1524
Sample Number: MA-1524B
Date Sampled: 01/10/2019
Dates Tested: 21/10/2019 - 01/11/2019
Sample Location: **Composite 2 BH1,2,3,4,5,7,8,9,10,14 (0.5 - 1.5m)**
Material: SILTY CLAY _ grey, red and brown

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**3.5**		
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)	1.64		
Optimum Moisture Content (%)	22.5		
Laboratory Density Ratio (%)	100.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.62		
Field Moisture Content (%)	22.3		
Moisture Content at Placement (%)	22.3		
Moisture Content Top 30mm (%)	27.0		
Moisture Content Rest of Sample (%)	24.5		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	96		
Swell (%)	1.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			



Sample Number	Sample Location	Moisture Content (%)	Material
MA-1524AL	25 (1.0 - 1.45m)	16.5 %	Silty CLAY - brown
MA-1524AM	25 (2.5 - 2.95m)	18.3 %	SILTY CLAY - grey , red and brown
MA-1524AN	26 (2.5 -2.95m)	15.6 %	SILTY CLAY - grey , red and brown
MA-1524AO	27 (0.7 - 0.7m)	26.5 %	Silty CLAY - pale brown
MA-1524AP	27 (4.0- 4.45m)	11.9 %	Silty CLAY - pale brown

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 228741

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Joel Brauer, Konrad Schultz
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details

Your Reference	**92370.00, Liverpool Boys & Girls High School**
Number of Samples	20 Soil
Date samples received	18/10/2019
Date completed instructions received	18/10/2019

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.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	25/10/2019
Date of Issue	25/10/2019

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Nick Sarlamis, Inorganics Supervisor
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		228741-1	228741-2	228741-3	228741-4	228741-7
Your Reference	UNITS	4	4	6	6	7
Depth		4.0-4.45	8.5-8.95	1.0-1.45	4.0-4.45	0.5-1.0
Date Sampled		02/10/2019	02/10/2019	01/10/2019	01/10/2019	01/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/10/2019	22/10/2019	22/10/2019	22/10/2019	22/10/2019
Date analysed	-	22/10/2019	22/10/2019	22/10/2019	22/10/2019	22/10/2019
pH 1:5 soil:water	pH Units	5.5	8.0	5.3	7.8	5.4
Electrical Conductivity 1:5 soil:water	µS/cm	800	740	130	150	60
Chloride, Cl 1:5 soil:water	mg/kg	1,100	1,000	45	170	25
Sulphate, SO4 1:5 soil:water	mg/kg	200	110	150	43	59

Misc Inorg - Soil						
Our Reference		228741-8	228741-9	228741-10	228741-13	228741-17
Your Reference	UNITS	7	18	18	26	27
Depth		2.5-2.65	1.0-1.45	4.0-4.45	1.0-1.45	2.5-2.95
Date Sampled		01/10/2019	03/10/2019	03/10/2019	04/10/2019	03/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/10/2019	22/10/2019	22/10/2019	22/10/2019	22/10/2019
Date analysed	-	22/10/2019	22/10/2019	22/10/2019	22/10/2019	22/10/2019
pH 1:5 soil:water	pH Units	6.1	4.9	5.9	5.2	5.1
Electrical Conductivity 1:5 soil:water	µS/cm	22	260	38	230	630
Chloride, Cl 1:5 soil:water	mg/kg	<10	230	20	120	910
Sulphate, SO4 1:5 soil:water	mg/kg	10	170	27	300	92

sPOCAS field test						
Our Reference		228741-1	228741-2	228741-3	228741-4	228741-5
Your Reference	UNITS	4	4	6	6	6
Depth		4.0-4.45	8.5-8.95	1.0-1.45	4.0-4.45	7.0-7.45
Date Sampled		02/10/2019	02/10/2019	01/10/2019	01/10/2019	01/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
pH_F (field pH test)*	pH Units	5.3	7.5	5.4	7.3	6.5
pH_{FOX} (field peroxide test)*	pH Units	4.3	7.6	4.0	5.9	6.1
Reaction Rate*	-	Slight	Slight	Moderate	Slight	Slight

sPOCAS field test						
Our Reference		228741-6	228741-9	228741-10	228741-11	228741-12
Your Reference	UNITS	6	18	18	18	18
Depth		10.0-10.45	1.0-1.45	4.0-4.45	7.0-7.45	10.0-10.45
Date Sampled		01/10/2019	03/10/2019	03/10/2019	03/10/2019	03/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
pH_F (field pH test)*	pH Units	7.0	5.0	6.0	7.5	7.3
pH_{FOX} (field peroxide test)*	pH Units	5.8	3.7	5.7	6.1	7.1
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference		228741-13	228741-14	228741-15	228741-16	228741-17
Your Reference	UNITS	26	26	26	27	27
Depth		1.0-1.45	5.5-5.95	10.0-10.43	0.4	2.5-2.95
Date Sampled		04/10/2019	04/10/2019	04/10/2019	03/10/2019	03/10/2019
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019	24/10/2019	24/10/2019
pH_F (field pH test)*	pH Units	5.3	6.6	8.4	7.6	5.6
pH_{FOX} (field peroxide test)*	pH Units	3.9	5.2	7.5	4.2	4.0
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test				
Our Reference		228741-18	228741-19	228741-20
Your Reference	UNITS	27	27	27
Depth		7.0-7.45	11.5-11.95	14.5-14.95
Date Sampled		03/10/2019	03/10/2019	03/10/2019
Type of sample		Soil	Soil	Soil
Date prepared	-	24/10/2019	24/10/2019	24/10/2019
Date analysed	-	24/10/2019	24/10/2019	24/10/2019
pH_F (field pH test)*	pH Units	6.9	6.9	7.6
pH_{FOX} (field peroxide test)*	pH Units	6.6	6.6	4.4
Reaction Rate*	-	Slight	Slight	Slight

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.
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	228741-2
Date prepared	-			22/10/2019	1	22/10/2019	22/10/2019		22/10/2019	22/10/2019
Date analysed	-			22/10/2019	1	22/10/2019	22/10/2019		22/10/2019	22/10/2019
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	5.5	5.5	0	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	800	770	4	97	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	1100	1000	10	99	#
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	200	220	10	114	#

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.

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; 60-140% for organics (+/-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.

Report Comments

MISC_INORG_DRY: CHLORIDE # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

MISC_INORG_DRY: SULPHATE ## Poor spike recovery was obtained for this sample. This is due to matrix interferences. However, an acceptable recovery was obtained for the LCS.