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Intrusive Geotechnical Investigation Report

Proposed Upgrade to Leppington Public School

144 Rickard Road, Leppington

Report No 20278/3-AA

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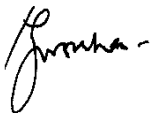
Author Signature	
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Job No: 20278/3
Our Ref: 20278/3-AA
21 January 2025

NSW Department of Education
School Infrastructure NSW (SINSW)
GPO Box 33
SYDNEY NSW 2001

Dear Sir

re: **Proposed Upgrade to Leppington Public School**
144 Rickard Road, Leppington
Intrusive Geotechnical Investigation Report

Please find herewith report on an Intrusive Geotechnical Investigation carried out for the proposed upgrade to Leppington Public School at Rickard Road, Leppington. This report has been prepared to support a Review of Environmental Factors (REF) for the proposed activity.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

INDRA JWORCHAN
Principal Geotechnical Engineer
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EXECUTIVE SUMMARY

The NSW Government is proposing upgrade to Leppington Public School to meet the growth in educational demand in Leppington and the broader South West Growth Area. The intent of the activity is to allow for upgrades to Leppington Public School that will provide a 'CORE 35' school standard in line with the Educational Facilities Standards and Guidelines (EFSG). The activity will increase the capacity of the school from 430 to 621 students. This Intrusive Geotechnical Investigation (IGI) report has been prepared to support a Review of Environmental Factors (REF) for the proposed activity and indicates the following:

- The subsurface profile across Leppington PS comprises a sequence of topsoil/fill and residual soils underlain by bedrock shale/siltstone. Fill is minor and localised. The depth to bedrock is anticipated to vary from about 2.0m to 5.0m from existing ground surface. Residual soils are stiff to hard clayey soils of medium to high plasticity.
- The depth to groundwater across the site is more than 6.0m from existing ground surface under normal climatic conditions. It should however be noted that fluctuations in the level of groundwater might occur due to variations in rainfall and/or other factors not evident during drilling.
- Residual soils across the site are reactive. However, these soils may be selectively used in controlled fill after removal of deleterious materials (such as topsoil, organic matter, very high plasticity clay, silt etc) and moisture conditioning.
- The soils likely to be disturbed or excavated during the proposed upgrade works are dispersive and saline. Therefore, earthworks for proposed upgrade will have to be carried out in accordance with a Saline Soil Management Plan to minimise impacts from erosion and salinity. Recommended Saline Soil Management Plan is provided in this report.
- Site preparation for proposed upgrade works is likely to involve excavation and fill operations. Excavations can be achieved using conventional earthmoving equipment such as excavators and dozers and fill should be placed in accordance with Australian Standard AS3798 and recommendations provided in this report. It is unlikely that the excavation works will encounter significant groundwater inflow. Minor groundwater inflow or seepage, if encountered, can be handled with conventional sump and pump method.
- Cut and fill slopes during and after proposed upgrade works should be battered for stability or retained with engineered retaining structures. For excavations within residual soils and controlled fill, recommended batter slopes for short term (temporary) stability is 1.0 vertical to 1.0 horizontal and that for long term (permanent) stability is 1.0 vertical to 2.5 horizontal.
- If batter slopes steeper than those recommended above are required, the batter slopes should be retained with engineered retaining structures. Appropriate retaining structures for the proposed development are anticipated to include gravity walls or cantilever walls or gravity walls designed for earth pressure parameters provided in this report.
- At the completion of earthworks, the building platforms for future buildings/structures are anticipated to vary from controlled fill to natural soils. Therefore, we anticipate appropriate Site Classifications for building sites across the school are likely to vary from Class M to H1 in accordance with Australian Standard AS2870.

- Appropriate footings for the proposed buildings and retaining structures comprise shallow (pad or strip) footings founded on controlled fill or residual soil, or deep footings socketed into bedrock. Deep footings (bored piers, screw piles etc) may be preferable if footings are required to withstand significant lateral and uplift loads. It is anticipated that the allowable bearing pressures for shallow footings founded in controlled fill and residual soils will vary from 100kPa to 200kPa. The allowable bearing pressure for deep footings socketed into bedrock is 700kPa or more.
- The sites for the proposed upgrade works are assessed to have a "Very Low Risk" of slope instability to the property at existing conditions. It is also our assessment that the risk of slope instability across the site can be maintained at "Very Low" so that the site will be suitable for proposed upgrade works from slope stability considerations provided earthworks and construction of proposed structures are carried out in accordance with recommendations provided in this report.
- Although dispersive and saline soils may impose some constraints on proposed upgrade works, the limitations are minor and can be addressed if earthworks are carried out in accordance with Saline Soil Management Plan provided in this report.

Based on above discussion, it is our assessment that the potential geotechnical risks at the site for the proposed activities are minor and can be addressed if earthworks and design of proposed structures are carried out in accordance with recommendation provided in this report. Furthermore, it is our assessment that the potential impact from the proposed activities on the locality, community and/or the environment is insignificant.

In conclusion, the site is assessed to be suitable for proposed activity provided earthworks and designs of ground floor slabs and footings of proposed school buildings/structures are carried out in accordance with recommendations provided in this report.

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Description
ASS	Acid Sulphate Soil
COLA	Covered Outdoor Learning Area
CSM	Conceptual Site Model
DoE	Department of Education
EC	Electrical Conductivity
ECe	Equivalent Electrical Conductivity
EFSG	Educational Facilities Standards and Guidelines
ESP	Exchangeable Sodium Percentage
GLS	General Learning Spaces
IGI	Intrusive Geotechnical Investigation
PGDR	Preliminary Geotechnical Desktop Report
PS	Public School
REF	Reference Environmental Factors
SMP	Soil Management Plan
SSMP	Saline Soil Management Plan
SINSW	School Infrastructures NSW
SPT	Standard Penetration Test
SWMS	Safe Work Method Statement

1.0 INTRODUCTION AND DECLARATION

This Intrusive Geotechnical Investigation (IGI) report has been prepared by Geotechnique Pty Ltd to support a Review of Environmental Factors (REF) for the Department of Education (DoE) for the upgrade to Leppington Public School (PS) (the **activity**). The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by State Environmental Planning Policy (Transport and Infrastructure) 2021 (T&I SEPP) as "development permitted without consent" on land carried out by or on behalf of a public authority under Part 5 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37 of the T&I SEPP.

Figure 1 below shows the location of the site.

Figure 1 - Location of Leppington Public School

The proposed activity is to upgrade the existing Leppington PS at 144 Rickard Road, Leppington, NSW, 2179 (the **site**).

This report supports REF and provides (1) assessment of subsurface conditions across the site and (2) geotechnical recommendations on site preparation and the design of the proposed upgrade activity. The IGI was completed in accordance with Australian Standard AS1726 (Reference 1).

2.0 SITE DESCRIPTION

Leppington PS is located at 144 Rickard Road, Leppington, on the eastern side of Rickard Road, north of Ingleburn Road and south of Byron Road. The site has an area of 3.013 ha and comprises 4 allotments, legally described as following:

- Lot 1 DP 127446
- Lot 1 DP 439310
- Lot 38E DP 8979
- Lot 39C DP 8979

The site currently comprises an existing co-education primary (K-6) public school with:

- 14 permanent buildings
- 11 demountable structures (including 2 male/female toilet blocks)
- interconnected paths
- covered walkways
- play areas and
- at-grade parking.

The site also contains locally listed heritage buildings along its southern boundary.

The buildings are one storey in height and there is a sport oval in the eastern portion of the site. The existing buildings are clustered in the north-western part of the site.

3.0 PROPOSED ACTIVITIES

The proposed activity involves upgrades to the existing Leppington PS, including the following:

- Demolition of existing structures and trees
- Erection of a new 3-storey teaching space along the northern boundary that includes 20 permanent teaching spaces and 3 support teaching spaces
- Erection of a new hall and Covered Outdoor learning Area (COLA) comprising of a hall, canteen and OSHC hub towards the eastern boundary of site
- Extension of the existing library (Building E) and adjoining playground
- Upgraded sports and play facilities
- Relocation of the Yarning Circle
- Erection of a substation and upgrades to site services
- Footpaths, fencing and associated works and
- Landscaping.

The intent of the activity is to allow for upgrades to Leppington PS that will provide a 'CORE 35' school standard in line with the Educational Facilities Standards and Guidelines (EFSG). The activity will increase the capacity of the school from 430 to 621 students.

Figure 2 shows the scope of works for the proposed activity.

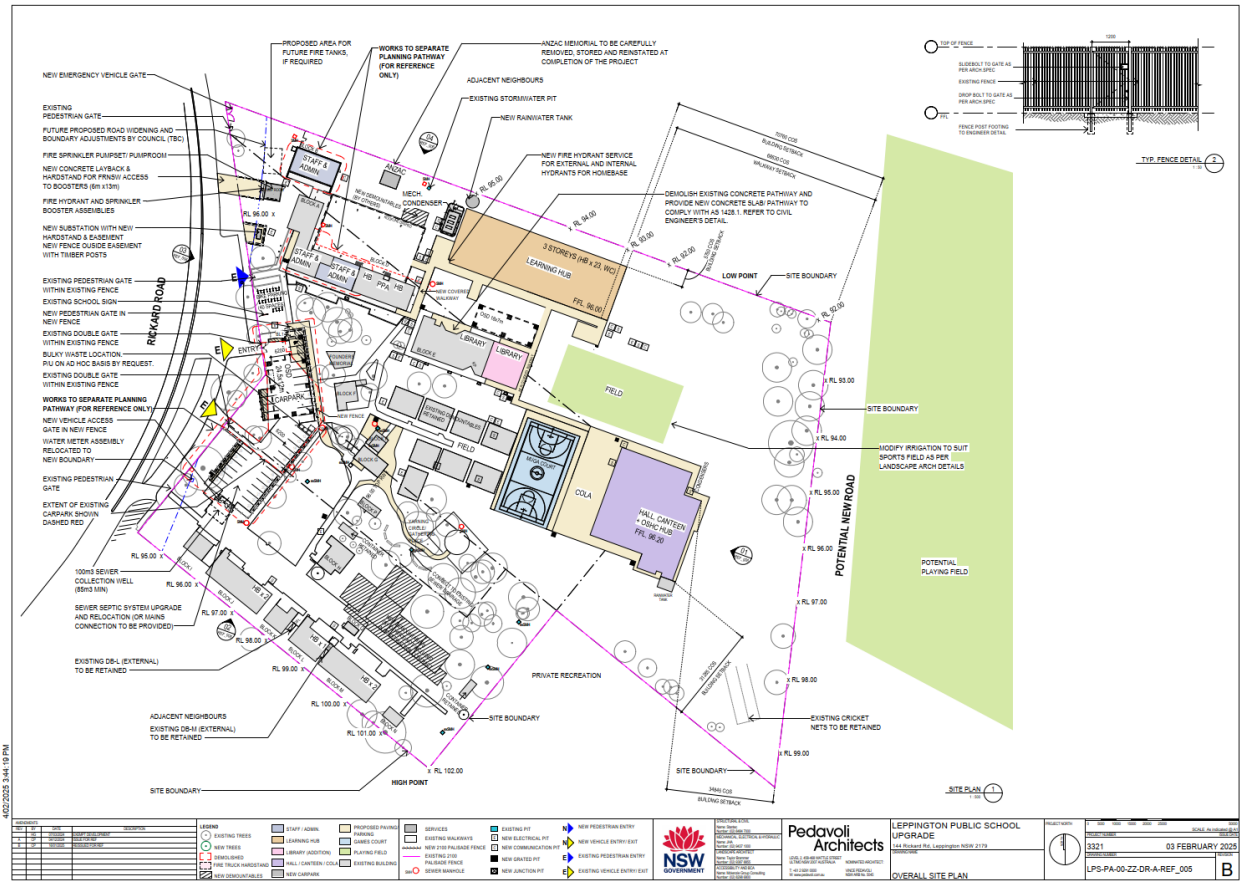

Figure 2 - Footprints of Proposed Structures in Leppington Public School

4.0 BACKGROUND INFORMATION

4.1 Regional Geology and Soil Landscape

Reference to the Geological Map of Penrith (scale 1:100,000) indicates that the bedrock at the site is Bringelly Shale, belonging to the Wianamatta Group of rocks and comprising shale, carbonaceous claystone, laminite, fine to medium grained lithic sandstone, and rare coal (Reference 2).

Reference to the Soil Landscape Map of Penrith (scale 1:100,000) indicates that the landscape at the site belongs to Blacktown Group, which is characterised with gently undulating rises on Wianamatta Group shales, with local relief to 30.0m, ground slope of less than 5 percent and broad rounded crests. The sub-surface soil within this landscape is likely to be up to 3.0m thick, moderately reactive, highly plastic and with poor drainage (Reference 3).

4.2 Soil Salinity

Reference to Map showing Salinity Potential in Western Sydney (Scale Approximate 1:143,000) prepared by Department of Infrastructures, Planning and Natural Resources (2002) indicates moderately to high salinity potential across the site (Reference 4).

4.3 Acid Sulphate Soils

Acid Sulphate Soil Risk Map (Edition 2, 1:25,000) of Liverpool prepared by Department of Land and Water Conservation indicates there no known occurrence of acid sulphate soil materials within the soil profiles at the site (Reference 5). Ground surface elevation (at least RL90.0m AHD) across the site is higher than areas with occurrence of acid sulphate soils.

4.4 Groundwater

A search of the website of Department of Primary Industries Office of Water for registered groundwater bore data shows no bores within a radius of 500.0m of the site (Reference 6).

4.5 Preliminary Geotechnical Desktop Study

Geotechnique Pty Ltd completed a Preliminary Geotechnical Desktop Study (PGDS) for the proposed upgrade of LPS and submitted Report No 20278/-AA dated 6 February 2024 (Reference 7). This report in general indicates the following:

- The subsurface profile across LPS comprises a sequence of topsoil/fill and residual soils underlain by bedrock shale/siltstone. Fill is minor and localised. The depth to bedrock is anticipated to vary from about 2.0m to 5.0m from existing ground surface. Residual soils are stiff to hard clayey soils of medium to high plasticity.
- The depth to groundwater across the site is likely to be in excess of 6.0m from existing ground surface under normal climatic conditions. It should however be noted that fluctuations in groundwater level might occur due to variations in rainfall and/or other factors not evident during drilling.
- Residual soils across the site are reactive, not ideal materials for use in controlled fill. However, these soils may be selectively used in controlled fill after removal of deleterious materials (such as topsoil, organic matter, very high plasticity clay, silt etc) and moisture conditioning.
- The soils likely to be disturbed or excavated during the proposed upgrade works are dispersive and saline. Therefore, earthworks for proposed upgrade will have to be carried out in accordance with a Saline Soil Management Plan to minimise impacts from erosion and salinity.
- Site preparation for proposed upgrade works is likely to involve excavation and fill operations. Excavations can be achieved using conventional earthmoving equipment such as excavators and dozers and fill should be placed in accordance with Australian Standard AS3798 (Reference 8) and recommendations provided in this report. It is unlikely that the excavation works will encounter significant groundwater inflow. Minor groundwater inflow or seepage, if encountered, can be handled with conventional sump and pump method.
- Cut and fill slopes during and after proposed upgrade works should be battered for stability or retained with engineered retaining structures. For excavations within residual soils and controlled fill, recommended batter slopes for short term (temporary) stability is 1.0 vertical to 1.0 horizontal and that for long term (permanent) stability is 1.0 vertical to 2.5 horizontal.

- If batter slopes steeper than those recommended above are required, the batter slopes should be retained with engineered retaining structures. Appropriate retaining structures for the proposed development are anticipated to include gravity walls or cantilever walls or gravity walls designed for earth pressure parameters provided in this report.
- At the completion of earthworks, the building platforms for future buildings are anticipated to vary from controlled fill to natural soils. Therefore, we anticipate appropriate Site Classifications for building sites across the school are likely to vary from Class M to H1 in accordance with Australian Standard AS2870 (Reference 9).
- Appropriate footings for the proposed buildings and retaining structures comprise shallow (pad or strip) footings founded on controlled fill or residual soils, or deep footings socketed into bedrock. Deep footings (bored piers, screw piles etc) may be preferable if footings are required to withstand significant lateral and uplift loads.
- The site for the proposed upgrade works is assessed to have a "Very Low Risk" of slope instability to the property at existing conditions (Reference 10). It is also our assessment that the risk of slope instability across the site can be maintained at "Very Low" so that the site will be suitable for proposed upgrade works from slope stability considerations provided earthworks and construction of proposed structures are carried out in accordance with recommendations provided in this report.
- Although dispersive and saline soils may impose some constraints on proposed upgrade works, the limitations are minor and can be addressed if earthworks are carried out in accordance with appropriate Saline Soil Management Plan.

From geotechnical engineering considerations, there are no significant geotechnical risks on proposed upgrade works in Leppington PS. Therefore, it is our assessment that the site is suitable for proposed upgrade works provided site preparation and designs of activity are carried out in accordance with recommendations in this report.

4.6 Intrusive Geotechnical Investigation

4.6.1 Field Works

Field works for the intrusive geotechnical investigation were carried out on 20 January and 17 April 2023 and consisted of the following.

- Review the PGDR relevant to the site and plan showing footprints of proposed upgrade activity.
- Review services plans obtained from "BYD" to assess locations of existing underground services across the site.
- Carry out a walk over survey to assess existing site conditions and based on proposed activity nominate 15 borehole locations, 11 shallower boreholes and 4 deeper boreholes.
- Scan the proposed borehole locations for underground services to ensure boreholes are located away from existing services, if any.
- Drill eleven (11) shallower boreholes (designated as BH1 to BH10) using an auger mounted on an excavator. These boreholes were terminated at auger refusal in bedrock or depth of about 2.5m from existing ground surface, whichever occurs first. Approximate locations of these borehole are indicated on Drawing No 20278/1-AB1 presented in Attachment A. Borehole logs are also presented in Appendix A.

- Conduct Dynamic Cone Penetrometer (DCP) tests adjacent to selected shallow boreholes to assess strength of subsurface soils. DCP tests were terminated due to refusal at depths of about 0.5m to 1.0m. DCP test results are included in appropriate borehole logs.
- Drill four (4) deeper boreholes (designated as BH12 to BH15) using a truck mounted drilling rig fully equipped for geotechnical investigation. These boreholes were drilled using TC-bit to depths of about 3.1m to 4.8m from existing ground surface. Approximate locations of these boreholes are also indicated on Drawing No 20278/1-AB1 presented in Attachment A. Borehole logs are also presented in Attachment A.
- Conduct Standard Penetration Tests (SPT) at regular depth intervals in deeper boreholes to assess the strength of the sub-surface soils. SPT results are included in appropriate borehole logs.
- Recover representative soil samples and rock cores from boreholes for visual assessments and laboratory tests.
- Measure depths to groundwater levels in boreholes, if encountered.
- Backfill the boreholes with recovered materials after logging and sampling.
- Locate borehole locations using our inhouse GPS.

Field works was supervised by a Field Engineer from this company and carried out in accordance with a Safe Work Method Statement (SWMS) to ensure works are carried out safely and with minimum impact to the environment.

4.6.2 Subsurface Profile

Sub-surface profiles encountered in boreholes are detailed in the borehole logs presented in Appendix A and summarised below in Table 1.

Table 1 - Sub-surface Profiles encountered in Boreholes

Borehole No	Easting (m)	Northing (m)	Ground Surface RL (m AHD)	Termination Depth (m)	Depth for Topsoil/ Fill (m)	Depth for Residual Soil (m)	Depth to Bedrock (m)
BH1	297651.0	6240216.4	94.9	2.5	-	0.0-2.3	2.3
BH2	297695.8	6240125.5	100.1	2.1	0.0-0.1	0.1-1.9	1.9
BH3	297798.5	6240165.5	95.4	2.1	0.0-0.1	0.1-1.9	1.9
BH4	297773.4	6240214.5	94.8	2.5	0.0-1.3	1.3->2.5	-
BH5	297814.1	6240243.2	92.2	2.5	0.0-0.4	0.4->2.5	-
BH6	297736.0	6240232.4	95.2	2.3	0.0-0.2	0.2->2.3	-
BH7	297715.2	6240258.6	95.7	2.1	0.0-0.9	0.9-2.0	2.0
BH8	297715.4	6240283.4	95.2	2.2	0.0-0.2	0.2->2.2	-
BH9	297704.2	6240200.4	96.7	2.5	0.0-0.2	0.2->2.5	-
BH10	297750.8	6240267.2	94.0	2.5	0.0-0.2	0.2->2.5	-
BH11	297649.4	6240299.9	95.7	2.5	0.0-0.2	0.2->2.5	-
BH12	297733.7	6240260.3	94.9	6.0	0.0-0.1	0.1-3.3	3.3
BH13	297797.8	6240240.3	93.7	6.0	0.0-0.2	0.20-4.8	4.8
BH14	297814.7	6240205.1	94.3	6.0	0.0-0.2	0.2-3.1	3.1
BH15	297725.1	6240171.1	97.6	6.0	0.0-0.2	0.2-3.2	3.2

Table 1 indicates that the subsurface profiles across the site generally comprise a sequence of topsoil and residual soils underlain by bedrock. However, localised fill of up about 1.0m thickness was encountered in boreholes BH4 and BH7. The depth to bedrock is anticipated to vary from about 2.0m to 5.0m from existing ground surface.

The subsurface materials across the site may in general be described as follows:

Topsoil	Clayey SILT, low plasticity, brown, with some roots
Fill	Silty CLAY, low to high plasticity, grey, brown, moisture content lower than plastic limit
Residual Soil	Clayey SILT, low plasticity, brown, moisture content lower than plastic limit
	Silty CLAY, low to high plasticity, red mottle pale grey, moisture content generally lower than plastic limit, stiff to hard, iron-staining, with some gravel
	Shaley CLAY, high plasticity, grey, moisture content generally lower than plastic limit, hard
Bedrock	SHALE/SILTSTONE, extremely to distinctly weathered, very low to low strength

Groundwater level was not encountered in all boreholes up to their termination depths of 2.1m to 6.0m from existing ground surface. Therefore, we anticipate that the depth to regional groundwater across the site is more than 6.0m. However, it should be noted that the groundwater levels might vary due to rainfall and other factors not evident during field work.

4.6.3 Laboratory Tests

Representative soil samples recovered from boreholes were tested in the NATA accredited laboratories in accordance with relevant Australian Standards, to determine the shrink swell index and chemical properties including Electrical Conductivity (EC), pH, chloride, resistivity and Exchangeable Sodium Percentage (ESP). Detailed laboratory test results are presented in Attachment B and summaries of test results are presented in the following Tables 2 and 3.

Table 2 - Results of Physical Properties Tests

Borehole No	Sample Depth (m)	Swell (%)	Shrink (%)	Shrink Swell Index (%/pF)
BH4	0.4-0.62	1.4	1.2	1.1
BH8	0.5-0.67	1.8	3.2	2.3
BH14	0.5-0.9	2.7	3.3	2.6
BH15	0.95-1.2	5.4	1.1	2.1

Table 3 - Results of Chemical Properties Tests

Borehole No	Sample Depth (m)	EC (µS/cm)	pH	Chloride (ppm)	Resistivity (ohm-m)	Exchangeable Sodium Percentage (%)
BH9	0.7-1.0	530	5.3	-	-	31.9
BH9	1.7-2.0	530	5.4	-	-	32.2
BH10	0.4-0.7	150	5.8	140	83	13.1
BH10	1.4-1.7	770	5.8	820	15	32.4
BH11	1.8-2.1	500	5.6	-	-	27.3
BH11	2.3-2.5	440	5.5	-	-	26.6

Borehole No	Sample Depth (m)	EC (µS/cm)	pH	Chloride (ppm)	Resistivity (ohm-m)	Exchangeable Sodium Percentage (%)
BH12	0.1-0.5	37	5.6	12	320	10.1
BH12	0.5-0.95	41	5.8	12	280	23.0
BH12	1.5-1.95	190	5.7	130	60	31.5
BH12	2.5-3.0	340	5.4	300	33	35.0
BH12	3.0-3.33	300	5.8	270	38	35.5
BH13	0.3-0.8	84	5.8	-	-	9.2
BH13	0.8-1.25	99	5.7	-	-	12.5
BH13	1.55-2.0	250	6.1	-	-	20.4
BH13	2.0-3.0	260	5.7	170	47	26.9
BH13	3.0-3.45	490	5.0	420	24	33.5
BH13	4.5-4.95	670	4.9	680	18	34.0
BH14	0.5-0.95	350	5.5	-	-	23.1
BH14	1.5-1.95	520	5.9	-	-	27.4
BH14	3.0-3.3	370	5.6	700	30	32.8
BH15	0.5-0.95	790	5.3	840	15	30.7
BH15	1.5-1.95	840	5.7	960	14	33.3
BH15	3.0-3.3	770	5.6	800	15	33.6

4.6.4 Recommended Geotechnical Model for the Site

Based on borehole information detailed in this report, a Geotechnical Model constituting two Geotechnical Units and detailed below in Table 4 is suggested for the site. Each Geotechnical Unit represents a specific nature of soil or bedrock encountered across the site.

Table 4 - Recommended Geotechnical Model

Geotechnical Unit	Material Description	Indicative Depth to Top of Unit (m)
Unit 1	Residual Soil	0.1-1.3
Unit 2	Bedrock	1.9-4.8

It is noted that the residual soils are overlain generally by 0.1m to 0.2m thick topsoil. However, up to about 1.0m thick fill was encountered in two boreholes (BH4 and BH7). We anticipate the topsoil and existing fill within footprints of proposed activity will be removed or replaced with controlled fill placed in accordance with recommendations provided below in this report. Controlled fill may be considered to belong to Unit 1. Based on visual assessment and results of SPT and DCP tests, indicative strength parameters, in terms of cohesion and internal friction angle, as well as modulus for each Geotechnical Unit are presented below in Table 5.

Table 5 - Effective Strength Parameters and Modulus

Geotechnical Units	Unit Weight (kN/m^3)	Undrained Cohesion (kPa)	Effective Cohesion (kPa)	Friction Angle (deg)	Young's Modulus (MPa)	Poisson's Ratio
Unit 1	18.5	100.0	0.0	27.0	25.0	0.30
Unit 2	22.0	300.0	30.0	30.0	100.0	0.25

4.6.5 Soil Erodibility

Erosion is the detachment and movement of soil materials. Soil erodibility or dispersibility is generally assessed by conducting chemical tests such as Exchangeable Sodium Percentage (ESP) and Sodium Absorption Ratio (SAR), and physical tests such as Emerson Class and Dispersion Percentage. It should be noted that assessment of soil dispersibility based on these methods might differ from each other.

For the proposed work, only ESP values for representative soil samples were determined. Soils with ESP values of 10% or more are considered sodic, and those with ESP more than 15% are considered highly sodic (Reference 11). Sodic soils are dispersive and susceptible to excessive erosion.

ESP values for 23 representative soil samples presented in Table 2 indicate that the ESP values vary from 9.2% to 35.5%. All samples except one have ESP of more than 10.0% and 19 these samples show ESP value of more than 15.0%. Therefore, it is our assessment that the soils likely to be disturbed or excavated during proposed activity are dispersive and susceptible to excessive erosion.

Therefore, we recommend that the earthworks for the proposed activity are carried out in accordance with an appropriate Soil Management Plan (SMP) in accordance with Landcom Guidelines to manage the impacts from the erosive soils (References 12 and 13).

4.6.6 Soil Salinity

Soil salinity is generally assessed by measuring Electrical Conductivity (EC) of a soil sample made up of 1:5 soil water suspension. Thus, determined EC is multiplied by a factor varying from 6 to 23, based on the texture of the soil sample, to obtain Corrected Electrical Conductivity designated as ECe (Reference 14). Alternatively, ECe may be directly measured in soil saturation extracts. Soils are classified as saline if ECe of the saturated extracts exceed 4.0dS/m. The criteria for assessment of soil salinity classes are shown in the following Table 6 (Reference 14).

Table 6 – Criteria for Soil Salinity Classification

Classification	EC_e (dS/m)	Comments
Non-saline	<2	Salinity effects mostly negligible
Slightly saline	2 – 4	Yields of very sensitive crops may be 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 tolerant crops yield satisfactorily

Electrical conductivity (EC) values for 23 representative soil samples are summarised in Table 3. For clayey soils encountered across the site an appropriate multiplying factor is assumed to vary from 9 to 10. Even if a factor of 10 is used, estimates of ECe values for soil samples are estimated to vary from about 0.4dS/m to 8.4dS/m. Almost half of samples show ECe values of more than 4.0dS/m. As saline soils samples have been collected from varying depths across the site and large number of sampling and testing will be required to delineate areas with saline soils, it is our recommendation that the soils likely to be disturbed or excavated during proposed activity are considered saline.

Therefore, earthworks for the proposed activity should be carried out in accordance with a Saline Soils Management Plan (SSMP) to manage impact from saline soils. Recommended SSMP is presented below in this report.

4.6.7 Exposure Classification

Australian Standard AS2870 (Reference 9) provides guidelines to assess Exposure Classification for saline and acid/sulphate soils. Table 7 below provides salinity and Exposure Classifications based on EC_e, and Table 8 provides Exposure Classification based on acidic and sulphate soils (Reference 9).

Table 7 – Exposure Classifications for Saline Soils

Electrical Conductivity, EC_e (dS/m)	Exposure Classification	Salinity Classification
<2	A1	Non-saline
2 – 4	A1	Slightly saline
4 – 8	A2	Moderately saline
8 – 16	B1	Very saline
>16	B2	Highly saline

Table 8 – Exposure Classifications for Sulphate Soils

Sulphate expressed as SO_3		pH	Exposure Classification*	
In Soil (ppm)	In Groundwater (ppm)		Soil Condition A	Soil Condition B
<5000	<1000	>5.5	A2	A1
5000-10000	1000-3000	4.5-5.5	B1	A2
10000-20000	3000-10000	4.0-4.5	B2	B1
>20000	>10000	<4.0	C2	B2

*Soil Condition A = high permeability soils (e.g. sands and gravels) which are below groundwater
*Soil Condition B = low permeability soils (e.g. silts and clays) and all soils above groundwater

Soils across the site are clayey and therefore appropriate “Soil Condition B” is appropriate for predominant clayey soils. Therefore, based on laboratory test results presented in Tables 3 and guidelines on Exposure Classifications presented in Tables 7 and 8, the Exposure Classifications for soils across the site belong to Class A1 or A2. Therefore, we recommend that the proposed activity use construction materials (such as concrete, bricks) and construction methods appropriate for Exposure Class A2.

4.6.8 Aggressivity Classification

Australian Standard AS2159 (Reference 15) provides Aggressivity Classifications of soil and groundwater applicable to iron/steel and concrete piles. The Aggressivity Classifications applicable to iron/steel piles is provided below in Table 9 and that applicable to concrete piles is provided in Table 10.

Table 9 – Aggressivity Classification for Steel

Chloride		pH	Resistivity (ohm cm)	Soil Condition A*	Soil Condition B#
In Soil (ppm)	In Water (ppm)				
<5000	<1000	>5.0	>5000	Non-aggressive	Non-aggressive
5000-20000	1000-10000	4.0-5.0	2000-5000	Mild	Non-aggressive
20000-50000	10000-20000	3.0-4.0	1000-2000	Moderate	Mild
>50000	>20000	<3.0	<1000	Severe	Moderate

Table 10 – Aggressivity Classification for Concrete

Sulphate expressed as SO_4		pH	Chloride in Water (ppm)	Soil Condition A	Soil Condition B
In Soil (ppm)	In Groundwater (ppm)				
<5000	<1000	>5.5	<6000	Mild	Non-aggressive
5000-10000	1000-3000	4.5-5.5	6000-12000	Moderate	Mild
10000-20000	3000-1000	4.0-4.5	12000-30000	Severe	Moderate
>20000	>10000	<4.0	>30000	Very Severe	Severe

As discussed above soils across the site are clayey and therefore Soil Condition B is appropriate. Based on laboratory test results presented in Tables 3 and guidelines on Aggressivity Classifications presented in Tables 9 and 10, the soils across the site are assessed to be Non-aggressivity to Mildly Aggressive to both steel concrete piles. Resistivity is dominant for steel piles and pH is dominant for concrete piles.

Therefore, we recommend that the steel and concrete piles for proposed activity are designed to suit Mildly Aggressive site (Reference 15).

4.6.9 Soil Reactivity

Shrink swell index of representative residual soils vary from 1.1%/pF to 2.6%/pF. Therefore, it is our assessment that the soils across the site are reactive and susceptible to shrink and swell movements.

4.6.10 Excavation Conditions

Proposed upgrade works across the school is anticipated to involve some cut and fill operations. Although details on depth of excavation is not provided, we anticipate proposed excavations will not be deeper than about 2.5m from existing ground surface. Therefore, the materials to be excavated are anticipated to comprise topsoil, fill, residual soils and bedrock (shale and siltstone). Bedrock may be encountered only in localised areas and where encountered bedrock up to depth of 2.5m is anticipated to be of very low to low strength.

It is also noted that the excavation into bedrock, if any, is anticipated to be minor. Therefore, it is our assessment that the excavation of topsoil, residual soils and bedrocks of very low to low strength can be achieved using conventional earthmoving equipment such as excavators and dozers.

Based on site observation during field works, we do not anticipate significant groundwater inflow during excavations to depth of about 2.5m. Minor groundwater inflow, if any, could be managed by a conventional sump and pump method. However, trafficability problems could arise locally during wet weather or if water is allowed to pond at the site.

4.6.11 Fill Placement

Site preparation for proposed upgrade works may involve placement of some fill. The fill should be placed in a controlled manner, and we recommend the following procedures for placement of controlled fill.

- Strip existing topsoil and fill and stockpile separately for possible future uses or dispose off the site. Topsoil may be used in landscaping.

- Undertake proof rolling (using an 8 to 10 tonnes roller) of the exposed residual soils to detect potentially weak spots (ground heave). Excavate areas of localised heaving to a depth of about 300mm and replace with granular fill, compacted as described below.
- Undertake proof rolling of soft spots backfilled with granular fill, as described above. If the backfilled area shows movement during proof rolling, this office should be contacted for further recommendations.
- Place suitable fill materials on proof rolled surface. Fill should be placed in horizontal layers of 200mm to 250mm maximum loose thickness and compacted to a Minimum Dry Density Ratio (MDDR) of 98% Standard, at moisture content within 2% of Optimum Moisture Content (OMC). However, the upper 500mm of controlled fill forming subgrade for access roads and car parks should be compacted to a MDDR of 100% Standard, at moisture content within 2% of OMC. Controlled fill should preferably comprise non-reactive fill (e.g. crushed sandstone), with a maximum particle size not exceeding 75mm, or low plasticity clay. The residual soils and bedrock obtained from excavations within the site may also be selectively used in controlled fill, after crushing to sizes finer than 75mm, moisture conditioning, and removal of unsuitable materials.
- Fill placement should be supervised to ensure that material quality, layer thickness, testing frequency and compaction criteria conform to the specifications. We recommend "Level 2" or better supervision, in accordance with AS3798 (Reference 8). It should be noted that a Geotechnical Inspection and Testing Authority will generally only provide certification on quality of entire compacted fill if Level 1 supervision and testing is carried out.

4.6.12 Batter Slopes and Retaining Structures

As described above, site preparation for the proposed upgrade works will involve cut and fill operations. Cuts are likely to be limited in residual soils. The cut and fill slopes should be battered for stability or retained by engineered retaining structures. If cut and fill slopes are to be battered for stability, we recommend the following batter slopes:

- For short-term stability in controlled fill and residual soils = 1 vertical to 1 horizontal
- For long-term stability in controlled fill and residual soils = 1 vertical to 2.5 horizontal

It is also recommended that batter slopes are provided with adequate surface and sub-surface drainage, and the crest of the batter slope is at least 1.0m away from the property boundaries.

However, if cut and fill slopes steeper than those recommended above are required for whatever reason, these slopes should be retained by engineered retaining structures. Appropriate retaining structures for the proposed upgrade works are anticipated to comprise cantilever walls and gravity walls. The pressure distribution on such walls is assumed to be triangular in shape and estimated as follows.

$$p_h = \gamma k H$$

Where,

p_h = Horizontal pressure (kN/m^2)
γ = Total unit weights of retained materials (kN/m^3)
k = Coefficient of earth pressure (k_a or k_o)
H = Retained height (m)

For design of flexible retaining structures where some lateral movement is acceptable, an active earth pressure coefficient (k_a) is recommended. However, if it is critical to limit the horizontal deformation, use of an earth pressure coefficient at rest (k_0) is recommended. Recommended earth pressure coefficients for the design of retaining structures are presented below.

- Total Unit Weight = 18.5kN/m^3
- Coefficient of active earth pressure (k_a) = 0.35
- Coefficient of at rest earth pressure (k_0) = 0.55
- Coefficient of passive pressure (k_p) =2.75

The above coefficients are based on the assumptions that the ground level behind the retaining structure is horizontal, and the retained material is effectively drained. Additional earth pressures resulting from surcharge load (buildings, infrastructures, etc) on retained materials and groundwater pressure, if any should also be allowed for in design of retaining structures. The design of any retaining structure should also be checked for bearing capacity, overturning, sliding and overall stability of the slope.

4.6.13 Site Classification

Australian Standard AS2870 (Reference 9) indicates that a building site can be classified based on thickness of clayey foundation soils and reactivity (shrink swell movements) of foundation soils. Site preparation for the proposed activity is anticipated to involve some cut and fill operations. Therefore, the thickness of clayey foundation soils as well as thickness of fill within footprints of proposed buildings at the completion of site preparation are not known at this stage. However, reactivity of fill materials is anticipated to be better or at least as good as residual soils across the site.

Laboratory tests on representative soil samples presented in Table 2 show shrink swell values of soils across the site vary from 1.1%/pF to 2.6%/pF. However, it is noted that the sample for lower shrink swell index of 1.1%/pF was collected from an area where some excavations have occurred. All remaining samples show shrink swell index of 2.1%/pF or more.

Therefore, it is our assessment that the indicative shrink swell index for foundation soils at completion of site preparation will be in the range of 2.0%/pF to 2.5%/pF. Therefore, depending on anticipated combined thickness of residual soils and controlled fill, building sites for proposed activity across Leppington PS will vary from “Class M to H1” in accordance with Australian Standard AS2870 (Reference 9) The general definitions of site classes provided in Australian Standard AS2870 are reproduced below in Table 11.

Table 11 - Definitions of Site Classifications

Site Classification	Soils Thickness* (m)	Foundation Conditions	Ground Movement (mm)
Class M	0.6-1.8	Moderately reactive clay or silt sites, which might experience moderate ground movement from moisture changes	20.0 to 40.0
Class H1	More than 1.8	Highly reactive clay sites, which might experience extreme ground movement from moisture changes	40.0 to 60.0

* Total thickness of controlled fill and residual soil combined

The above classifications should be confirmed by sampling and testing of foundation soils after construction of building platforms is completed.

4.6.14 Floor Slabs

We anticipate foundation materials at ground floor levels of buildings for proposed activity will include controlled fill or residual soils. Under such circumstances, ground floor slabs for the buildings for proposed activity may be designed and constructed as ground bearing slabs, or suspended slabs supported by footings designed in accordance with recommendations provided in this report.

Ground bearing floor slabs for a proposed building may be designed to suit Site Class for the building site (anticipated to either Class M or H1) in accordance with Australian Standard AS2870 (Reference 9). Alternatively, we recommend a Modulus of Subgrade Reaction value of 20kPa/mm and 25.0kPa for design of ground-bearing slabs on controlled fill and residual soils respectively.

Please note, shrink swell movements of 20.0mm to 40.0mm is anticipated for Class M and 40.0mm to 60.0mm is anticipated for Class H1 site. The design of ground bearing slabs should also consider likely shrink swell movements due to effect of climatic factors. However, this movement can be reduced by providing a layer of 100mm to 200mm thick roadbase or crushed sandstone and minimising wetting and drying of foundation soils/subgrade.

4.6.15 Footings

Loading conditions for the proposed activity are not known at this stage. However, we consider that appropriate footings for proposed buildings and other structures would comprise shallow footings (pad and strip footings) founded on controlled fill, residual soils or deep footings (bored piers or screw piles) founded on or socketed into bedrock. Deep footings would be preferable if footings are required to support high vertical loads as well as significant lateral and uplift pressures. The recommended allowable bearing pressures for design of shallow and deep footings are presented in the following Table 12.

Table 12 – Recommended Bearing Pressures

Founding Material	Founding Depth from Existing Ground Surface (m)	Ultimate Bearing Pressure (kPa)	Ultimate Shaft Adhesion (kPa)	Allowable Bearing Pressure (kPa)	Allowable Shaft Adhesion (kPa)
Unit 1 Controlled Fill/Residual Soil	0.0-1.5	300.0	Ignore	100.0	Ignore
Unit 1 Residual Soil	1.5-2.0	500.0	30.0	200.0	5.0
Unit 2 Bedrock	>2.0	2000.0	150.0	700.0	70.0

The following should be noted:

- The ultimate bearing pressure and shaft adhesion are based on the ultimate capacities mobilised at large displacements, about 5.0% to 10.0% of pile diameter or minimum footing width. These values assume a clean rock socket with a roughness Category of R2 or better (Reference 16).
- The allowable bearing pressure and shaft adhesion are based on the capacities mobilised at displacements of about 1.0% of pile diameter or minimum footing width.
- The ultimate and allowable bearing pressures for Unit 3 are based on the assumptions that the piers are socketed at last 0.3m into appropriate rock units.

- Differential settlements are estimated to be about halves the estimated total settlements.
- The shaft adhesions against uplift pressures are halves the shaft adhesions for compressive loads presented in above table.
- For limit state design, geotechnical strength reduction factor ϕ_g of 0.50 is recommended in accordance with AS2159 (Reference 15). However, reduction factor ϕ_g can be increased up to 0.7 to 0.8 if pile design is verified by analyses of pile load tests and sufficient construction monitoring is carried out.

It is preferable that the footings are founded on similar foundation. As depths of bedrock with the recommended allowable bearing pressures is anticipated to vary across the site, the founding depths of footings to be constructed will also vary. Therefore, an experienced Geotechnical Engineer should confirm bearing pressures at founding levels during construction, on the basis of assessment made during footing excavation or pier hole drilling.

4.6.16 Saline Soil Management Plan

Most soils across the site are assessed to be saline. Although some soils are anticipated to be non-saline, large number of sampling and testing will be required to delineate areas with non-saline soils. Therefore, for ease of earthworks, we recommend that the soils across the site are considered to be saline. In addition, soils across the site are assessed to be dispersive and therefore susceptible to excessive erosion. Therefore, earthworks for the proposed upgrade works should be carried out in accordance with a Saline Soil Management Plan (SSMP) aimed at minimising impacts of erosion as well as soil salinity.

The objective of this SSMP is to minimise the impact of saline and dispersive soils on the proposed upgrade works and minimise the impact of the proposed workson the existing salinity and hydrology. More specifically, this SSMP aims to address the following:

- Minimise the disruption to natural surface water drainage
- Minimise the potential for waterlogging or surface water pooling
- Minimise the potential for raising the water table beneath the site
- Minimise the potential for cyclic wetting and drying areas
- Minimise the potential for excessive soil erosion
- Minimise the degradation of building products (masonry, concrete, steel) in the presence of aggressive and/or saline soils

The following principals are recommended for adoption during the earthworks to minimise impacts from saline and dispersive soils:

- Erosion and Sediment Control Plans must be developed and implemented in accordance with the Landcom Guidelines to manage the impacts from the erosive soils (References 12 and 13). All sediment and erosion controls proposed by the Erosion and Sediment Control Plan are to be installed prior to commencement of any excavation or earthworks.
- Map the current primary drainage lines and incorporate these into the surface water drainage system for the site. Do not fill in or block these drainage lines unless appropriate alternative drainage is provided.
- Develop the best use of the existing topography in order to minimise cut and fill operations.

- Where creation of individual building platform requires substantial cut and/or fill consider the use of tiered buildings and/or building with slabs suspended on piers. This will minimise the obstruction of the natural surface water flow.
- Minimise the use of retaining structures; use safely inclined slopes, with grass and plant cover as an alternative. Gabion walls are also a better alternative as they are free draining.
- Reduce groundwater recharge through appropriate land use and land management practices. This can be achieved by minimising deep infiltration and by maximising vegetation cover, planting deep-rooted trees and the use of salt tolerant plants.
- Construct a V-drain behind the crest of all slopes to divert water away from the slope face.
- Ensure that earthworks and construction activities do not affect the natural flow of groundwater. Where groundwater is intercepted during development works/excavation, the flow should be diverted to stormwater drains or creeks by providing appropriate surface and sub-surface drainage.
- On-site water detention in un-lined basins should be prevented, as this provides a localised potential groundwater re-charge. Lined basins, relying solely on evaporation should be used as an alternative.
- The finished ground surface after completion of earthworks should be provided with adequate fall to the street or stormwater manholes to allow run-off of water and prevent water ponding, waterlogging and infiltration of rainwater.
- Construction materials and methods should be appropriate to assess Exposure and Aggressivity Classification presented in this report.

4.6.17 Slope Stability

Site factors such as slope angles, depth of insitu soils, strengths of sub-surface materials, and concentrations of water generally govern the stability of a site. "Practice Note Guidelines for Landslide Risk Management", prepared by Australian Geomechanics Society (Reference 10), recommends that the landslide (slope failure) risk at a site is assessed on the basis of the likelihood of a landslide (slope failure) event and the consequences of that event.

Applying the above guidelines, the risk of landslide (slope failure) across the site at its existing conditions is assessed as follows:

- Qualitative Measures of Likelihood - For the existing site conditions, it is our assessment that an event of a landslide (slope failure) is "Rare", which means slope failures are conceivable but under exceptional circumstances, with indicative annual probability of $\approx 10^{-5}$.
- Qualitative Measures of Consequences to Property - It is our assessment that the consequences of landslide (slope failure) in the site to the property would be "Medium", resulting in moderate damage to some structures, or significant part of the site requiring large reinstatement/stabilisation works.

Based on the above Qualitative Measures, the site for the proposed upgrade is assessed to have a "Very Low to Low Risk" to the property. The definitions of the risk levels are provided in Reference 10 are reproduced below.

Risk Level		Implication
VH	Very High Risk	Extensive detailed investigation and research, planning and implementation of treatment options, essential to reduce risk to acceptable levels; may be too expensive and not practical.
H	High Risk	Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable levels.
M	Moderate Risk	Tolerable, provided treatment plan is implemented to maintain or reduce risks. May be accepted. Might require investigation and planning of treatment options.
L	Low Risk	Usually accepted. Treatment requirements and responsibility to be defined to maintain or reduce risk.
VL	Very Low Risk	Acceptable. Manage by normal slope maintenance procedures.

Based on a “Very Low to Low" risk to property, it is considered that the site is assessed to be suitable for proposed activity providing site preparation works and construction of proposed structures do not increase the risk of slope instability. Therefore, the risk of slope instability does not impose any limitation of proposed activity.

5.0 POTENTIAL GEOTECHNICAL CONSTRAINTS OR RISKS

Based on anticipated site conditions the geotechnical risks to proposed activity include the following:

- Risk of variability in depth to bedrock of varying strengths
- Risk of occurrence of reactive soils
- Risk of occurrence of dispersive soils
- Risk of occurrence of saline soils

Boreholes indicate that the depth to bedrock across the site varies from about 1.9m to 4.8m. It will be preferable that footings of proposed buildings/structures are founded on similar foundation materials. Therefore, designer of buildings/structures should consider the impacts of variability in depth to bedrock on design and costing of the buildings/structures.

The soils across the site are reactive, saline and susceptible to erosion. Therefore, designs of ground bearing slabs should suit the reactivity of the site and earthworks should be appropriately managed to minimise impacts from saline and dispersible soils.

6.0 MITIGATION MEASURES FOR GEOTECHNICAL RISKS

The potential geotechnical constraints or risk on proposed upgrade to Leppington PS include variability in the depth to bedrock and presence of reactive, salinity and erodible soils. Table 13 in the following page presents recommended mitigation measures to address these geotechnical constraints or risks so that the residual risks are “Low” and the site is suitable for the proposed upgrade works.

Table 13 – Recommended Mitigation Measures to Manage Geotechnical Risks

Mitigation Number/Names	**Aspect and Relevant Section of Report**	**Mitigation measure**	**Reason for Mitigation Measure**
Geotechnical Risk - Variability in Depth to Bedrock	Design & Construction Sections 4.6.2 & 4.6.15	Site inspection should be carried out during construction stage to determine the depth to bedrock and ascertain allowable bearing pressures for design of footings. The designer should recognise variability in thickness of soils and the depth to bedrock to ascertain that the designs of activities are appropriate to site conditions and its impact on project design and costing. It is preferable that the footings of proposed structures are founded on bedrock.	To reduce the risk or uncertainties due to variation in thickness of soils and depth to bedrock so that actual founding depths for footings or piers supporting buildings and other major structures are known. This means appropriate, economical and reliable foundation design can be achieved and potential variation claims during construction stage can be minimised.
Geotechnical Risk- Reactive Soil	Design, Construction & Operation Sections 4.6.2, 4.6.9 &4.6.13	The designer should ascertain site classifications for every building footprint by conducting additional testing after construction of building platform. The designer should recognise that the subsurface soils across the site are reactive and susceptible to shrink swell. However, site classifications for a building site depends on thickness and reactivity of soils within the footprint of that building site.	To reduce the risk or uncertainties due to variation in thickness and reactivity of soils so that appropriate, economical and reliable design of building slabs and pavements can be achieved, and potential variation claims during construction stage can be minimised.
Geotechnical Risk- Dispersive Soil	Design, Construction & Operation Section 4.6.5	Earthworks, including disturbance and excavation of soils, during proposed activity should be carried out in accordance with an appropriate Soil Management Plan (SMP) to manage and minimize impacts from dispersive soils to the proposed activity and vice versa. The designer should recognise that the subsurface soils across the site are dispersive and susceptible to excessive erosion. The cost for management of dispersive soil should be considered in project costing.	To manage adverse impacts from dispersive soils to the proposed activity and vice versa and to reduce variation claims during construction stage

Mitigation Number/Names	Aspect and Relevant Section of Report	Mitigation measure	Reason for Mitigation Measure
Geotechnical Risk-Saline Soil	Design, Construction & Operation Sections 4.6.6, 4.6.7, 4.6.8 & 4.6.16	Earthworks, including disturbance and excavation of soils, during proposed activity should be carried out in accordance with an appropriate Saline Soil Management Plan (SSMP) to manage and minimize impacts from saline soils to the proposed activity and vice versa. The designer should recognise that the subsurface soils across the site are saline. The cost for management of saline soil should be considered in project costing. It is possible that non-saline soil may be encountered in some portions of the site. Unless additional testing is carried out to delineate non-saline soil, disturbance, and excavation of localised non-saline soils should also be carried in accordance with SSMP.	To manage adverse impacts from saline soils to the proposed activity and vice versa and to reduce variation claims during construction stage

7.0 SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

Based on nature of potential geotechnical risks or issues at the site, it is our assessment that the potential impacts of proposed activities can be appropriately mitigated or managed in accordance with the recommended mitigation measures presented in Table 13. Therefore, from geotechnical engineering consideration, it is determined that the extent and nature of potential impacts from the proposed activities are "Low" and will not have significant impact on the locality, community and/or the environment.

8.0 CONCLUSIONS

Based on results of PGDS and IGI, it is our assessment that the 144 Rickard Road, Leppington, is suitable for proposed upgrade to Leppington PS from geotechnical engineering considerations provided: (1) geotechnical constraints imposed by variability in depth to bedrock and presence of reactive, saline and erodible soils are addressed in accordance with mitigation measures provided in this report; and (2) site preparation and design of floor slabs and footings of proposed buildings and other structures are carried out in accordance with geotechnical recommendations provided in this report. From geotechnical engineering considerations, the extent and nature of potential impacts from the proposed activities are "Low" and will not have significant impact on the locality, community and/or the environment.

If you have any questions, please do not hesitate to contact the undersigned.

Yours faithfully
GEOTECHNIQUE PTY LTD

INDRA JWORCHAN
Principal Geotechnical Engineer

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ATTACHMENT A

Drawing No 20278/1-AB1 Plan Showing Locations of Boreholes

Borehole Logs

Imagery © NearMap.com

LEGEND

● Borehole

0 20 40 60 80 100m

Scale 1:2000

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NOTES

1. Site features are indicative and are not to scale.
2. This drawing has been produced using a base plan provided by others to which additional information e.g test pits, borehole locations or notes have been added. Some or all of the plan may not be relevant at the time of producing this drawing

NSW Department of Education
SINSW Procurement
Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Borehole Locations

Drawing No: 20278/1-AB1
Job No: 20278/1
Drawn By: MH
Date: 28 April 2023
Checked By: SS/IJ

File No: 20278-1
Layers: 0, AB1

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH1
Date : 20/01/2023
Logged/Checked by: SS/IJ

drill model and mounting : Yanmar 5.5t Excavator **slope :** **deg.** **R.L. surface :** 94.895

hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	DRY			DS		0		ML	Clayey SILT, low plasticity, brown		St-VSt		Garden mulch on surface Residual
				DS		1		CH	Silty CLAY, high plasticity, red mottled grey	M<PL			
								CH	Silty CLAY, high plasticity, grey mottled red, trace ironstone gravel				
						2		CH	Shaley CLAY, high plasticity, grey		H		
									SHALE/SILTSTONE, grey, low strength, extremely to distinctly weathered				Bedrock
						3			Borehole BH1 terminated at 2.5m				Excavator lifting at 2.5m due to strength of rock
						4							
						5							
						6							
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH2
Date : 20/01/2023
Logged/Checked by: SS/IJ

drill model and mounting : Yanmar 5.5t Excavator **slope :** **deg.** **R.L. surface :** 100.068

hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	DRY			U_{50}		0		CH	TOPSOIL: Clayey Silt, low plasticity, brown, with root fibres	M<PL	St-VSt		Residual
								CH	Silty CLAY, high plasticity, red Silty CLAY, high plasticity, grey, with ironstone gravel				
				DS		1							
								CH	Shaley CLAY, high plasticity, grey		H		
						2			SHALE, grey, low to medium strength, extremely to distinctly weathered				Bedrock
									Borehole BH2 terminated at 2.1m				
						3							
						4							
						5							
						6							
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH3
Date : 20/01/2023
Logged/Checked by: SS/IJ

drill model and mounting : Yanmar 5.5t Excavator **slope :** **deg.** **R.L. surface :** 95.434

hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	DRY			DS		0		CH	TOPSOIL: Silty Clay, low plasticity, brown, with root fibres	M<PL	St-VSt		Residual
									Silty CLAY, high plasticity, grey				
						1		CH	Silty CLAY, high plasticity, grey, with ironstone gravel				
								CH	Shaley CLAY, high plasticity, grey		H		
						2			SHALE, grey, low strength, extremely to distinctly weathered				Bedrock
									Borehole BH3 terminated at 2.1m				
						3							
						4							
						5							
						6							
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH4
Date : 20/01/2023
Logged/Checked by: SS/IJ

drill model and mounting : Yanmar 5.5t Excavator **slope :** **deg.** **R.L. surface :** 94.809

hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	DRY			U_{50}		0			TOPSOIL: Silty Clay, medium plasticity, brown/grey, with root fibres				
						1			FILL: Silty Clay, high plasticity, grey/brown				
				DS				CI-CH	Silty CLAY, medium to high plasticity, brown	M<PL	St-VSt		Residual
								CH	Silty CLAY, high plasticity, red				
				DS		2		CH	Silty CLAY, high plasticity, grey, with ironstone gravel	M<PL			
									Borehole BH4 terminated at 2.5m				
						3							
						4							
						5							
						6							
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH5
Date : 20/01/2023
Logged/Checked by: SS/IJ

drill model and mounting : Yanmar 5.5t Excavator **slope :** **deg.** **R.L. surface :** 92.212

hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	DRY			DS DS		0 1 2			FILL: Silty Clay, medium plasticity, brown				
								CH	Silty CLAY, high plasticity, red mottled grey	M<PL	St-VSt		Residual
								CH	Silty CLAY, high plasticity, grey mottled red and yellow				
									Borehole BH5 terminated at 2.5m				
						3 4 5 6 7 8 9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH6
Date : 20/01/2023
Logged/Checked by: SS/IJ

drill model and mounting : Yanmar 5.5t Excavator **slope :** **deg.** **R.L. surface :** 95.155

hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	DRY			DS DS		0 1 2		CH CH CH	TOPSOIL: Clayey Silt, low plasticity, brown, with root fibres Silty CLAY, high plasticity, red Silty CLAY, high plasticity, grey mottled red Silty CLAY, high plasticity, grey, with ironstone gravel	M<PL	St-VSt		Residual
						3 4 5 6 7 8 9			Borehole BH6 terminated at 2.3m				

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH7
Date : 20/01/2023
Logged/Checked by: SS/IJ

drill model and mounting : Yanmar 5.5t Excavator **slope :** **deg.** **R.L. surface :** 95.693

hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	DRY			DS		0			TOPSOIL: Clayey Silt, low plasticity, brown, with root fibres	M<PL	St-VSt		Residual
				DS		1		CH	FILL: Silty Clay, low to medium plasticity, brown/red				
						2		CH	Silty CLAY, high plasticity, red				
									Silty CLAY, high plasticity, grey, with ironstone gravel				
									SHALE, grey, low strength, extremely to distinctly weathered				Bedrock
									Borehole BH7 terminated at 2.1m				
						3							
						4							
						5							
						6							
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH8
Date : 20/01/2023
Logged/Checked by: SS/IJ

drill model and mounting : Yanmar 5.5t Excavator **slope :** **deg.** **R.L. surface :** 95.165

hole diameter : 250 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
Auger	DRY	DS		U_{50}		0		CH	TOPSOIL: Silty Clay, low to medium plasticity, brown, with root fibres	M<PL	St		Residual
						1			Silty CLAY, high plasticity, red				
				DS		2		CH	Silty CLAY, high plasticity, grey, with ironstone gravel				
									Borehole BH8 terminated at 2.2m				
						3							
						4							
						5							
						6							
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH9
Date : 17/04/2023
Logged/Checked by: PP/IJ

drill model and mounting : Comachhio 305 **slope :** **deg.** **R.L. surface :** 96.733

hole diameter : 100 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
					CONE 5 5 5 4 4 8 8 20 R	0			TOPSOIL: Silty Clay, low to medium plasticity, pale brown, trace grass and grass roots				
								CI-CH	Silty CLAY, medium to high plasticity, brown	M≈PL	VSt		Residual
				DS		1		CL-CI	@0.6m, low to medium plasticity, grey mottled brown				
				DS		2			@2.2m, traces of gravel				Grading into weathered rock
	DRY												
									Borehole BH9 terminated at 2.5m				
						3							
						4							
						5							
						6							
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH10
Date : 17/04/2023
Logged/Checked by: PP/IJ

drill model and mounting : Comachhio 305 **slope :** **deg.** **R.L. surface :** 94.033

hole diameter : 100 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
	DRY			DS DS	CONE 2,4,4,4,4,3,7,3,2,1,3,7,8,R	0 1 2		CI-CH	TOPSOIL: Silty Clay, low to medium plasticity, black-brown, trace grass roots Silty CLAY, medium to high plasticity, mottled grey-brown @1.7m, grey mottled brown	M≈PL	St-VSt H		Residual
						3 4 5 6 7 8 9			Borehole BH10 terminated at 2.5m				

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH11
Date : 17/04/2023
Logged/Checked by: PP/IJ

drill model and mounting : Comachhio 305 **slope :** **deg.** **R.L. surface :** 95.714

hole diameter : 100 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
	DRY			DS DS	CONE 3, 6, 9, 7, 7, 11, 14/R	0 1 2		CI-CH CL-CI	TOPSOIL: Silty Clay, low to medium plasticity, brown, trace grass and grass roots Silty CLAY, medium to high plasticity, pale brown Shaley CLAY/Clayey SHALE, low to medium plasticity, grey mottled brown	M<PL M≈PL	VSt-H H		Residual
						3 4 5 6 7 8 9			Borehole BH11 terminated at 2.5m				

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH12
Date : 14/04/2023
Logged/Checked by: PP/IJ

drill model and mounting : Comachhio 305 **slope :** **deg.** **R.L. surface :** 94.946

hole diameter : 100 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			TOPSOIL: Silty Clay, low to medium plasticity, black, trace grass and grass roots	M<PL	St-VSt		Residual
				DS				CI	Silty CLAY, medium plasticity, brown				
				SPT	N=19 4,7,12								
				U_{50}		1			@0.9m, grey mottled brown				
								CL-CI	Silty CLAY, low to medium plasticity, grey mottled brown, trace ironstone				
				SPT	N=31 7,13,18						H		
						2							
				DS									
				SPT	7,12,12	3							
	DRY								SHALE, grey, extremely weathered, very low to low strength				Bedrock
						4			@3.8m, grey, distinctly weathered, low to medium strength				
						5							
						6			Borehole BH12 terminated at 6.0m				
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure **Job No. :** 20278/1
Project : SINSW Procurement **Borehole No. :** BH13
Location : Leppington Public School (ID 2926) **Date :** 14/04/2023
144 Rickard Road, Leppington **Logged/Checked by:** PP/IJ

drill model and mounting : Comachhio 305 **slope :** **deg.** **R.L. surface :** 93.666

hole diameter : 100 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			TOPSOIL: Silty Clay, low to medium plasticity, brown-black, trace grass roots				
								CI-CH	Silty CLAY, medium to high plasticity, black brown, trace ironstone and rootlets	M≈PL	St		Possible fill
				DS									
				SPT	N=10 5,5,5	1							
								CH	@1.1m, high plasticity, brown mottled grey, trace ironstone				Residual
				U_{50}									
				SPT	N=11 3,5,6								
						2			@2.0m, brown				
				DS									
									@3.0m, trace ironstone				
				SPT	N=12 2,5,7	3		CL-CI	Shaley CLAY, low to medium plasticity, grey mottled red, trace ironstone				
											VSt-H		
						4							
					N=24 5,7,17								
	DRY					5			SHALE, grey, extremely weathered, very low to low strength, iron stained				Bedrock
									@5.0m, grey, distinctly weathered, low to medium strength, iron stained				@5.0m, increase in resistance
									@5.5m, grey, distinctly weathered, very low to low strength				
						6			Borehole BH13 terminated at 6.0m				
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure **Job No. :** 20278/1
Project : SINSW Procurement **Borehole No. :** BH14
Location : Leppington Public School (ID 2926) **Date :** 14/04/2023
144 Rickard Road, Leppington **Logged/Checked by:** PP/IJ

drill model and mounting : Comachhio 305 **slope :** **deg.** **R.L. surface :** 94.303

hole diameter : 100 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			TOPSOIL: Silty Clay, low to medium plasticity, pale brown, trace grass roots				
								CI-CH	Silty CLAY, medium to high plasticity, red mottled grey	M≈PL	St-VSt		Residual soil
		U_{50}		DS	N=15 5,5,10	1							
					N=27 8,12,15				@1.6m, grey mottled red, trace ironstone				
				DS		2		CL-CI	Shaley CLAY, low to medium plasticity, grey mottled red				
					N=R 7,18	3			SHALE, grey, extremely weathered, very low to low strength, iron stained		H		Bedrock
	DRY					4			@4.5m, grey, distinctly weathered, low to medium strength				Increase in resistance
						5							
						6			Borehole BH14 terminated at 6.0m				
						7							
						8							
						9							

engineering log - borehole

Client : NSW Department of Education, School Infrastructure
Project : SINSW Procurement
Location : Leppington Public School (ID 2926)
144 Rickard Road, Leppington

Job No. : 20278/1
Borehole No. : BH15
Date : 17/04/2023
Logged/Checked by: PP/IJ

drill model and mounting : Comachhio 305 **slope :** **deg.** **R.L. surface :** 97.570

hole diameter : 100 **mm** **bearing :** **deg.** **datum :** AHD

method	groundwater	env samples	PID reading (ppm)	geo samples	field test	depth or R.L. in meters	graphic log	classification symbol	MATERIAL DESCRIPTION soil type, plasticity or particle characteristic, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa	Remarks and additional observations
						0			TOPSOIL: Silty Clay, low to medium plasticity, pale brown, trace grass and grass roots				
								CI-CH	Silty CLAY, medium to high plasticity, brown	M<PL	VSt-H		Residual
		DS		SPT	N=15 3,7,8								
				U_{50}		1		CL-CI	@0.9m, low to medium plasticity, grey mottled red				Shaley Clay
		DS		SPT	N=19 6,8,11	2							
				SPT	11,22,HB	3			@2.9m, traces of ironstone				
	DRY								SHALE, grey, extremely weathered, very low to low strength, iron staining				Bedrock
						4			@4.2m, distinctly weathered, low to medium strength				
						5			@5.5m, distinctly to slightly weathered, medium to high strength				
						6			Borehole BH15 terminated at 6.0m				
						7							
						8							
						9							

GEOTECHNIQUE PTY LTD

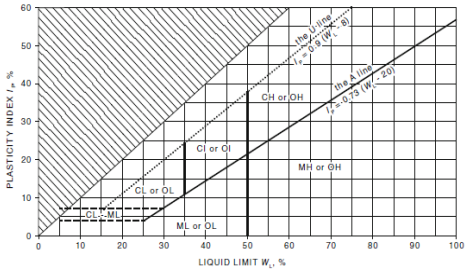
Log Symbols & Abbreviations (Non-cored Borehole Log)

Log Column	Symbol/Value	Description
Drilling Method	V-bit TC-bit RR DB BB	Hardened steel 'V' shaped bit attached to auger Tungsten Carbide bit attached to auger Tricone (Rock Roller) bit Drag bit Blade bit
Groundwater	Dry  	Groundwater not encountered to the drilled or auger refusal depth Groundwater level at depths shown on log Groundwater seepage at depths shown on log
Environment Sample	GP G P	Glass bottle and plastic bag sample over depths shown on log Glass bottle sample over depths shown on log Plastic bag sample over depths shown on log
PID Reading	100	PID reading in ppm
Geotechnical Sample	DS DB U_{50}	Disturbed Small bag sample over depths shown on log Disturbed Bulk sample over depths shown on log Undisturbed 50mm tube sample over depths shown on log
Field Test	N=10 3,5,5 N=R 10,15/100	Standard Penetration Test (SPT) 'N' value. Individual numbers indicate blows per 150mm penetration. 'R' represents refusal to penetration in hard/very dense soils or in cobbles or boulders. The first number represents10 blows for 150mm penetration whereas the second number represents 15 blows for 100mm penetration where SPT met refusal
	DCP/PSP: 5 6 R/10	Dynamic Cone Penetration (DCP) or Perth Sand Penetrometer (PSP). Each number represents blows per 100mm penetration. 'R/10' represents refusal after 10mm penetration in hard/very dense soils or in gravels or boulders.
Classification	GP GW GM GC SP SW SM SC ML MI MH CL CI CH	Poorly Graded GRAVEL Well graded GRAVEL Silty GRAVEL Clayey GRAVEL Poorly graded SAND Well graded SAND Silty SAND Clayey SAND SILT / Sandy SILT / clayey SILT, low plasticity SILT / Sandy SILT / clayey SILT, medium plasticity SILT / Sandy SILT / clayey SILT, high plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, low plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, medium plasticity CLAY / Silty CLAY / Sandy CLAY / Gravelly CLAY, high plasticity
Moisture Condition Cohesive soils Cohesionless soils	 M<PL M=PL M>PL D M W	 Moisture content less than Plastic Limit Moisture content equal to Plastic Limit Moisture content to be greater than Plastic Limit Dry - Runs freely through hand Moist - Tends to cohere Wet - Tends to cohere
Consistency Cohesive soils	 VS S F St VSt H	**Term** / **Undrained shear strength, C_u (kPa)** / **Hand Penetrometer (Qu)** Very Soft / ≤12 / <25 Soft / >12 & ≤25 / 25 – 50 Firm / >25 & ≤50 / 50 – 100 Stiff / >50 & ≤100 / 100 – 200 Very Stiff / >100 & ≤200 / 200 – 400 Hard / >200 / >400
Density Index Cohesionless soils	 VL L M D VD	**Term** / **Density Index, I_D (%)** / **SPT 'N' (blows/300mm)** Very Loose / ≤15 / ≤5 Loose / >15 & ≤35 / >5 & ≤10 Medium Dense / >35 & ≤65 / >10 & ≤30 Dense / >65 & ≤85 / >30 & ≤50 Very Dense / >85 / >50
Hand Penetrometer	100 200	Unconfined compressive strength (q_u) in kPa determined using pocket penetrometer, at depths shown on log
Remarks	 Residual Alluvium Colluvial Aeolian Marine	Geological origin of soils Residual soils above bedrock River deposited Alluvial soils Gravity deposited Colluvial soils Wind deposited Aeolian soils Marine Soils

GEOTECHNIQUE PTY LTD

AS1726 : 2017– Unified Soil Classification System

Major Divisions		Particle size (mm)	Group Symbol	Typical Names	Field Identifications Sand and Gravels			Laboratory classification				
OVERSIZE	BOULDERS	>200						Use the gradation of material passing 63mm for classification of fractions according to the criteria given in 'Major Divisions'	% Fines (2)	Plasticity of Fine Fraction	$C_u = D_{60}/D_{10}$	$C_c = (D_{30})^2/(D_{10}D_{60})$	Notes
	COBBLES	63										
COARSE GRAINED SOIL (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm)	Coarse 19	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>4	between 1 and 3	1. Identify lines by the method given for fine grained soils 2. Borderline classifications occur when the percentage of fines (fraction smaller than 0.075mm size) is greater than 5% and less than 12%. Borderline classifications require the use of dual symbols e.g. SP-SM, GW-GC
		Medium 6.7	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			GM	Silty gravels, gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 2.36	GC	Clayey gravels, gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line or I_p>7	-	-	
	SAND (more than half of coarse fraction is smaller than 2.36mm)	Coarse 0.6	SW	Well-graded sands, gravelly sands, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength				≤5	-	>6	between 1 and 3	
		Medium 0.21	SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength				≤5	-	Fails to comply with above		
			SM	Silty sands, sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength				≥12	Below 'A' line or I_p<4	-	-	
		Fine 0.075	SC	Clayey sand, sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength				≥12	Above 'A' line of I_p>7	-	-	
FINE GRAINED SOIL (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit<50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	**Dry Strength**	**Dilatancy**	**Toughness**		More than 35% passing 0.075mm	Below 'A' line			
					None to low	Slow to rapid	Low						
			CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium to high	None to very slow	Medium			Above 'A' line			
			OL	Organic silts and organic silty clays of low plasticity	Low to medium	Slow	Low			Below 'A' line			
	SILT (0.075mm to 0.002mm) & CLAY (<0.002mm) Liquid Limit>50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Low to medium	None to slow	Low to medium			Below 'A' line			
			CH	Inorganic clays of medium to high plasticity, fat clays	High to very high	None	High			Above 'A' line			
			OH (1)	Organic clays of medium to high plasticity, organic silts	Medium to high	None to very slow	Low to medium			Below 'A' line			
	HIGHLY ORGANIC SOILS		Pt (1)	Peat and highly organic soils	Identified by colour, odour, spongy feel and generally by fibrous texture				Effervesces with H_2O_2				



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Log Symbols & Abbreviations (Cored Borehole Log)

Log Column	Symbol / Abbreviation	Description	
Core Size		Nominal Core Size (mm)	
	NQ	47	
	NMLC	52	
	HQ	63	
Water Loss	◀	Complete water loss	
	◁	Partial water loss	
Weathering (AS1726:2017)	RS	Residual Soil	Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported
	XW	Extremely Weathered	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
	HW	Highly Weathered	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 recognizable. Rock 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.
	MW	Moderately Weathered	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 recognizable, but shows little or no change of strength from fresh rock
	SW	Slightly Weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change in strength from fresh rock
	FR	Fresh	Rock shows no sign of decomposition of individual minerals or colour changes
		Note : Where it is not possible to distinguish between HW and MW rock the term Distinctly Weathered (DW) may be used. DW is defined as 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased by deposition of weathering products in pores'	
Strength (AS1726:2017)		**Term**	**Point Load Strength Index (I_{s50}, MPa)**
	VL	Very Low	≥0.03 ≤0.1
	L	Low	>0.1 ≤0.3
	M	Medium	>0.3 ≤1
	H	High	>1 ≤3
	VH	Very High	>3 ≤10
	EH	Extremely High	>10
Defect Spacing		**Description**	**Spacing (mm)**
		Extremely closely spaced	<20
		Very closely spaced	20 to 60
		Closely spaced	60 to 200
		Medium spaced	200 to 600
		Widely spaced	600 to 2000
		Very widely spaced	2000 to 6000
		Extremely widely spaced	>6000
Defect Description (AS1726:2017) Type			
	Pt	Parting	
	Jo	Joint	
	Sh	Sheared Surface	
	Sz	Sheared Zone	
	Ss	Sheared Seam	
	Cs	Crushed Seam	
	Is	Infilled Seam	
	Ews	Extremely Weathered Seam	
Macro-surface geometry	St	Stepped	
	Cu	Curved	
	Un	Undulating	
	Ir	Irregular	
	Pl	Planar	
Micro-surface geometry	Vro	Very Rough	
	Ro	Rough	
	Sm	Smooth	
	Po	Polished	
	Sl	Slickensided	
Coating or infilling	cn	clean	
	sn	stained	
	vn	veneer	
	cg	coating	

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AS1726 – Identification of Sedimentary Rocks for Engineering Purposes

Grain Size mm		Bedded rocks (mostly sedimentary)							
More than 20	20	Grain Size Description			At least 50% of grains are of carbonate			At least 50% of grains are of fine-grained volcanic rock	
	6	RUDACEOUS		CONGLOMERATE Rounded boulders, cobbles and gravel cemented in a finer matrix	LIMESTONE and DOLOMITE (undifferentiated)	Calcirudite		Fragments of volcanic ejecta in a finer matrix	SALINE ROCKS
	2			Breccia Irregular rock fragments in a finer matrix				Rounded grains AGGLOMERATE Angular grains VOLCANIC BRECCIA	Halite Anhydrite
	0.6	ARENACEOUS	Coarse	SANDSTONE Angular or rounded grains, commonly cemented by clay, calcite or iron minerals		Calcarenite		Cemented volcanic ash TUFF	Gypsum
	0.2		Medium	Quartzite Quartz grains and siliceous cement					
	0.06		Fine	Arkose Many feldspar grains Greywacke Many rock chips					
	0.002	ARGILLACEOUS		MUDSTONE	SILTSTONE Mostly silt	Calcareous Mudstone	Calcisiltite	CHALK	Fine-grained TUFF
	Less than 0.002			SHALE Fissile	CLAYSTONE Mostly clay		Calcilutite		Very fine-grained TUFF
Amorphous or crypto-crystalline				Flint: occurs as hands of nodules in the chalk Chert: occurs as nodules and beds in limestone and calcareous sandstone					COAL LIGNITE
				Granular cemented – except amorphous rocks					
				SILICEOUS	CALCAREOUS			SILICEOUS	CARBONACEOUS
				SEDIMENTARY ROCKS Granular cemented rocks vary greatly in strength, some sandstones are stronger than many Igneous rocks. Bedding may not show in hand specimens and is best seen in outcrop. Only sedimentary rocks, and some metamorphic rocks derived from them, contain fossils Calcareous rocks contain calcite (calcium carbonate) which effervesces with dilute hydrochloric acid					

AS1726 – Identification of Metamorphic and Igneous Rocks for Engineering Purposes

Obviously foliated rocks (mostly metamorphic)		Rocks with massive structure and crystalline texture (mostly igneous)						Grain size (mm)
Grain size description			Grain size description	Pegmatite			Pyrosenite	More than 20
		MARBLE						20
	GNEISS Well developed but often widely spaced foliation sometimes with schistose bands	QUARTZITE		GRANITE	Diorite	GABBRO	Peridorite	6
COARSE		Granulite	COARSE	These rocks are sometimes phorphyritic and are then described, for example, as porphyritic granite				
	Migmatite Irregularly foliated: mixed schists and gneisses	HORNFELS						2
	SCHIST Well developed undulose foliation; generally much mica	Amphibolite		Micorgranite	Microdiorite			0.6
MEDIUM		Serpentine	MEDIUM	These rocks are sometimes phorphyritic and are then described as porphyries		Dolerite		0.2
								0.06
	PHYLLITE Slightly undulose foliation; sometimes 'spotted'			RHYOLITE	ANDESITE			0.002
FINE	SLATE Well developed plane cleavage (foliation)		FINE	These rocks are sometimes phorphyritic and are then described as porphyries		BASALT		Less than 0.002
	Mylonite Found in fault zones, mainly in igneous and metamorphic areas			Obsidian	Volcanic glass			Amorphous or cryptocrystalline
CRYSTALLINE				Pale<----------->Dark				
SILICEOUS		Mainly SILICEOUS		ACID Much quartz	INTERMEDIATE Some quartz	BASIC Little or no quartz	ULTRA BASIC	
METAMORPHIC ROCKS Most metamorphic rocks are distinguished by foliation which may impart fissility. Foliation in gneisses is best observed in outcrop. Non-foliated metamorphics are difficult to recognize except by association. Any rock baked by contact metamorphism is described as 'hornfels' and is generally somewhat stronger than the parent rock Most fresh metamorphic rocks are strong although perhaps fissile			IGNEOUS ROCKS Composed of closely interlocking mineral grains. Strong when fresh; not porous Mode of occurrence : 1 Batholith; 2 Laccoliths; 3 Sills; 4 Dykes; 5 Lava Flows; 6 Veins					

ATTACHMENT B

Laboratory Test Results

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Indra Jworchan
Client	Geotechnique
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Project	**20278/1 144 Rickard Road,Leppimngton**
Order Number	**20278/1**
Samples	23

LABORATORY DETAILS

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Laboratory	SGS Alexandria Environmental
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SGS Reference	**SE246280 R0**
Date Received	20/4/2023
Date Reported	28/4/2023

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES

Dong LIANG
Metals/Inorganics Team Leader

Shane MCDERMOTT
Inorganic/Metals Chemist

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography [AN245] Tested: 26/4/2023

PARAMETER	UOM	LOR	BH10 SOIL 0.4-0.7 20/4/2023 SE246280.003	BH10 SOIL 1.4-1.7 20/4/2023 SE246280.004	BH12 SOIL 0.1-0.5 20/4/2023 SE246280.007	BH12 SOIL 0.5-0.95 20/4/2023 SE246280.008	BH12 SOIL 1.5-1.95 20/4/2023 SE246280.009
Chloride	mg/kg	0.25	140	820	12	12	130

PARAMETER	UOM	LOR	BH12 SOIL 2.5-3.0 20/4/2023 SE246280.010	BH12 SOIL 3.0-3.33 20/4/2023 SE246280.011	BH13 SOIL 2.0-3.0 20/4/2023 SE246280.015	BH13 SOIL 3.0-3.45 20/4/2023 SE246280.016	BH13 SOIL 4.5-4.95 20/4/2023 SE246280.017
Chloride	mg/kg	0.25	300	270	170	420	680

PARAMETER	UOM	LOR	BH14 SOIL 3.0-3.3 20/4/2023 SE246280.020	BH15 SOIL 0.5-0.95 20/4/2023 SE246280.021	BH15 SOIL 1.5-1.95 20/4/2023 SE246280.022	BH15 SOIL 3.0-3.3 20/4/2023 SE246280.023
Chloride	mg/kg	0.25	700	840	960	800

pH in soil (1:5) [AN101] Tested: 26/4/2023

PARAMETER	UOM	LOR	BH9 SOIL 0.7-1.0 20/4/2023 SE246280.001	BH9 SOIL 1.7-2.0 20/4/2023 SE246280.002	BH10 SOIL 0.4-0.7 20/4/2023 SE246280.003	BH10 SOIL 1.4-1.7 20/4/2023 SE246280.004	BH11 SOIL 1.8-2.1 20/4/2023 SE246280.005
pH	pH Units	0.1	5.1	5.3	5.9	5.1	5.7

PARAMETER	UOM	LOR	BH11 SOIL 2.3-2.5 20/4/2023 SE246280.006	BH12 SOIL 0.1-0.5 20/4/2023 SE246280.007	BH12 SOIL 0.5-0.95 20/4/2023 SE246280.008	BH12 SOIL 1.5-1.95 20/4/2023 SE246280.009	BH12 SOIL 2.5-3.0 20/4/2023 SE246280.010
pH	pH Units	0.1	5.7	6.1	6.1	5.4	5.8

PARAMETER	UOM	LOR	BH12 SOIL 3.0-3.33 20/4/2023 SE246280.011	BH13 SOIL 0.3-0.8 20/4/2023 SE246280.012	BH13 SOIL 0.8-1.25 20/4/2023 SE246280.013	BH13 SOIL 1.55-2.0 20/4/2023 SE246280.014	BH13 SOIL 2.0-3.0 20/4/2023 SE246280.015
pH	pH Units	0.1	5.4	5.6	5.6	5.2	5.0

PARAMETER	UOM	LOR	BH13 SOIL 3.0-3.45 20/4/2023 SE246280.016	BH13 SOIL 4.5-4.95 20/4/2023 SE246280.017	BH14 SOIL 0.5-0.95 20/4/2023 SE246280.018	BH14 SOIL 1.5-1.95 20/4/2023 SE246280.019	BH14 SOIL 3.0-3.3 20/4/2023 SE246280.020
pH	pH Units	0.1	4.5	4.9	5.1	5.1	5.0

PARAMETER	UOM	LOR	BH15 SOIL 0.5-0.95 20/4/2023 SE246280.021	BH15 SOIL 1.5-1.95 20/4/2023 SE246280.022	BH15 SOIL 3.0-3.3 20/4/2023 SE246280.023
pH	pH Units	0.1	4.7	4.9	4.6

Conductivity and TDS by Calculation - Soil [AN106] Tested: 26/4/2023

PARAMETER	UOM	LOR	BH9 SOIL 0.7-1.0 20/4/2023 SE246280.001	BH9 SOIL 1.7-2.0 20/4/2023 SE246280.002	BH10 SOIL 0.4-0.7 20/4/2023 SE246280.003	BH10 SOIL 1.4-1.7 20/4/2023 SE246280.004	BH11 SOIL 1.8-2.1 20/4/2023 SE246280.005
Conductivity of Extract (1:5 as received)	µS/cm	1	460	450	120	670	450
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	530	530	150	770	500
Resistivity of extract (1:5 as received)*	ohm m	0.1	-	-	83	15	-

PARAMETER	UOM	LOR	BH11 SOIL 2.3-2.5 20/4/2023 SE246280.006	BH12 SOIL 0.1-0.5 20/4/2023 SE246280.007	BH12 SOIL 0.5-0.95 20/4/2023 SE246280.008	BH12 SOIL 1.5-1.95 20/4/2023 SE246280.009	BH12 SOIL 2.5-3.0 20/4/2023 SE246280.010
Conductivity of Extract (1:5 as received)	µS/cm	1	400	32	35	170	310
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	440	37	41	190	340
Resistivity of extract (1:5 as received)*	ohm m	0.1	-	320	280	60	33

PARAMETER	UOM	LOR	BH12 SOIL 3.0-3.33 20/4/2023 SE246280.011	BH13 SOIL 0.3-0.8 20/4/2023 SE246280.012	BH13 SOIL 0.8-1.25 20/4/2023 SE246280.013	BH13 SOIL 1.55-2.0 20/4/2023 SE246280.014	BH13 SOIL 2.0-3.0 20/4/2023 SE246280.015
Conductivity of Extract (1:5 as received)	µS/cm	1	270	71	85	210	220
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	300	84	99	250	260
Resistivity of extract (1:5 as received)*	ohm m	0.1	38	-	-	-	47

PARAMETER	UOM	LOR	BH13 SOIL 3.0-3.45 20/4/2023 SE246280.016	BH13 SOIL 4.5-4.95 20/4/2023 SE246280.017	BH14 SOIL 0.5-0.95 20/4/2023 SE246280.018	BH14 SOIL 1.5-1.95 20/4/2023 SE246280.019	BH14 SOIL 3.0-3.3 20/4/2023 SE246280.020
Conductivity of Extract (1:5 as received)	µS/cm	1	410	570	300	460	330
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	490	670	350	520	370
Resistivity of extract (1:5 as received)*	ohm m	0.1	24	18	-	-	30

PARAMETER	UOM	LOR	BH15 SOIL 0.5-0.95 20/4/2023 SE246280.021	BH15 SOIL 1.5-1.95 20/4/2023 SE246280.022	BH15 SOIL 3.0-3.3 20/4/2023 SE246280.023
Conductivity of Extract (1:5 as received)	µS/cm	1	690	730	680
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	790	840	770
Resistivity of extract (1:5 as received)*	ohm m	0.1	15	14	15

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) [AN122] Tested: 28/4/2023

PARAMETER	UOM	LOR	BH9 SOIL 0.7-1.0 20/4/2023 SE246280.001	BH9 SOIL 1.7-2.0 20/4/2023 SE246280.002	BH10 SOIL 0.4-0.7 20/4/2023 SE246280.003	BH10 SOIL 1.4-1.7 20/4/2023 SE246280.004	BH11 SOIL 1.8-2.1 20/4/2023 SE246280.005
Exchangeable Calcium, Ca	mg/kg	2	15	15	480	26	37
Exchangeable Calcium, Ca	meq/100g	0.01	0.08	0.07	2.4	0.13	0.19
Exchangeable Calcium Percentage*	%	0.1	0.5	0.4	13.3	0.8	1.3
Exchangeable Potassium, K	mg/kg	2	220	250	210	200	210
Exchangeable Potassium, K	meq/100g	0.01	0.55	0.64	0.54	0.51	0.55
Exchangeable Potassium Percentage*	%	0.1	3.5	3.9	3.0	3.3	3.7
Exchangeable Magnesium, Mg	mg/kg	2	1200	1300	1500	1200	1200
Exchangeable Magnesium, Mg	meq/100g	0.02	10	10	13	9.8	9.9
Exchangeable Magnesium Percentage*	%	0.1	64.1	63.4	70.6	63.5	67.7
Exchangeable Sodium, Na	mg/kg	2	1100	1200	540	1200	920
Exchangeable Sodium, Na	meq/100g	0.01	5.0	5.3	2.3	5.0	4.0
Exchangeable Sodium Percentage*	%	0.1	31.9	32.2	13.1	32.4	27.3
Cation Exchange Capacity	meq/100g	0.02	16	16	18	15	15

PARAMETER	UOM	LOR	BH11 SOIL 2.3-2.5 20/4/2023 SE246280.006	BH12 SOIL 0.1-0.5 20/4/2023 SE246280.007	BH12 SOIL 0.5-0.95 20/4/2023 SE246280.008	BH12 SOIL 1.5-1.95 20/4/2023 SE246280.009	BH12 SOIL 2.5-3.0 20/4/2023 SE246280.010
Exchangeable Calcium, Ca	mg/kg	2	32	290	16	10	23
Exchangeable Calcium, Ca	meq/100g	0.01	0.16	1.5	0.08	0.05	0.12
Exchangeable Calcium Percentage*	%	0.1	0.9	21.3	0.6	0.4	1.1
Exchangeable Potassium, K	mg/kg	2	270	160	200	150	260
Exchangeable Potassium, K	meq/100g	0.01	0.69	0.40	0.51	0.39	0.66
Exchangeable Potassium Percentage*	%	0.1	3.8	5.9	4.0	3.0	6.1
Exchangeable Magnesium, Mg	mg/kg	2	1500	530	1100	1100	760
Exchangeable Magnesium, Mg	meq/100g	0.02	12	4.3	9.4	8.7	6.2
Exchangeable Magnesium Percentage*	%	0.1	68.7	62.7	72.4	65.2	57.8
Exchangeable Sodium, Na	mg/kg	2	1100	160	690	970	870
Exchangeable Sodium, Na	meq/100g	0.01	4.8	0.69	3.0	4.2	3.8
Exchangeable Sodium Percentage*	%	0.1	26.6	10.1	23.0	31.5	35.0
Cation Exchange Capacity	meq/100g	0.02	18	6.9	13	13	11

PARAMETER	UOM	LOR	BH12 SOIL 3.0-3.33 20/4/2023 SE246280.011	BH13 SOIL 0.3-0.8 20/4/2023 SE246280.012	BH13 SOIL 0.8-1.25 20/4/2023 SE246280.013	BH13 SOIL 1.55-2.0 20/4/2023 SE246280.014	BH13 SOIL 2.0-3.0 20/4/2023 SE246280.015
Exchangeable Calcium, Ca	mg/kg	2	24	370	390	190	44
Exchangeable Calcium, Ca	meq/100g	0.01	0.12	1.9	2.0	0.96	0.22
Exchangeable Calcium Percentage*	%	0.1	1.0	13.6	15.2	6.1	1.6
Exchangeable Potassium, K	mg/kg	2	200	220	190	180	160
Exchangeable Potassium, K	meq/100g	0.01	0.50	0.56	0.49	0.47	0.40
Exchangeable Potassium Percentage*	%	0.1	4.3	4.1	3.8	3.0	3.0
Exchangeable Magnesium, Mg	mg/kg	2	850	1200	1100	1400	1100
Exchangeable Magnesium, Mg	meq/100g	0.02	7.0	10	8.8	11	9.2
Exchangeable Magnesium Percentage*	%	0.1	59.2	73.2	68.5	70.6	68.5
Exchangeable Sodium, Na	mg/kg	2	970	290	370	740	830
Exchangeable Sodium, Na	meq/100g	0.01	4.2	1.3	1.6	3.2	3.6
Exchangeable Sodium Percentage*	%	0.1	35.5	9.2	12.5	20.4	26.9
Cation Exchange Capacity	meq/100g	0.02	12	14	13	16	13

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) [AN122] Tested: 28/4/2023 (continued)

PARAMETER	UOM	LOR	BH13 SOIL 3.0-3.45 20/4/2023 SE246280.016	BH13 SOIL 4.5-4.95 20/4/2023 SE246280.017	BH14 SOIL 0.5-0.95 20/4/2023 SE246280.018	BH14 SOIL 1.5-1.95 20/4/2023 SE246280.019	BH14 SOIL 3.0-3.3 20/4/2023 SE246280.020
Exchangeable Calcium, Ca	mg/kg	2	8	90	95	120	26
Exchangeable Calcium, Ca	meq/100g	0.01	0.04	0.45	0.47	0.60	0.13
Exchangeable Calcium Percentage*	%	0.1	0.2	2.5	2.4	3.2	1.0
Exchangeable Potassium, K	mg/kg	2	240	260	220	220	200
Exchangeable Potassium, K	meq/100g	0.01	0.61	0.67	0.55	0.56	0.51
Exchangeable Potassium Percentage*	%	0.1	3.7	3.8	2.7	3.0	3.7
Exchangeable Magnesium, Mg	mg/kg	2	1200	1300	1800	1500	1000
Exchangeable Magnesium, Mg	meq/100g	0.02	10	11	14	12	8.6
Exchangeable Magnesium Percentage*	%	0.1	62.5	59.6	71.8	66.4	62.5
Exchangeable Sodium, Na	mg/kg	2	1300	1400	1100	1200	1000
Exchangeable Sodium, Na	meq/100g	0.01	5.5	6.0	4.7	5.1	4.5
Exchangeable Sodium Percentage*	%	0.1	33.5	34.0	23.1	27.4	32.8
Cation Exchange Capacity	meq/100g	0.02	16	18	20	19	14

PARAMETER	UOM	LOR	BH15 SOIL 0.5-0.95 20/4/2023 SE246280.021	BH15 SOIL 1.5-1.95 20/4/2023 SE246280.022	BH15 SOIL 3.0-3.3 20/4/2023 SE246280.023
Exchangeable Calcium, Ca	mg/kg	2	32	30	13
Exchangeable Calcium, Ca	meq/100g	0.01	0.16	0.15	0.07
Exchangeable Calcium Percentage*	%	0.1	0.8	0.9	0.4
Exchangeable Potassium, K	mg/kg	2	280	270	290
Exchangeable Potassium, K	meq/100g	0.01	0.71	0.70	0.73
Exchangeable Potassium Percentage*	%	0.1	3.6	4.2	4.5
Exchangeable Magnesium, Mg	mg/kg	2	1600	1200	1200
Exchangeable Magnesium, Mg	meq/100g	0.02	13	10	10
Exchangeable Magnesium Percentage*	%	0.1	64.9	61.5	61.6
Exchangeable Sodium, Na	mg/kg	2	1400	1300	1300
Exchangeable Sodium, Na	meq/100g	0.01	6.1	5.5	5.5
Exchangeable Sodium Percentage*	%	0.1	30.7	33.3	33.6
Cation Exchange Capacity	meq/100g	0.02	20	17	16

Moisture Content [AN002] Tested: 24/4/2023

PARAMETER	UOM	LOR	BH9 SOIL 0.7-1.0 20/4/2023 SE246280.001	BH9 SOIL 1.7-2.0 20/4/2023 SE246280.002	BH10 SOIL 0.4-0.7 20/4/2023 SE246280.003	BH10 SOIL 1.4-1.7 20/4/2023 SE246280.004	BH11 SOIL 1.8-2.1 20/4/2023 SE246280.005
% Moisture	%w/w	1	13.8	14.0	16.9	13.2	10.1

PARAMETER	UOM	LOR	BH11 SOIL 2.3-2.5 20/4/2023 SE246280.006	BH12 SOIL 0.1-0.5 20/4/2023 SE246280.007	BH12 SOIL 0.5-0.95 20/4/2023 SE246280.008	BH12 SOIL 1.5-1.95 20/4/2023 SE246280.009	BH12 SOIL 2.5-3.0 20/4/2023 SE246280.010
% Moisture	%w/w	1	9.6	15.6	14.1	12.5	8.6

PARAMETER	UOM	LOR	BH12 SOIL 3.0-3.33 20/4/2023 SE246280.011	BH13 SOIL 0.3-0.8 20/4/2023 SE246280.012	BH13 SOIL 0.8-1.25 20/4/2023 SE246280.013	BH13 SOIL 1.55-2.0 20/4/2023 SE246280.014	BH13 SOIL 2.0-3.0 20/4/2023 SE246280.015
% Moisture	%w/w	1	10.4	15.6	14.0	15.1	17.5

PARAMETER	UOM	LOR	BH13 SOIL 3.0-3.45 20/4/2023 SE246280.016	BH13 SOIL 4.5-4.95 20/4/2023 SE246280.017	BH14 SOIL 0.5-0.95 20/4/2023 SE246280.018	BH14 SOIL 1.5-1.95 20/4/2023 SE246280.019	BH14 SOIL 3.0-3.3 20/4/2023 SE246280.020
% Moisture	%w/w	1	16.0	15.6	15.6	11.8	9.7

PARAMETER	UOM	LOR	BH15 SOIL 0.5-0.95 20/4/2023 SE246280.021	BH15 SOIL 1.5-1.95 20/4/2023 SE246280.022	BH15 SOIL 3.0-3.3 20/4/2023 SE246280.023
% Moisture	%w/w	1	13.8	13.2	12.5

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract of as received sample with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN122	Exchangeable Cations, CEC and ESP: Soil sample is extracted in 1M Ammonium Acetate at pH=7 (or 1M Ammonium Chloride at pH=7) with cations (Na, K, Ca & Mg) then determined by ICP OES/ICP MS and reported as Exchangeable Cations. For saline soils, these results can be corrected for water soluble cations and reported as Exchangeable cations in meq/100g or soil can be pre-treated (aqueous ethanol/aqueous glycerol) prior to extraction. Cation Exchange Capacity (CEC) is the sum of the exchangeable cations in meq/100g.
AN122	The Exchangeable Sodium Percentage (ESP) is calculated as the exchangeable sodium divided by the CEC (all in meq/100g) times 100. ESP can be used to categorise the sodicity of the soil as below: ESP < 6% non-sodic ESP 6-15% sodic ESP >15% strongly sodic Method is referenced to Rayment and Lyons, 2011, sections 15D3 and 15N1.-
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
		NVL	Not validated.	LOR	Limit of Reporting.
**	Indicative data, theoretical holding time exceeded.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		
***	Indicates that both * and ** apply.				

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

STATEMENT OF QA/QC PERFORMANCE

SE246280 R0

CLIENT DETAILS

Contact	Indra Jworchan
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
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Project	**20278/1 144 Rickard Road,Leppimngton**
Order Number	**20278/1**
Samples	23

LABORATORY DETAILS

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Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE246280 R0**
Date Received	20 Apr 2023
Date Reported	28 Apr 2023

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met with the exception of the following:

Duplicate	Conductivity and TDS by Calculation - Soil	2 items

SAMPLE SUMMARY

Sample counts by matrix	23 Soil	Type of documentation received	COC
Date documentation received	20/4/2023	Samples received in good order	Yes
Samples received without headspace	N/A	Sample temperature upon receipt	20.0°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	None	Samples clearly labelled	Yes
Complete documentation received	Yes		

HOLDING TIME SUMMARY

SE246280 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH9	SE246280.001	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH9	SE246280.002	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH10	SE246280.003	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH10	SE246280.004	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH11	SE246280.005	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH11	SE246280.006	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH12	SE246280.007	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH12	SE246280.008	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH12	SE246280.009	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH12	SE246280.010	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH12	SE246280.011	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH13	SE246280.012	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH13	SE246280.013	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH13	SE246280.014	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH13	SE246280.015	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH13	SE246280.016	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH13	SE246280.017	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH14	SE246280.018	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH14	SE246280.019	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH14	SE246280.020	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH15	SE246280.021	LB277720	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH15	SE246280.022	LB277720	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023
BH15	SE246280.023	LB277720	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	27 Apr 2023

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR)

Method: ME-(AU)-[ENV]AN122

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH9	SE246280.001	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH9	SE246280.002	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH10	SE246280.003	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH10	SE246280.004	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH11	SE246280.005	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH11	SE246280.006	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH12	SE246280.007	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH12	SE246280.008	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH12	SE246280.009	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH12	SE246280.010	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH12	SE246280.011	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH13	SE246280.012	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH13	SE246280.013	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH13	SE246280.014	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH13	SE246280.015	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH13	SE246280.016	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH13	SE246280.017	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH14	SE246280.018	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH14	SE246280.019	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH14	SE246280.020	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH15	SE246280.021	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH15	SE246280.022	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023
BH15	SE246280.023	LB277959	20 Apr 2023	20 Apr 2023	18 May 2023	28 Apr 2023	18 May 2023	28 Apr 2023

Moisture Content

Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH9	SE246280.001	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH9	SE246280.002	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH10	SE246280.003	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH10	SE246280.004	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH11	SE246280.005	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH11	SE246280.006	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH12	SE246280.007	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH12	SE246280.008	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH12	SE246280.009	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023

HOLDING TIME SUMMARY

SE246280 R0

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Moisture Content (continued)

Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH12	SE246280.010	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH12	SE246280.011	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH13	SE246280.012	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH13	SE246280.013	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH13	SE246280.014	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH13	SE246280.015	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH13	SE246280.016	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH13	SE246280.017	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH14	SE246280.018	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH14	SE246280.019	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH14	SE246280.020	LB277643	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH15	SE246280.021	LB277644	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH15	SE246280.022	LB277644	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023
BH15	SE246280.023	LB277644	20 Apr 2023	20 Apr 2023	04 May 2023	24 Apr 2023	29 Apr 2023	27 Apr 2023

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH9	SE246280.001	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH9	SE246280.002	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH10	SE246280.003	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH10	SE246280.004	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH11	SE246280.005	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH11	SE246280.006	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH12	SE246280.007	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH12	SE246280.008	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH12	SE246280.009	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH12	SE246280.010	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH12	SE246280.011	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH13	SE246280.012	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH13	SE246280.013	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH13	SE246280.014	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH13	SE246280.015	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH13	SE246280.016	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH13	SE246280.017	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH14	SE246280.018	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH14	SE246280.019	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH14	SE246280.020	LB277719	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH15	SE246280.021	LB277720	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH15	SE246280.022	LB277720	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023
BH15	SE246280.023	LB277720	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	27 Apr 2023	26 Apr 2023

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH10	SE246280.003	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH10	SE246280.004	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH12	SE246280.007	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH12	SE246280.008	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH12	SE246280.009	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH12	SE246280.010	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH12	SE246280.011	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH13	SE246280.015	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH13	SE246280.016	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH13	SE246280.017	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH14	SE246280.020	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH15	SE246280.021	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH15	SE246280.022	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023
BH15	SE246280.023	LB277716	20 Apr 2023	20 Apr 2023	27 Apr 2023	26 Apr 2023	24 May 2023	28 Apr 2023

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result
LB277719.001	Conductivity of Extract (1:5 as received)	µS/cm	1	<1
	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	0.85
LB277720.001	Conductivity of Extract (1:5 as received)	µS/cm	1	<1
	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	0

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR)

Method: ME-(AU)-[ENV]AN122

Sample Number	Parameter	Units	LOR	Result
LB277959.001	Exchangeable Sodium, Na	mg/kg	2	0.1602
	Exchangeable Potassium, K	mg/kg	2	0.0938
	Exchangeable Calcium, Ca	mg/kg	2	0.0617
	Exchangeable Magnesium, Mg	mg/kg	2	0.008

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result
LB277716.001	Chloride	mg/kg	0.25	<0.25

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean
The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR
Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may give a different calculated RPD.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE246280.010	LB277719.014	Conductivity of Extract (1:5 as received)	µS/cm	1	310	310	31	0
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	340	34.672811059	31	0
SE246280.020	LB277719.025	Conductivity of Extract (1:5 as received)	µS/cm	1	330	550	30	51 ②
		Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	370	12.312302839	30	51 ②

Moisture Content

Method: ME-(AU)-[ENV]AN002

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE246280.010	LB277643.011	% Moisture	%w/w	1	8.6	8.9	41	4
SE246280.020	LB277643.022	% Moisture	%w/w	1	9.7	9.2	41	5
SE246280.021	LB277644.011	% Moisture	%w/w	1	13.8	14.1	37	2
SE246393.009	LB277644.020	% Moisture	%w/w	1	14.8	15.7	37	6

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE246280.010	LB277719.014	pH	pH Units	0.1	5.8	5.7	32	2
SE246280.020	LB277719.025	pH	pH Units	0.1	5.0	5.2	32	4
SE246280.021	LB277720.026	pH	pH Units	0.1	4.7	4.7	32	0
SE246367.003	LB277720.025	pH	pH Units	0.1	8.4	8.4	31	0

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE246280.020	LB277716.023	Chloride	mg/kg	0.25	700	690	30	0
SE246367.003	LB277716.022	Chloride	mg/kg	0.25	6.89065300896	6.9521766965	34	1

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Conductivity and TDS by Calculation - Soil

Method: ME-(AU)-[ENV]AN106

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB277719.002	Conductivity of Extract (1:5 as received)	µS/cm	1	310	303	85 - 115	102
	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	NA	303	85 - 115	102
LB277720.002	Conductivity of Extract (1:5 as received)	µS/cm	1	310	303	85 - 115	102
	Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	NA	303	85 - 115	102

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR)

Method: ME-(AU)-[ENV]AN122

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB277959.002	Exchangeable Sodium, Na	meq/100g	0.01	0.21	0.194	80 - 120	110
	Exchangeable Potassium, K	meq/100g	0.01	0.63	0.63	80 - 120	100
	Exchangeable Calcium, Ca	meq/100g	0.01	6.0	6.3	80 - 120	96
	Exchangeable Magnesium, Mg	meq/100g	0.02	1.1	1.11	80 - 120	99

pH in soil (1:5)

Method: ME-(AU)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB277719.003	pH	pH Units	0.1	7.4	7.415	98 - 102	100
LB277720.003	pH	pH Units	0.1	7.4	7.415	98 - 102	100

Soluble Anions (1:5) in Soil/Solids by Ion Chromatography

Method: ME-(AU)-[ENV]AN245

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB277716.002	Chloride	mg/kg	0.25	94	100	70 - 130	94

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spikes were required for this job.

MATRIX SPIKE DUPLICATES

SE246280 R0

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.
***	Indicates that both * and ** apply.
-	Sample not analysed for this analyte.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.
①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to relevant report comments for further information.

GEOTECHNIQUE PTY LTD

Laboratory Test Request / Chain of Custody Record

Lemko Place
PENRITH NSW 2750

P O Box 880
PENRITH NSW 2751

Tel: (02) 4722 2700
Fax: (02) 4722 6161
email: info@geotech.com.au

TO:	SGS ENVIRONMENTAL SERVICES UNIT 16 33 MADDOX STREET ALEXANDRIA NSW 2015	Sampling By: PP	Job No 20278/1
		Project:	Proposed Leppington School Upgrade
PH:	02 8594 0400 FAX: 02 8594 0499	Project Manager: IJ	Location: 144 Rickard Road, Leppimngton
ATTN:	Ms Emily Yin		

	Sampling details					Results required by:								
	Location	Depth	Soil	Water	EC (1:5)	pH	Exchangeable sodium % (Dispersivity)	Chloride	Resistivity				Notes	Keep Sample
1	BH 9	0.7-1.0	DSP		✓	✓	✓							✓
2	BH9	1.7-2.0	DSP		✓	✓	✓							✓
3	BH10	0.4-0.7	DSP		✓	✓	✓	✓	✓					✓
4	BH10	1.4-1.7	DSP		✓	✓	✓	✓	✓					✓
5	BH11	1.8-2.1	DSP		✓	✓	✓							✓
6	BH11	2.3-2.5	DSP		✓	✓	✓							✓
7	BH12	0.1-0.5	DSP		✓	✓	✓	✓	✓					✓
8	BH12	0.5-0.95	DSP		✓	✓	✓	✓	✓					✓
9	BH12	1.5-1.95	DSP		✓	✓	✓	✓	✓					✓
10	BH12	2.5-3.0	DSP		✓	✓	✓	✓	✓					✓
11	BH12	3.0-3.33	DSP		✓	✓	✓	✓	✓					✓
12	BH13	0.3-0.8	DSP		✓	✓	✓							✓
13	BH13	0.8-1.25	DSP		✓	✓	✓							✓
14	BH13	1.55-2.0	DSP		✓	✓	✓							✓
15	BH13	2.0-3.0	DSP		✓	✓	✓	✓	✓					✓
16	BH13	3.0-3.45	DSP		✓	✓	✓	✓	✓					✓
17	BH13	4.5-4.95	DSP		✓	✓	✓	✓	✓					✓
18	BH14	0.5-0.95	DSP		✓	✓	✓							✓
19	BH14	1.5-1.95	DSP		✓	✓	✓							✓
20	BH14	3.0-3.3	DSP		✓	✓	✓	✓	✓					✓
21	BH15	0.5-0.95	DSP		✓	✓	✓	✓	✓					✓
22	BH15	1.5-1.95	DSP		✓	✓	✓	✓	✓					✓
23	BH15	3.0-3.3	DSP		✓	✓	✓	✓	✓					✓

SGS EHS Sydney COC
SE246280

Excel Geotech_Geo Required

Relinquished by			Received by		
Name	Signature	Date	Name	Signature	
Pratik Pokhrel		20/04/2023		20.4.23	2:40

Legend:

WG	USG	Undisturbed soil sample (gla	DSP	Disturbed soil sample (small plastic bag)	* Purge & Trap
WP	DSG	Disturbed soil sample (glass	✓	Test required	# Geotechnique Screen

SAMPLE RECEIPT ADVICE

SE246280

CLIENT DETAILS

Contact	Indra Jworchan
Client	Geotechnique
Address	P.O. Box 880 NSW 2751
Telephone	02 4722 2700
Facsimile	02 4722 6161
Email	indra.jworchan@geotech.com.au
Project	**20278/1 144 Rickard Road,Leppimngton**
Order Number	**20278/1**
Samples	23

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Thu 20/4/2023
Report Due	Fri 28/4/2023
SGS Reference	**SE246280**

SUBMISSION DETAILS

This is to confirm that 23 samples were received on Thursday 20/4/2023. Results are expected to be ready by COB Friday 28/4/2023. Please quote SGS reference SE246280 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	23 Soil	Type of documentation received	COC
Date documentation received	20/4/2023	Samples received in good order	Yes
Samples received without headspace	N/A	Sample temperature upon receipt	20.0°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	None	Samples clearly labelled	Yes
Complete documentation received	Yes		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

Sampling date was not provided. It is assumed to be as date samples were relinquished.

SAMPLE RECEIPT ADVICE

SE246280

CLIENT DETAILS

Client Geotechnique

Project 20278/1 144 Rickard Road,Leppimngton

SUMMARY OF ANALYSIS

No.	Sample ID	Conductivity and TDS by Calculation - Soil	Exchangeable Cations and Cation Exchange Capacity	Moisture Content	pH in soil (1:5)	Soluble Anions (1:5) in Soil/Solids by Ion
001	BH9 0.7-1.0	2	13	1	1	-
002	BH9 1.7-2.0	2	13	1	1	-
003	BH10 0.4-0.7	3	13	1	1	1
004	BH10 1.4-1.7	3	13	1	1	1
005	BH11 1.8-2.1	2	13	1	1	-
006	BH11 2.3-2.5	2	13	1	1	-
007	BH12 0.1-0.5	3	13	1	1	1
008	BH12 0.5-0.95	3	13	1	1	1
009	BH12 1.5-1.95	3	13	1	1	1
010	BH12 2.5-3.0	3	13	1	1	1
011	BH12 3.0-3.33	3	13	1	1	1
012	BH13 0.3-0.8	2	13	1	1	-
013	BH13 0.8-1.25	2	13	1	1	-
014	BH13 1.55-2.0	2	13	1	1	-
015	BH13 2.0-3.0	3	13	1	1	1
016	BH13 3.0-3.45	3	13	1	1	1
017	BH13 4.5-4.95	3	13	1	1	1
018	BH14 0.5-0.95	2	13	1	1	-
019	BH14 1.5-1.95	2	13	1	1	-
020	BH14 3.0-3.3	3	13	1	1	1
021	BH15 0.5-0.95	3	13	1	1	1
022	BH15 1.5-1.95	3	13	1	1	1
023	BH15 3.0-3.3	3	13	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

GEOTECH TESTING PTY LTD®
ABN 71 076 676 321

TEST RESULTS - SHRINK / SWELL INDEX

NSW DEPARTMENT OF EDUCATION
GPO BOX 4037
SYDNEY NSW 2001

Laboratory: Penrith
Job No: 20278/1

GEOTECHNICAL INVESTIGATION LEPPINGTON
SINSW PROCUREMENT - DET - VARIOUS LOCATIONS

Test Procedure: AS 1289 7.1.1

Sample Identification	Borehole 4	Borehole 8		
Depth (m)	0.4 - 0.62	0.5 - 0.67		
Laboratory Number	20278/1-1	20278/1-2		
Date Tested:	24/01/2023	24/01/2023		
Tested By:	NP	NP		
Checked By:	AK	AK		
Test Description				
Moisture Content				
Initial %	12.5	17.2		
Final %	22.1	22.8		
Swell %	1.4	1.8		
Shrinkage %	1.2	3.2		
Shrink/Swell Index $\%/_pF$	1.1	2.3		
Material Description				

Form No R007 Version 13 07/21

Report Date
26/01/2023

NATA

Accredited for compliance with ISO/IEC 17025 - Testing.

A Kench

NATA Accreditation Number 2734
Corporate Site Number 2727

Approved Signatory

34 Borec Road, Penrith NSW 2750
Telephone: (02) 4722 2744

Unit 4, 18-20 Whyalla Place, Prestons NSW 2170
Telephone: (02) 9607 6111

email: info@geotech.com.au www.geotech.com.au

GEOTECH TESTING PTY LTD®
ABN 71 076 676 321

TEST RESULTS - SHRINK / SWELL INDEX

NSW DEPARTMENT OF EDUCATION
GPO BOX 4037
SYDNEY NSW 2001

Laboratory: Penrith
Job No: 20278/1

GEOTECHNICAL INVESTIGATION LEPPINGTON
SINSW PROCUREMENT - DET - VARIOUS LOCATIONS

Test Procedure: AS 1289 7.1.1				
Sample Identification	Borehole 14	Borehole 15		
Depth (m)	0.5 - 0.9	0.95 - 1.2		
Laboratory Number	20278/1-3	20278/1-4		
Date Tested:	24/04/2023	24/04/2023		
Tested By:	LC	LC		
Checked By:	AK	AK		
Test Description				
Moisture Content				
Initial %	16.6	14.7		
Final %	21.8	22.1		
Swell %	2.7	5.4		
Shrinkage %	3.3	1.1		
Shrink/Swell Index $\%/_pF$	2.6	2.1		
Material Description				

Form No R007 Version 13 07/21

Report Date
28/04/2023

Accredited for compliance with
ISO/IEC 17025 - Testing.

A Kench

NATA Accreditation Number 2734
Corporate Site Number 2727

Approved Signatory

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