Douglas PARTNERS

GROUNDED EXPERTISE

Report on Supplementary Geotechnical Investigation

Proposed Multi-purpose Medium Hall

38-54 and 66 Eton Street, Sutherland NSW

Prepared for School Infrastructure NSW

Project 224456.01

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

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

Report on Supplementary Geotechnical Investigation
Proposed Multi-purpose Medium Hall
38-54 and 66 Eton Street, Sutherland NSW

1. Introduction

This report prepared by Douglas Partners Pty Ltd (Douglas) presents the results of a supplementary geotechnical investigation undertaken for a proposed multi-purpose medium hall at Sutherland Public School (SPS) at 38-54 and 66 Eton Street, Sutherland NSW (the site). The investigation was carried out as a variation to the Short Form Work Order DDWO05264/23.

It is understood that the proposed development of the site includes the construction of a multi-purpose medium hall including toilets and a canteen. Douglas has previously undertaken a geotechnical investigation (DP Ref: 224456.01.R.002.Rev0) for the proposed development in which three possible locations were "assessed." Additional investigation has been undertaken at proposed "location 1" ("the subject site" herein).

The aim of the supplementary investigation was to assess the subsurface profile across the subject site and provide comments and recommendations relevant to design and construction. The additional investigation included the drilling of five boreholes and laboratory testing of selected samples. Details of the additional field work are presented in this report along with relevant information from the previous investigation.

A contamination assessment was undertaken in conjunction with the geotechnical investigation and is reported separately (Douglas ref. 224456.00.R.002).

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

2. Site description

The main campus of SPS is located at 38-54 Eton Street with separate sports fields located to the south of President Avenue at 66 Eton Street. The subject site is located centrally within the main campus of SPS, spanning across Lots 6 to 8 in Deposited Plan 802.

The school is bounded by Flora Street to the north, Merton Street to the east, Eton Street to the west and President Avenue to the south.

The subject site is currently occupied by one-storey brick building, covered walkways and play areas, multi-use hardstand open spaces, turfed (natural and artificial) areas, car park areas and minor landscaped garden beds.

The subject site slopes gently from about RL 113 in the north to RL 111 in the south, as shown in Figure 1 overleaf (levels are relative to the Australian Height Datum, AHD).

Figure 1: Aerial image of site overlain by 2 m surface contours to AHD

3. Previous investigations

The locations of previous nearby geotechnical investigations undertaken by DP are shown in Figure 2 overleaf and include:

- Project 8603, 1984, 10-12 Boyle Steet: three test pits to 2.6 m to 2.9 m depth for proposed offices;
- Project 40773, 2007, 11-15 Gray Street: four rock-cored boreholes to 4.5 m to 5.6 m depth with groundwater monitoring well installations for a proposed commercial and residential development;
- Project 72998, 2012, 123 Flora Street: two rock-cored boreholes to 10.1 m and 15.3 m depth for proposed multi-level buildings;
- Project 73935, 2014, 551 President Avenue: four augered boreholes to 3.8 m to 4.0 m depth and dynamic cone penetrometer testing (DCPs) for a proposed swimming pool; and
- Project 224456.01, 2023, SPS: twelve boreholes (BH01 to BH12) to depths between 2.1 m and 4.0 m within Sutherland Public School for three site location options previously proposed for the multi-purpose medium hall. The detailed results within “site location 1” are included in this report, as described in subsequent sections of this report.

The subsurface conditions encountered in the previous investigation undertaken at SPS (DP Ref: 224456.01.R.002.Rev0) typically comprised:

Pavement:	Asphaltic concrete pavement at some locations to depths of 0.1 m; overlying
Fill:	Gravelly sand, sand, sandy silt and clay encountered to depths between 0.2 m to 1.3 m; overlying
Residual Clay:	Medium to high plasticity clay, with consistency ranging between stiff to hard. Residual clay was observed to depths of between 2.3 m and 2.8 m; overlying
Weathered Siltstone Bedrock	very low and low strength siltstone bedrock.

Groundwater was not observed during the field work for the previous investigations. The groundwater monitoring wells installed for Project 40773 showed water levels between 1 m and 5 m depth. This was considered to be perched seepage within the soil and weathered rock profile rather than the regional groundwater table.

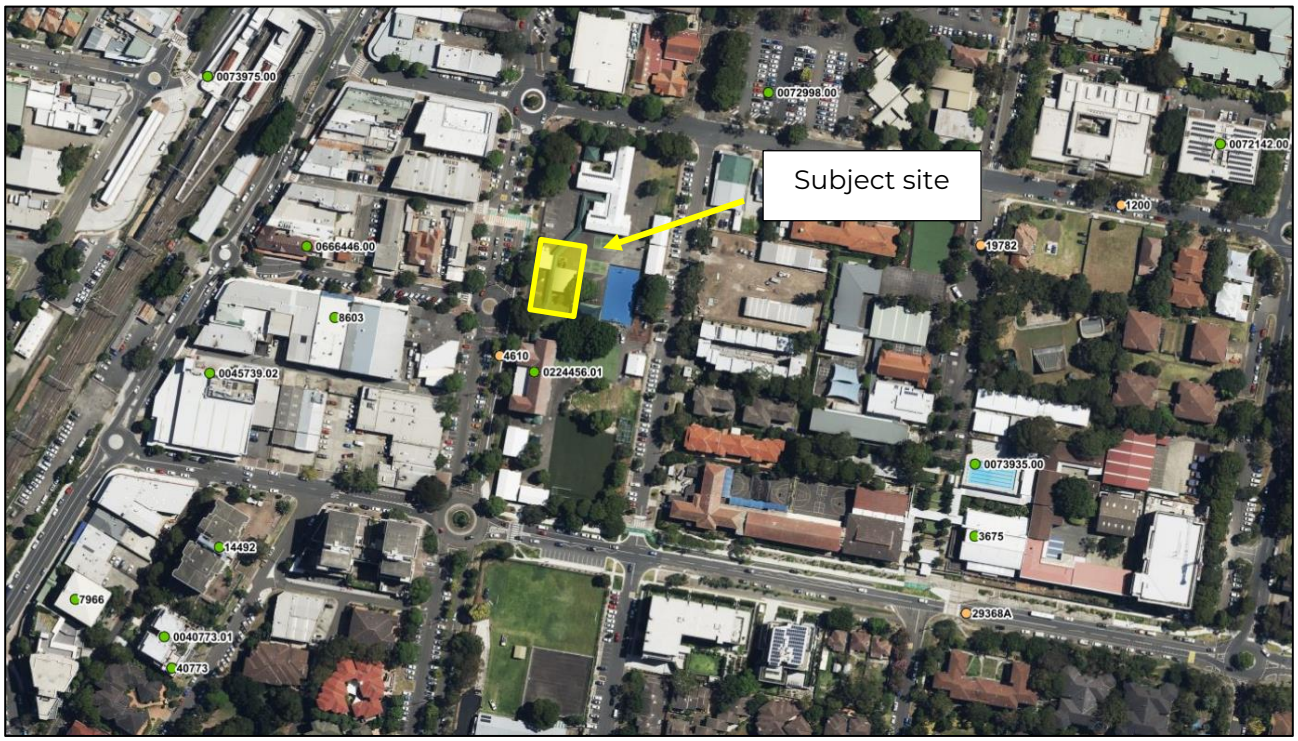

Figure 2: Previous investigations by DP near and within Sutherland Public School (green and orange circles)

4. Published data

4.1 Geology

Reference to the Sydney 1:100 000 Geological Series Map indicates that the site is underlain by Hawkesbury Sandstone (shale lenses) of the Triassic period, which typically comprises fluvially deposited laminated mudstone, claystone, siltstone and sandstone. An extract of the geological map is shown in Figure 3 overleaf.

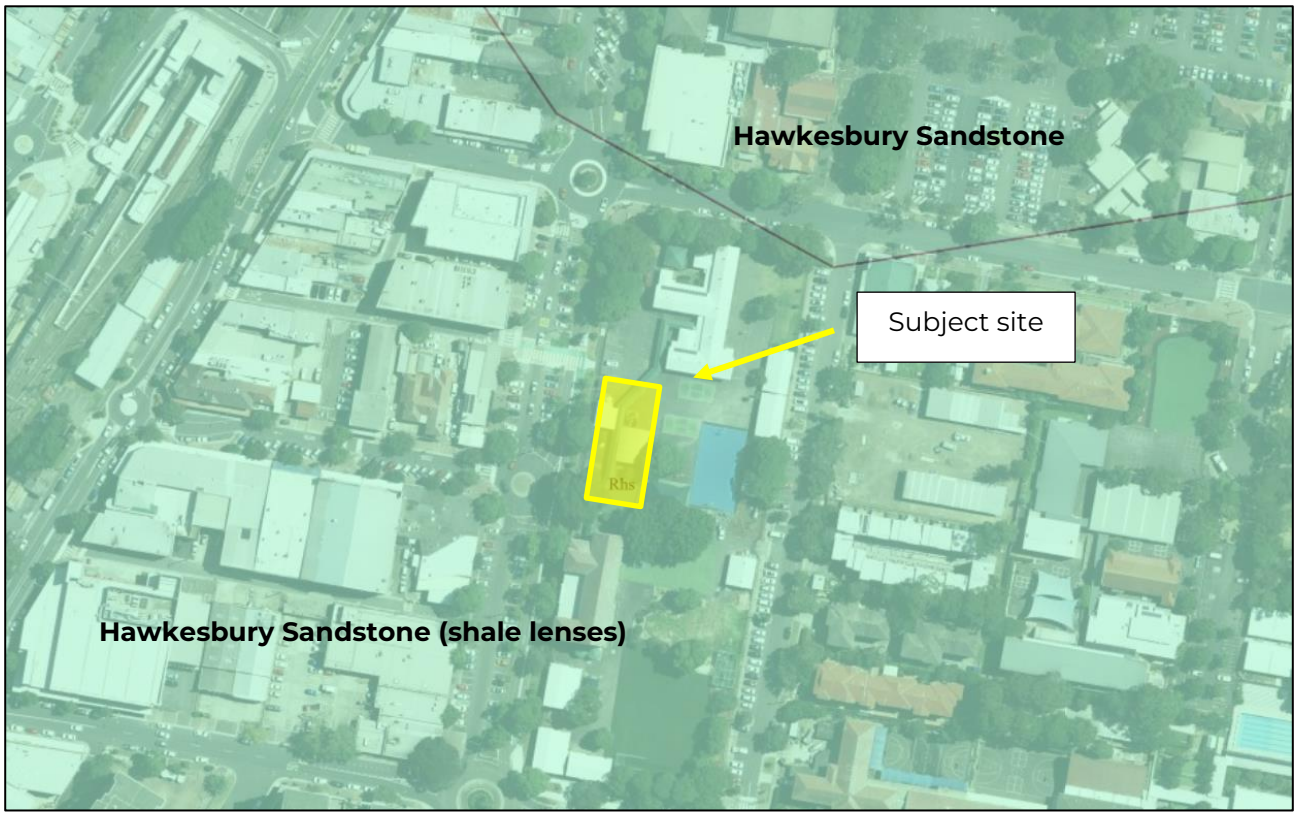

Figure 3: Extract from Sydney 1:100 000 Geological Series Map

4.2 Hydrogeology

No shallow registered groundwater bores are located near the site. Shallow water seepage was observed at depths of between 1 m and 5 m during previous investigations near the site.

4.3 Soil landscape

Reference to the Sydney 1:100 000 Soil Landscape Series map indicates that the site is underlain by a landscape group known as the Gymea soil landscape. An extract of the soil landscape map is shown in Figure 4 overleaf.

The Gymea soil landscape is an erosional soil landscape and is characterised by topography of undulating to rolling rises and low hills on Hawkesbury Sandstone, with local relief of 20 m to 80 m and slope gradients of 10% to 25%.

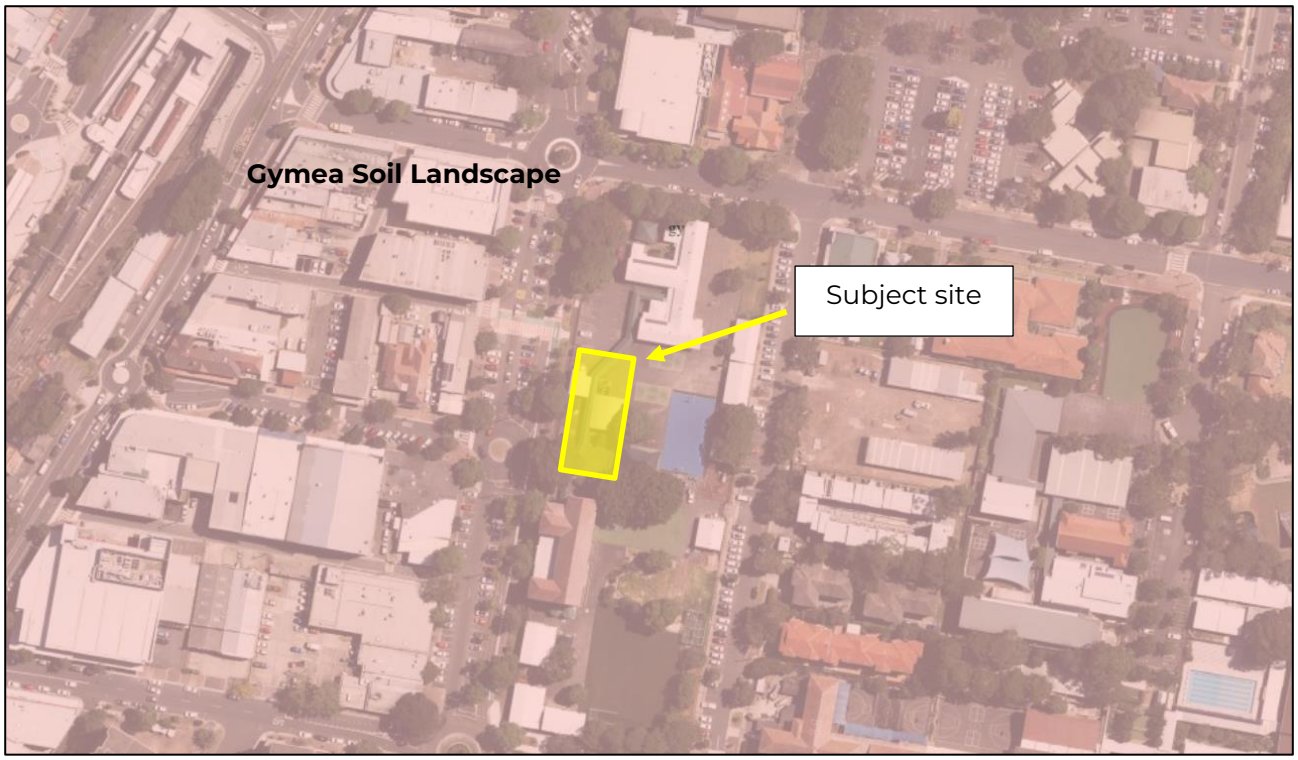

Figure 4: Extract from Sydney 1:10 00 Soil Landscape Map

4.4 Acid sulfate soils

Reference to the 1:25 000 Acid Sulfate Soils (ASS) Risk map indicates that the site is in an area of no known occurrence of acid sulfate soils. The nearest mapped occurrences of ASS are close to the Woronora River, which is over 1 km away from the school. The high elevation and geology at the site suggest that the presence of acid sulphate soils is unlikely.

4.5 Salinity

Dryland salinity risk and hazard mapping was undertaken in 2000 by the former NSW Government Departments of Land and Water Conservation to show the broad distribution of areas considered as having either a high salinity risk or a high salinity hazard.

The school site is not located within, or close to, mapped areas with high salinity risk or high salinity hazard. The nearest areas mapped as having high salinity risk / hazard are in Western Sydney.

5. Field work methods

The field work for the current investigation included the drilling of 5 boreholes (BH101 to BH105) within the subject site using a difficult-access drilling rig to depths between 2.7 m to 4.0 m. Drilling was undertaken using 110 mm diameter solid flight augers to the top of weathered rock. Standard penetration tests (SPTs) were carried out and soil samples were collected for laboratory testing in each borehole. The boreholes were terminated due to practical refusal in inferred very low to low strength rock. Supervision of the drilling and logging of the boreholes was completed

by an experienced engineer. Logging of the soil was undertaken in general accordance with AS 1726:2017.

Coordinates and surface levels for all borehole locations were determined using a differential Global Positioning System (dGPS) receiver, which has an accuracy of 0.1 m. Coordinates are in GDA2020/MGA Zone 56 format (Geocentric Datum of Australia 2020 base with Map Grid of Australia projection) and levels are relative to Australian Height Datum (AHD). The borehole locations for the current investigation are shown on Drawing 1 in Appendix B. The relevant borehole locations from the previous investigation at the subject site are also shown on Drawing 1.

6. Field work results

The detailed subsurface conditions encountered are presented in the borehole logs in Appendix C. The relevant borehole logs from the previous investigation at the site are also included. Notes defining descriptive terms and classification methods are included in Appendix A.

The general subsurface profile encountered at the borehole locations across the subject site may be summarised as follows:

Pavement:	Asphaltic concrete pavement, with thickness of between 50 mm and 100 mm was encountered at all boreholes except BH04, BH05 and BH103, which were located within turfed areas or garden beds; overlying
Fill:	Gravelly sand, sand, silty sand, sandy silt, silty clay and clay encountered to depths between 0.2 m to 1.3 m with varying proportion of other inclusions such as roots, wood fragments, ash and plaster; overlying
Residual CLAY:	Medium to high plasticity clay, with consistency ranging between stiff to hard. Residual clay was observed to depths of between 2.3 m and 2.8 m; overlying
Weathered Siltstone Bedrock	Inferred very low and low strength siltstone bedrock.

Table 1 and Table 2 overleaf summarise the levels at which different materials were encountered in the boreholes.

Free groundwater was not observed during auger drilling in any of the boreholes.

Table 1: Summary of Inferred Material Strata Levels (2023 Boreholes)

Stratum	Depth (m) [RL (m, AHD)] of Top of Stratum				
	BH01	BH02	BH03	BH04	BH05
Ground Surface (Fill)	[112.4]	[112.8]	[112.3]	[111.6]	[111.7]
Residual Clay	0.6 [111.8]	0.2 [112.6]	0.3 [112.0]	1.3 [110.3]	0.6 [111.1]
Weathered Siltstone	2.4 [110.0]	2.3 [110.5]	2.3 [110.0]	2.8 [108.8]	2.5 [109.2]
Base of Borehole	2.8 [109.6]	2.9 [109.9]	2.6 [109.7]	2.9 [108.7]	2.6 [109.1]

Table 2: Summary of Inferred Material Strata Levels (2024 Boreholes)

Stratum	Depth (m) [RL (m, AHD)] of Top of Stratum				
	BH101	BH102	BH103	BH104	BH105
Ground Surface (Fill)	[112.2]	[112.2]	[111.9]	[112.1]	[112.1]
Residual Clay	1.0 [111.2]	0.7 [111.5]	1.2 [111.2]	0.6 [111.5]	0.6 [111.5]
Weathered Siltstone	2.6 [109.6]	2.5 [109.7]	3.0 [108.9]	2.8 [109.3]	2.7 [109.4]
Base of Borehole	2.7 [109.5]	2.9 [109.3]	4.0 [107.9]	3.0 [109.1]	4.0 [108.1]

7. Laboratory testing

Six soil / rock samples across the current and previous investigations for the subject site were sent to a NATA accredited analytical laboratory and were analysed to assess the exposure classification to buried steel and concrete elements in accordance with the provisions of AS2159–2009 “Piling – Design and Installation”. The results for aggressivity are summarised in Table 3 and the detailed results are included in Appendix D.

Table 3: Summary of aggressivity test results

Sample / Depth (m)	Material	pH	Electrical Conductivity (µS/cm)	Chloride (mg/kg)	Sulphate (mg/kg)
BH02 / 2.5-2.9	SILTSTONE	4.8	52	<10	42
BH03 / 0.4-0.5	CLAY	7.0	110	20	20
BH05 / 1.0-1.45	CLAY	4.6	35	<10	32
BH101 / 0.4-0.5	FILL/Sandy SILT	5.0	74	<10	100
BH104 / 0.05-0.2	FILL/Sandy SILT	5.7	41	<10	27
BH105 / 1.8-2.0	Silty Gravelly CLAY	4.7	29	<10	28

Soil salinity values (ECe) have been calculated using the methods of the "Site Investigations for Urban Salinity" booklet, prepared by the Department of Land and Water Conservation (DLWC, 2002). The soil samples were classified as per soil textural classification methods to determine the multiplication factors (M) for the samples. Textural classifications and calculated soil salinities (ECe = M x $EC_{1:5}$) are shown in Table 4.

Table 4: Analytical and Calculated Results for Salinity in Soil

Sample / Depth (m)	Description	Soil Texture Group	M	ECe (dS/m)
BH03 / 0.4-0.5	CLAY	Medium Clay	7	0.8
BH05 / 1.0-1.45	CLAY	Medium Clay	7	0.2
BH101 / 0.4-0.5	FILL / Sandy SILT	Sandy Loam	14	1.0
BH104 / 0.05-0.2	FILL / Sandy SILT	Sandy Loam	14	0.6
BH105 / 1.8-2.0	Silty Gravelly CLAY	Medium Clay	7	0.2

Notes: M = multiplication factor based on textural classification; ECe = salinity value (calculated value); Salinity Class per DLWC (2002), using the criteria of Richards (1954)

Testing was undertaken on two samples across the current and previous investigations for the subject site for Atterberg limits and linear shrinkage, and one sample for shrink-swell index. The results are summarised in Table 5, and the detailed laboratory test reports are included in Appendix D.

Table 5: Results for Atterberg Limits and Shrink-Swell in Soil

Sample / Depth (m)	Description	W_P (%)	W_L (%)	PI (%)	LS (%)	I_{ss} (%)
BH01 / 1.0-1.45	CLAY	23	48	25	12.5	-
BH03 / 0.5-0.7	CLAY	-	-	-	-	1.8

Notes: WP = plastic limit; WL = liquid limit; PI = plasticity index; LS = linear shrinkage; Iss = shrink-swell index

8. Geotechnical model

The proposed development area is underlain by variable depths of fill. Residual clays underlie the fill in all areas, which are derived from weathering of the siltstone and sandstone within the Hawkesbury Sandstone unit and are typically stiff to hard, medium to high plasticity and moderately reactive. The residual clays are underlain by a weathered siltstone profile, which is typically very low and low strength to the depths of this geotechnical investigation.

Groundwater was not encountered during the investigation and the groundwater table is likely to be well below the bedrock surface. Seepage would be expected to occur near the rock surface and through joints or partings within the bedrock.

The interpreted geotechnical model is illustrated in Cross-Section A-A' in Drawing 2 in Appendix B.

9. Comments

9.1 Proposed development

It is understood the proposed development will include the construction of a multi-purpose medium hall including toilets and a canteen. No basement levels are proposed for the new building; however, small retaining walls may be required in some areas due to site topography.

9.2 Site preparation

Any existing fill that is required to support slabs, pavements or structures will need to be assessed on a case-by-case basis for its suitability for the proposed application. Where required, new fill should be placed in accordance with the following site preparation measures outlined below:

- Strip organic-rich topsoil from areas in which new engineered fill or structures are proposed;
- Excavate existing fill from areas in which new engineered fill or structures are proposed;
- Compact the exposed surface and proof-roll using a roller of 12 t deadweight (or equivalent) in the presence of a geotechnical engineer. Any areas exhibiting unacceptable movements during the proof-roll may require further rectification;
- Place fill in maximum 250 mm thick loose layers and compact to achieve a dry density ratio of between 98% and 102% relative to Standard compaction, with moisture contents maintained within 2% of Standard optimum moisture content;
- Poor trafficability should be expected across unpaved areas of the sites. A layer of granular product (e.g., roadbase, recycled crushed concrete, etc.) should be considered as the top layer of fill to improve trafficability on site;
- Density testing should be undertaken in accordance with the requirements of AS3798–2007 "Guidelines on earthworks for commercial and residential developments".

The underlying residual soils are suitable for re-use as an engineered fill however, for clay soils, it is very important to control the moisture content during compaction. For moderately to highly reactive clay soils, it is recommended that the soils be compacted at moisture contents between 100% and 102% of the Standard optimum moisture content.

The suitability of re-using site-won fill and natural soil should also be considered from a contamination perspective.

If fill is imported to the site, then the engineering properties (e.g., plasticity, reactivity, CBR, etc.) should ideally be equivalent, or superior, to the existing materials on site.

9.3 Pavements

All subgrades formed in residual clays must be conditioned so that they have field moisture contents within 2% of the standard optimum moisture content.

A design California bearing ratio (CBR) of 3% is suggested as a preliminary value for residual clays at the site.

The CBR of any imported fill should also be assessed to confirm the suggested design value is appropriate.

The subgrade should be prepared in accordance with Section 9.2 of this report. The granular pavement layers (i.e., roadbase) should be compacted to achieve a dry density ratio of at least 98% relative to Modified compaction.

Suitable cross-fall drainage and robust subsoil drainage lines should be provided to reduce the risk of the subgrade becoming saturated during the life of the pavement.

9.4 Excavation conditions

Excavations are expected for general site levelling, construction of retaining walls, services trenches, footings and other localised excavations relating to the development. It is expected that excavations would be carried out through mostly fill and residual soil and possibly through weathered rock. These excavations should be readily achieved using conventional earthmoving equipment such as tracked excavators.

If required, excavation into low strength rock or stronger will require ripping equipment and / or rock hammers for effective removal.

Careful excavation near any existing structures will be necessary to minimise ground movements and prevent damage to the structure. An assessment should be undertaken to assess the impact of the excavation on the nearby structure prior to commencing excavation.

The use of heavy ripping equipment and / or rock hammers, if required, will cause vibrations which have the potential to cause discomfort to nearby residents and damage to buildings. Typically, vibrations will need to be limited to 8 mm/s (component peak particle velocity) or less for sensitive structures. Vibration trials and continuous monitoring may be required during the works if heavy equipment or rock hammers are to be used near sensitive structures.

All excavated materials will need to be disposed of in accordance with the provisions of the current legislation and guidelines including the Waste Classification Guidelines (NSW EPA, 2014).

9.5 Excavation support

Vertical excavations within the fill, soil and very low strength rock will not be stable. For slopes up to 3 m high, maximum temporary batter slopes of 1.5H:1V (Horizontal : Vertical) in soil and 0.75H:1V in very low strength rock are recommended. Permanent batter slopes should not be steeper than 2H:1V and should generally be flatter where vegetation maintenance is required. Erosion protection should be provided for all permanent batters. Vertical unsupported excavation in low to medium strength or stronger rock may be possible, if encountered, provided it is free of adverse joints, however further advice should be sought in this case.

Surcharge loads should not be placed within a distance equal to the vertical height of the batter from the crest, unless specific geotechnical stability analysis shows that the loads can be placed closer.

Shallow retaining structures (if required) may be designed using the parameters in Table 6. It is suggested that preliminary design could be based on a triangular distribution with the lateral earth pressure being determined as a proportion of the vertical stress as given in the following formula:

$\sigma_z = K\ z\ \gamma$, where σ_z = Horizontal pressure at depth z (kPa)
K = Earth pressure coefficient
z = Depth (m)
γ = Unit weight of soil or rock (kN/m^3)

Table 6: Retaining wall design parameters

Material	Unit Weight (kN/m^3)	Active Earth Pressure Coefficient (K_a)	Ultimate Passive Earth Pressure (kPa)[1]
Fill	20	0.4	-
Stiff to Hard Residual Clay	20	0.3	250
Weathered Siltstone	22	0.25[2]	400

Notes: [1]Below a minimum of 0.5 m embedment below the base of the excavation;
[2]Provided that adverse jointing is not encountered in the rock.

To minimise ground (and wall) movements, the Active Earth Pressure coefficient (K_a) should be generally increased by 50% where retaining walls are close to existing structures and services. Where small movements of retaining walls are acceptable, they may be designed for the 'active' (K_a) condition.

Embedment of retaining walls can be used to achieve passive support with passive earth pressure starting from 0.5 m below excavation toe / base level. The ultimate passive pressures will require a factor of safety to be included in the design.

Lateral pressures due to surcharge loads from adjacent buildings, sloping ground surfaces, pavements and construction machinery should be included where relevant. Hydrostatic pressure acting on retaining walls should also be included in the design where adequate drainage is not provided behind the full height of the walls.

9.6 Groundwater

The regional groundwater table is expected to be much deeper than shallow excavations that might occur during the proposed development at the site. Some minor seepage along the top of clay and bedrock and through joints and partings within the rock mass may occur and mostly after rainfall.

Drainage measures will need to be provided in any subsurface structures or behind retaining walls to allow any seepage to flow around the structures rather than exert hydrostatic pressures against them.

9.7 Foundations

Due to the presence and depths of fill material on site, a site classification of Class P is necessary in accordance with AS2870–2011 "Residential slabs and footings". Footings should be designed to found on the underlying residual soils or weathered rock, or the uncontrolled fill can be removed and replaced with engineered compacted fill suitable to provide support to the footings. If the fill is removed, then the site classification of Class M would be appropriate for the moderately reactive residual clays at the site. It is recommended that all footings are founded on material of similar strength to avoid excessive differential settlement.

Bored piles are also suitable for the site, and these may be found on very low strength rock or stronger. Higher bearing pressures are achievable in better quality rock. Rock quality is expected to improve with depth, but cored boreholes would be required to confirm the level and strength of the rock.

Suggested design values for shallow footings and bored piles are provided in Table 7.

Table 7: Foundation design parameters – shallow footings and bored piles

Material	Maximum Allowable		Maximum Ultimate		Young's Modulus (MPa)
	End Bearing (kPa)	Shaft Adhesion[1] (kPa)	End Bearing (kPa)	Shaft Adhesion[1] (kPa)	
Engineered Fill or Stiff Residual Clay	100	-	250	-	15
Very Stiff to Hard Residual Clay	200	-	500	-	35
Weathered Siltstone (very low strength and stronger)	1000	100	3000	150	50 to 300

Notes: [1]Only for bored piles below 1 m depth and where adequate socket roughness has been achieved.

A geotechnical strength reduction factor (ϕ_g) should be applied to the ultimate values provided in Table 7 if the limit-state design process is undertaken to design the piles. Australian Standard AS2159–2009 "Piling – Design and Installation" provides information on how to determine an appropriate value of ϕ_g which is based on a risk assessment. The pile designer will need to confirm a ϕ_g value when the piling contractor is selected, however it is suggested that a preliminary value of 0.40 be adopted at this stage.

Settlement of a footing or pile is dependent on the loads applied to the footing or pile and the foundation conditions. The total (long-term) settlement of a footing or pile designed using the allowable parameters provided in this report should be less than 1% of the footing width or pile diameter upon application of the design load. Serviceability analysis should be undertaken if the ultimate bearing pressures (incorporating a suitable reduction factor) are used to proportion the piles.

All footings and bored piles should be inspected by an experienced geotechnical professional during construction to check the adequacy of the foundation material and, in the case of piles, to check the socket cleanliness and roughness. Seepage should be removed from excavations prior to pouring concrete.

9.8 Salinity

The results of the laboratory testing and soil textural classification indicate non-saline conditions (referring to DLWC (2002) methods using the criteria outlined by Richards (1954)). Provided that any imported fill is non-saline, standard construction practices will be suitable for the site with respect to soil salinity.

9.9 Aggressivity

The laboratory test results indicate that the samples are generally non-aggressive to moderately aggressive to buried concrete and non-aggressive to mildly aggressive to buried steel elements in accordance with the provisions of AS2159–2009 "Piling – Design and Installation".

9.10 Seismic loading

In accordance with AS1170–2007 "Structural Design Actions, Part 4: Earthquake Actions in Australia", a hazard factor (Z) of 0.08 and a site subsoil Class B_e are appropriate for the site.

10. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report (or services) for this project at 38-54 and 66 Eton Street, Sutherland NSW in line with Douglas' proposal dated 08/07/2024 and acceptance received from Glenn Francis of School Infrastructure NSW. The work was carried out under the Short Form Work Order DDWO05264/23. This report is provided for the exclusive use of School Infrastructure NSW for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and / or their agents.

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

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

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

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

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

Appendix A

About This Report

About this Report

November 2023

Introduction

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

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

Copyright

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

continued next page

About this Report

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

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Terminology, Symbols and Abbreviations

November 2023

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style XW. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	KL
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	UK
No data	Information required to allow classification of the property was not available. For example if drilling is commenced from the base of a hole predrilled by others	ND
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example providing a description of the strength of a concrete pavement	NA

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

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Soil Descriptions

Terminology
Symbols
Abbreviations

March 2024

Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:

The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	Particle Size (mm)	Behaviour Model	
		Behaviour	Approximate Dry Mass
Boulder	>200	Excluded from particle behaviour model as "oversize"	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	Definition[1]	Relative Proportion	
		In Fine Grained Soil	In Coarse Grained Soil
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to its engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer "identification of minor components" below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, "INTERBEDDED Silty CLAY AND SAND".

Soil Descriptions

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component [1]	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		Particle size (mm)
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	"oozes" when agitated	w=LL
	Wet of liquid limit	"oozes"	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as "extremely weathered material" in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than 'very low' as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Fluvial	Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin)	FLV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be "oversize" may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with "MIXTURE OF".

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Rock Strength

Rock strength is defined by the unconfined compressive strength, and it refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects.

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

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

[1] Rock strength classification is based on UCS. The UCS to $I_{s(50)}$ ratio varies significantly for different rock types and specific ratios may be required for each site. The point load Index ranges shown above are as suggested in AS1726 and should not be relied upon without supporting evidence.

The following abbreviation codes are used for soil layers or seams of material "within rock" but for which the equivalent UCS strength is less than 0.6 MPa.

Scenario	Abbreviation Code
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The properties of the material encountered over this interval are described in the "Description of Strata" and soil properties columns.	SOIL
The material encountered has an equivalent UCS strength of less than 0.6 MPa, and therefore is considered to be soil (as per Note 1 of Table 20 of AS 1726-2017). The prominence of the material is such that it can be considered to be a seam (as defined in Table 22 of AS1726-2017) and the properties of the material are described in the defect column.	SEAM

Degree of Weathering

The degree of weathering of rock is classified as follows:

Weathering Term	Description	Abbreviation Code
Residual Soil[1]	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.	RS
Extremely weathered[1]	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	XW
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 recognisable. 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.	HW
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 recognisable but shows little or no change of strength from fresh rock.	MW
Slightly weathered	Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.	SW
Fresh	No signs of decomposition or staining.	FR
Note: If HW and MW cannot be differentiated use DW (see below)		
Distinctly weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores.	DW

[1] The parent rock type, of which the residual/extremely weathered material is a derivative, will be stated in the description (where discernible).

Degree of Alteration

The degree of alteration of the rock material (physical or chemical changes caused by hot gasses or liquids at depth) is classified as follows:

Term	Description	Abbreviation Code
Extremely altered	Material is altered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.	XA
Highly altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is changed by alteration. Some primary minerals are altered to clay minerals. Porosity may be increased by leaching or may be decreased due to precipitation of secondary materials in pores.	HA
Moderately altered	The whole of the rock material is discoloured, usually by staining or bleaching to the extent that the colour of the original rock is not recognisable but shows little or no change of strength from fresh rock.	MA
Slightly altered	Rock is slightly discoloured but shows little or no change of strength from fresh rock	SA
Note: If HA and MA cannot be differentiated use DA (see below)		
Distinctly altered	Rock strength usually changed by alteration. The rock may be highly discoloured, usually by staining or bleaching. Porosity may be increased by leaching or may be decreased due to precipitation of secondary minerals in pores.	DA

Degree of Fracturing

The following descriptive classification apply to the spacing of natural occurring fractures in the rock mass. It includes bedding plane partings, joints and other defects, but excludes drilling breaks. These terms are generally not required on investigation logs where fracture spacing is presented as a histogram, and where used are presented in an unabbreviated format.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with occasional fragments
Fractured	Core lengths of 30-100 mm with occasional shorter and longer sections
Slightly Fractured	Core lengths of 300 mm or longer with occasional sections of 100-300 mm
Unbroken	Core contains very few fractures

Rock Quality Designation

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

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

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

Stratification Spacing

These terms may be used to describe the spacing of bedding partings in sedimentary rocks. Where used, these terms are generally presented in an unabbreviated format

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

Defect Descriptions

Defect Type

Term	Abbreviation Code
Bedding plane	B
Cleavage	CL
Crushed seam	CS
Crushed zone	CZ
Drilling break	DB
Decomposed seam	DS
Drill lift	DL
Extremely Weathered seam	EW
Fault	F
Fracture	FC
Fragmented	FG
Handling break	HB
Infilled seam	IS
Joint	JT
Lamination	LAM
Shear seam	SS
Shear zone	SZ
Vein	VN
Mechanical break	MB
Parting	P
Sheared Surface	S

Rock Defect Orientation

Term	Abbreviation Code
Horizontal	H
Vertical	V
Sub-horizontal	SH
Sub-vertical	SV

Rock Defect Coating

Term	Abbreviation Code
Clean	CN
Coating	CT
Healed	HE
Infilled	INF
Stained	SN
Tight	TI
Veneer	VNR

Rock Defect Infill

Term	Abbreviation Code
Calcite	CA
Carbonaceous	CBS
Clay	CLAY
Iron oxide	FE
Manganese	MN
Pyrite	Py
Secondary material	MS
Silt	M
Quartz	Qz
Unidentified material	MU

Rock Defect Shape/Planarity

Term	Abbreviation Code
Curved	CU
Discontinuous	DIS
Irregular	IR
Planar	PR
Stepped	ST
Undulating	UN

Rock Defect Roughness

Term	Abbreviation Code
Polished	PO
Rough	RF
Smooth	SM
Slickensided	SL
Very rough	VR

Defect Orientation

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

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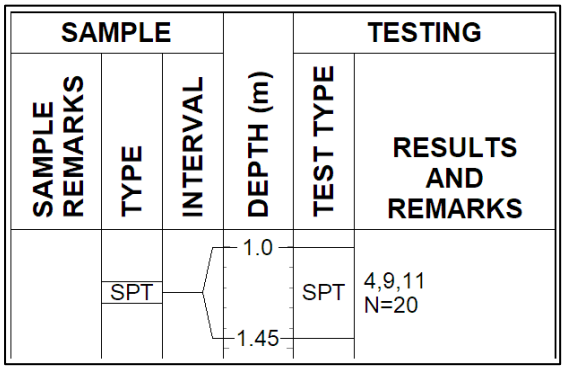
Sampling, Testing and Excavation Methodology

Terminology
Symbols
Abbreviations

March 2024

Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid Sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Environmental sample	ES
Gas sample	G
Piston sample	P
Sample from SPT test	SPT
Undisturbed tube sample	U[1]
Water sample	W
Material Sample	MT
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y =x blows for y mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

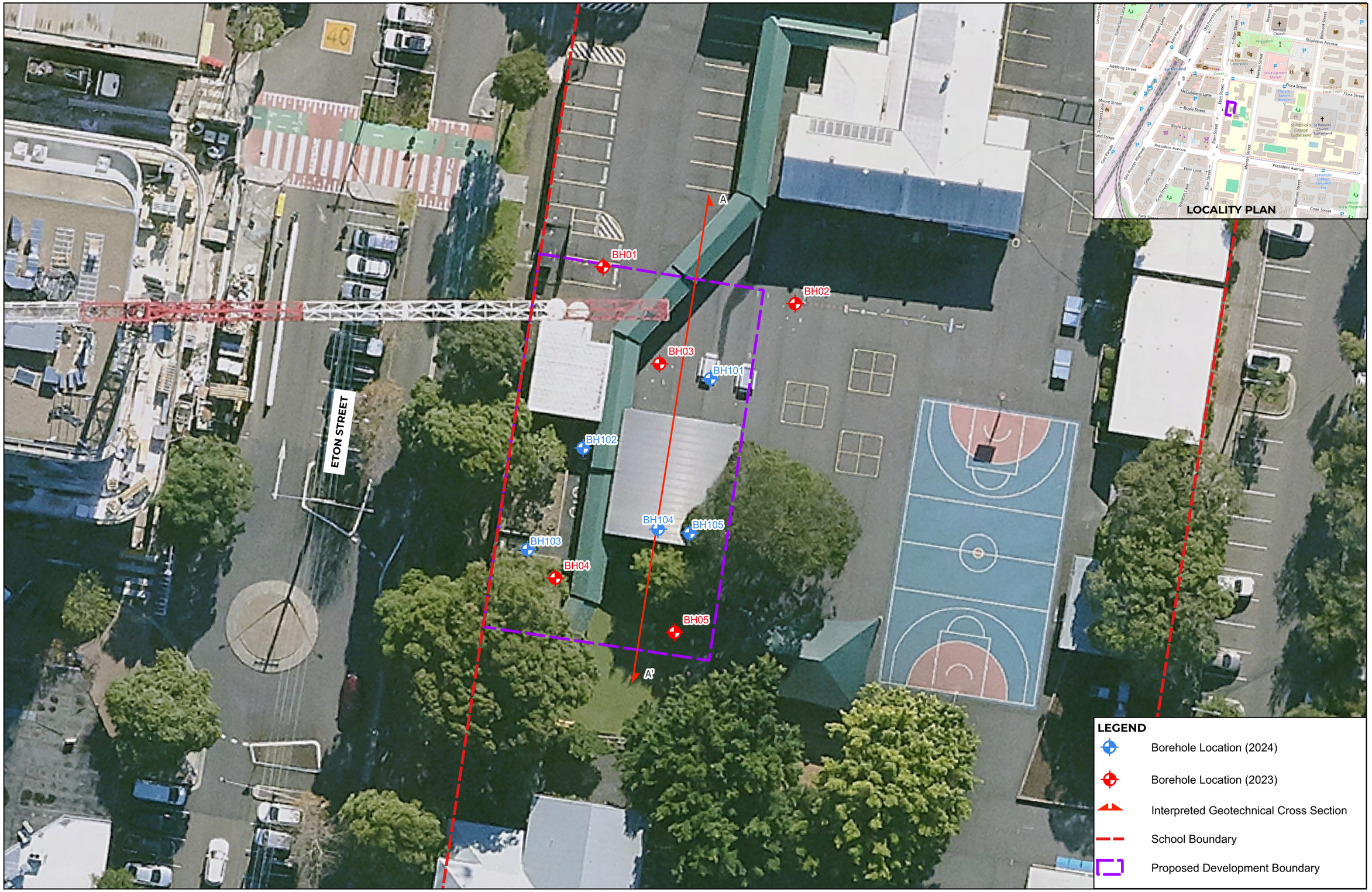
Method	Abbreviation Code
Direct Push	DP
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD[1]
Air Track	AT
Diatube	DT[1]
Hand auger	HA[1]
Hand tools (unspecified)	HAND
Existing exposure	X
Hollow flight auger	HSA[1]
HQ coring	HQ3
HMLC series coring	HMLC
NMLC series coring	NMLC
NQ coring	NQ3
PQ coring	PQ3
Predrilled	PD
Push tube	PT[1]
Ripping tyne/ripper	R
Rock roller	RR[1]
Rock breaker/hydraulic hammer	EH
Sonic drilling	SON[1]
Mud/blade bucket	MB[1]
Toothed bucket	TB[1]
Vibrocore	VC[1]
Vacuum excavation	VE
Wash bore (unspecified bit type)	WB[1]

[1] – numeric suffixes indicate tool diameter/width in mm

Douglas PARTNERS

Appendix B

Drawings



REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0	INITIAL ISSUE	05.08.2024	EC

SCALE: 0 4 8 12 16 m
1:350 @ A3

Douglas PARTNERS
OFFICE: SYDNEY
96-98 Hermitage Rd, West Ryde NSW 2114
(02)9809 0666

CLIENT: **School Infrastructure NSW**

NOTE:
1: Basemap from Metromap (Dated 26.05.2024)

COORDINATE REFERENCE SYSTEM: GDA2020 / MGA zone 56

PROJECT NAME: **Proposed Multi-Purpose Medium Hall**

PROJECT ADDRESS: **38-54 and 66 Eton Street, Sutherland**

DRAWING TITLE: **Test Location Plan**

PROJECT NO: **224456.01**

DRAWING NO: **1**

REVISION: **0**

A

A'

ELEVATION (AHD)

114.5
114.0
113.5
113.0
112.5
112.0
111.5
111.0
110.5
110.0
109.5
109.0
108.5
108.0
107.5
107.0
106.5

APPROXIMATE DEVELOPMENT BOUNDARY

APPROXIMATE DEVELOPMENT BOUNDARY

BH01 *Offset 9.08m*
BH02 *Offset 10.05m*
BH03 *Offset 2.17m*
BH101 *Offset 3.02m*
BH102 *Offset 8.19m*
BH105 *Offset 3.38m*
BH104 *Offset 0.25m*
BH103 *Offset 12.01m*
BH04 *Offset 8.89m*
BH05 *Offset 3.39m*

FILL

RESIDUAL CLAY

WEATHERED SILTSTONE

0 5 10 15 20 25 30 35 40 45 50

DISTANCE ALONG PROFILE (m)

LEGEND

- ASPHALTIC CONCRETE
- FILL
- CH - High Plasticity CLAY
- SILTSTONE
- CI-CH - Medium to High Plasticity CLAY

TESTS / OTHER

N - Standard penetration test value
— ? — — - Interpreted geotechnical boundary

SOIL CONSISTENCY

vs - Very Soft
s - Soft
f - Firm
st - Stiff
vst - Very Stiff
h - Hard
na - not applicable
nd - no data

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0	INITIAL ISSUE	05.08.2024	EC

0 1 2 3 4 6 8 10
1:200 @ A3
Vertical Exaggeration = 5.0

Douglas PARTNERS
OFFICE: SYDNEY
96-98 Hermitage Rd, West Ryde NSW 2114
(02) 9809 0666

CLIENT:
School Infrastructure NSW

NOTES
1. Subsurface conditions are accurate at the borehole locations only. Variations in subsurface conditions may occur between borehole locations. Interpreted strata boundaries are approximate and should be used as a guide only.
2. Summary logs only and should be read in conjunction with detailed logs.
3. Horizontal and vertical scales are not equal.

PROJECT NAME:
Proposed Multi-Purpose Medium Hall
PROJECT ADDRESS:
38-54 and 66 Eton Street, Sutherland

DRAWING TITLE:
INTERPRETED GEOTECHNICAL CROSS SECTION A-A'

PROJECT No: **224456.01**
DRAWING No: **2**
REVISION: **0**

Appendix C

Results of Field Work

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland

SURFACE LEVEL: 112.4 AHD
EASTING: 320800.2
NORTHING: 6232529.2
DIP/AZIMUTH: 90°/--

BORE No: BH01
PROJECT No: 224456.00
DATE: 27/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
112	0.1	ASPHALTIC CONCRETE			0.1				
		FILL/ Gravelly SAND: fine to coarse, grey to dark grey, fine to medium angular igneous gravel, dry, apparently well compacted		E	0.2				
	0.35	FILL/ SAND: fine to medium, dark grey, with clay nodules, moist		E*	0.5				
	0.6	CLAY CI: medium plasticity, red-brown and pale grey, w<PL, stiff, residual			0.6				
				E	0.9				
	1	Below 1.0m: very stiff			1.0				1
111				S			3,7,10 N = 17		
					1.45				
	2								2
110	2.4	SILTSTONE: dark grey and orange-brown, very low strength, highly weathered, Hawkesbury Sandstone			2.5				
		Below 2.6m: low strength		S			10,25/100 refusal		
	2.75	Bore discontinued at 2.75m Refusal			2.75				
	3								3
109									
	4								4
108									

RIG: Comacchio 205 **DRILLER:** DB **LOGGED:** TM **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD01/20230927TM Taken from 0.5-0.6m

SAMPLING & IN SITU TESTING LEGEND

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

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland

SURFACE LEVEL: 112.8 AHD
EASTING: 320819
NORTHING: 6232525.6
DIP/AZIMUTH: 90°/--

BORE No: BH02
PROJECT No: 224456.00
DATE: 27/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.1	ASPHALTIC CONCRETE			0.1				
	0.2	FILL/ CLAY: medium plasticity, red-brown and brown, trace fine to medium angular igneous gravel, w<PL		E	0.2				
		CLAY CI: medium plasticity, red-brown and pale grey, w<PL, stiff, residual			0.5				
				E	0.6				
112					0.9				
	1			E	1.0				1
		Below 1.0m: very stiff to hard		S			6,12,15 N = 27		
					1.45				
111	2								2
	2.3	SILTSTONE: dark grey and orange-brown, very low strength, highly weathered, Hawkesbury Sandstone			2.5				
		Below 2.7m: low strength		S			12,25,20/100 refusal		
110	2.9	Bore discontinued at 2.9m Refusal			2.9				
	3								3
109									
	4								4
108									

RIG: Comacchio 205 **DRILLER:** DB **LOGGED:** TM **CASING:** Uncased
TYPE OF BORING: Solid flight auger to 2.5m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland

SURFACE LEVEL: 112.3 AHD
EASTING: 320805.7
NORTHING: 6232519.7
DIP/AZIMUTH: 90°/--

BORE No: BH03
PROJECT No: 224456.00
DATE: 27/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
112	0.1	ASPHALTIC CONCRETE			0.1				
		FILL/ Gravelly SAND: fine to medium, dark grey, fine to medium angular igneous gravel, dry, apparently well compacted		E	0.2				
	0.3	CLAY CI-CH: medium to high plasticity, red-brown and pale grey, w<PL, stiff, residual		E	0.4				
				U	0.5				
					0.7				
				E	0.9				
	1	Below 1.0m: very stiff to hard			1.0				1
111				S			6,14,16 N = 30		
					1.45				
	2								2
110	2.3	SILTSTONE: dark grey and orange-brown, very low strength, highly weathered, Hawkesbury Sandstone							
	2.55	Below 2.5m: low strength		S	2.5		10/50 refusal		
		Bore discontinued at 2.55m Refusal			2.55				
	3								3
109									
	4								4
108									

RIG: Comacchio 205 **DRILLER:** DB **LOGGED:** TM **CASING:** Uncased
TYPE OF BORING: Solid flight auger to 2.5m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland

SURFACE LEVEL: 111.6 AHD
EASTING: 320795.6
NORTHING: 6232498.8
DIP/AZIMUTH: 90°/--

BORE No: BH04
PROJECT No: 224456.00
DATE: 27/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
111	0.0	FILL/ Sandy SILT: low plasticity, brown to dark grey, trace rootlets			0.1				
				E	0.2				
					0.4				
				E	0.5				
					0.9				
	1			E*	1.0				1
				S			2,2,6 N = 8		
	1.3	CLAY CI-CH: medium to high plasticity, red-brown and pale grey, w<PL, stiff to very stiff, residual			1.45				
					1.5				
110				E	1.6				
					1.9				
	2			E	2.0				2
					2.5				
109				S			11,20,25/100 refusal		
	2.8								
	2.9	SILTSTONE: dark grey and orange-brown, low strength, highly weathered, Hawkesbury Sandstone			2.9				
	3	Bore discontinued at 2.9m Refusal							3
108									
	4								4
107									

RIG: Comacchio 205 **DRILLER:** DB **LOGGED:** TM **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *BD02/20230927TM Taken from 0.9-1.0m

SAMPLING & IN SITU TESTING LEGEND

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

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BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland

SURFACE LEVEL: 111.7 AHD
EASTING: 320807.2
NORTHING: 6232493.5
DIP/AZIMUTH: 90°/--

BORE No: BH05
PROJECT No: 224456.00
DATE: 27/9/2023
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
111	0.0	FILL/ Sandy SILT: low plasticity, brown to dark grey, trace rootlets		E	0.0–0.1				
				E	0.4–0.5				
	0.6	CLAY CI-CH: medium to high plasticity, red-brown and pale grey, w<PL, very stiff, residual		E	0.9–1.0				
	1			S	1.45		6,8,10 N = 18		
110	2								
	2.5			S	2.5–2.55		10/50 refusal		
	2.55	SILTSTONE: dark grey and orange-brown, low strength, highly weathered, Hawkesbury Sandstone							
109		Bore discontinued at 2.55m Refusal							
	3								
108	4								
107									

RIG: Comacchio 205 **DRILLER:** DB **LOGGED:** TM **CASING:** Uncased

TYPE OF BORING: Solid flight auger to 2.5m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

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

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland, NSW 2232

SURFACE LEVEL: 112.2 AHD
COORDINATE: E:320810.7, N:6232518.3
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH101
PROJECT No: 224456.01
DATE: 16/07/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	112	0.10	ASPHALTIC CONCRETE: 100 mm			NA	NA				0.10		
			FILL / Sandy SILT: brown; low plasticity; fine to medium sand.		FILL	ND	w>PL		ES		0.20		
									A/ES		0.40		
											0.50		
									ES		0.80		
		1.00	Silty CLAY (CH), with gravel: pale grey mottled red-brown; high plasticity; fine to medium, angular to sub-angular, ironstone gravel.		RS	VSt	w<PL				1.00		
	111								SPT			SPT	8,10,15 N=25
											1.45		
									ES		1.80		
	110	2									2.00		
		2.60	SILTSTONE: dark grey; inferred very low to low strength with extremely weathered and ironstone bands. Hawkesbury Sandstone			NA	NA				2.50		
			Borehole discontinued at 2.70m depth. Target depth reached.						SPT		2.70	SPT	16,25/50 (HB)
	109	3											
	108	4											

NOTES: (#) Soil origin is "probable" unless otherwise stated. (*) Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Bobcat
METHOD: AD/T to 2.7 m
REMARKS: No free groundwater observed

OPERATOR: Ground Test (C.S.)

LOGGED: CSY
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Generated with CORE-GS by Geroc - Soil Log

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland, NSW 2232

SURFACE LEVEL: 112.2 AHD
COORDINATE: E:320798.3, N:6232511.5
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH102
PROJECT No: 224456.01
DATE: 16/07/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[*] DENSITY.[*]	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	112	0.10	ASPHALTIC CONCRETE: 100 mm			NA	NA				0.10		
			FILL / Sandy SILT, trace gravel: brown and grey; low plasticity; fine to medium sand; fine to medium, ironstone gravel; trace rootlets and ash.		FILL	ND	w>PL		A/ES		0.20		
									A		0.40		
		0.70									0.50		
			Silty CLAY (CI), trace gravel: red-brown mottled brown; medium plasticity; fine, ironstone gravel; trace roots.			St - VSt	w>PL		ES		0.80		
	111	1									1.00		
									SPT			SPT	3,5,9 N=14 400kPa
			1.30m: becoming pale grey		RS								600kPa
											1.45	PP	
						VSt	w=PL to w<PL					PP	
	110	2							ES		1.80		
											2.00		
		2.50									2.50		
			SILTSTONE: dark grey; inferred very low to low strength with extremely weathered and ironstone bands. Hawkesbury Sandstone			NA	NA		SPT			SPT	9,15,25/100 (HB)
											2.90		
	109	3	Borehole discontinued at 2.90m depth. Target depth reached.										
	108	4											

NOTES: [#] Soil origin is "probable" unless otherwise stated. [*] Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Bobcat
METHOD: AD/T to 2.9 m
REMARKS: No free groundwater observed

OPERATOR: Ground Test (C.S.)

LOGGED: CSY
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland, NSW 2232

SURFACE LEVEL: 111.9 AHD
COORDINATE: E:320792.9, N:6232501.6
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH103
PROJECT No: 224456.01
DATE: 16/07/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[*] / DENSITY.[*]	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
		0.00	FILL / Sandy SILT, trace gravel: dark brown; low plasticity; fine to medium sand; fine, sandstone gravel; with wood fragment and rootlets.		FILL	ND	w>PL		ES		0.10		
									ES		0.40 0.50		
		0.70	FILL / Silty CLAY, trace gravel: red-brown mottled brown; medium to high plasticity; fine, ironstone gravel; trace rootlets.		FILL possibly RS	ND	w>PL		ES		0.80		
	111	1									1.00		
		1.20	Silty CLAY (CH), trace gravel: pale grey mottled red-brown; high plasticity; fine, ironstone gravel; trace rootlets.		RS	St - VSt	w=PL		SPT		1.45	SPT	4,6,6 N=12 540-580kPa
												PP	
	110	2							A		1.80 2.00		
		2.40			XWM	H	w<PL		SPT		2.50	SPT	12,19,24 N=43
	109	3.00	SILTSTONE: dark grey; inferred very low strength with extremely weathered and ironstone bands. Hawkesbury Sandstone			NA	NA				2.95		
	108	4											
			Borehole discontinued at 4.00m depth. Target depth reached.										
	107												

NOTES: [#] Soil origin is "probable" unless otherwise stated. [*] Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Bobcat
METHOD: AD/T to 4.0 m
REMARKS: No free groundwater observed

OPERATOR: Ground Test (C.S.)

LOGGED: CSY
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland, NSW 2232

SURFACE LEVEL: 112.1 AHD
COORDINATE: E:320805.6, N:6232503.6
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH104
PROJECT No: 224456.01
DATE: 16/07/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
						NA	NA						
	112	0.05	ASHPALTIC CONCRETE: 50 mm								0.05		
			FILL / Sandy SILT, trace gravel: brown; low plasticity; fine to medium sand; fine, ironstone gravel; trace rootlets.		FILL	ND	w>PL		A/ES		0.20		
											0.40		
									ES		0.50		
		0.60	Silty CLAY (CH), trace gravel: red-brown; high plasticity; fine, ironstone gravel; trace rootlets.										
		1									1.00		
	111						w=PL		SPT			SPT	5,6,10 N=16
													600-kPa
											1.45	PP	
					RS	St - VSt			ES		1.50		
		2	2.00m: becoming pale grey								2.00		
	110								ES		2.20		
							w<PL						
											2.50		
									SPT			SPT	9,15,21 N=36
		2.80	SILTSTONE: dark grey; inferred very low strength with extremely weathered and ironstone bands. Hawkesbury Sandstone			NA	NA				2.95		
		3	Borehole discontinued at 3.00m depth. Target depth reached.										
	109												
		4											
	108												

NOTES: (#) Soil origin is "probable" unless otherwise stated. (*) Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Bobcat
METHOD: AD/T to 3.0 m
REMARKS: No free groundwater observed

OPERATOR: Ground Test (C.S.)

LOGGED: CSY
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

BOREHOLE LOG

CLIENT: School Infrastructure NSW
PROJECT: Proposed Multi-Purpose Medium Hall
LOCATION: 38-54 and 66 Eton Street, Sutherland, NSW 2232

SURFACE LEVEL: 112.1 AHD
COORDINATE: E:320808.7, N:6232503.2
DATUM/GRID: MGA2020 Zone 56
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH105
PROJECT No: 224456.01
DATE: 16/07/24
SHEET: 1 of 1

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) / DENSITY.(*)	MOISTURE	REMARKS	SAMPLE TYPE	SAMPLE INTERVAL	DEPTH (m)	TESTING AND REMARKS: TEST TYPE	TESTING AND REMARKS: RESULTS AND REMARKS
	112	0.10	ASPHALTIC CONCRETE: 100 mm			NA	NA				0.10		
			FILL / Silty SAND, trace gravel: brown; fine to medium; low plasticity silt; fine, ironstone gravel; trace plaster and root fibers.		FILL				ES		0.20		
		0.30	FILL / Silty CLAY, with sand, trace gravel: brown and red-brown; low to medium plasticity; fine to medium sand; fine to medium, igneous and ironstone gravel; trace root fibers, possibly reworked natural.		FILL possibly RS	ND	M		ES		0.40		
		0.60	Silty CLAY (CH), trace gravel: red-brown; high plasticity; fine, ironstone gravel; trace roots.								0.50		
									A/ES		0.80		
	111	1	1.20m: becoming pale grey		RS	VSt - H	w=PL				1.00		
									SPT			SPT	5,9,9 N=18
											1.45	PP	500-kPa
		1.70	Silty Gravelly CLAY (CI): pale grey mottled red-brown; medium plasticity; fine to medium, siltstone and ironstone gravel.						A		1.80		
	110	2			XWM		w<PL				2.00		
											2.50		
		2.70	SILTSTONE: dark grey; inferred very low to low strength with extremely weathered and ironstone bands. Hawkesbury Sandstone						SPT			SPT	6,17,18/100 (HB)
											2.90		
	109	3				NA	NA		A		3.00		
											3.20		
		4											
	108		Borehole discontinued at 4.00m depth. Target depth reached.										

NOTES: (#) Soil origin is "probable" unless otherwise stated. (*) Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Bobcat
METHOD: AD/T to 4.0 m
REMARKS: No free groundwater observed

OPERATOR: Ground Test (C.S.)

LOGGED: CSY
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Appendix D

Laboratory Test Results

Material Test Report

Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Email: andrew.hutchings@douglaspartners.com.au

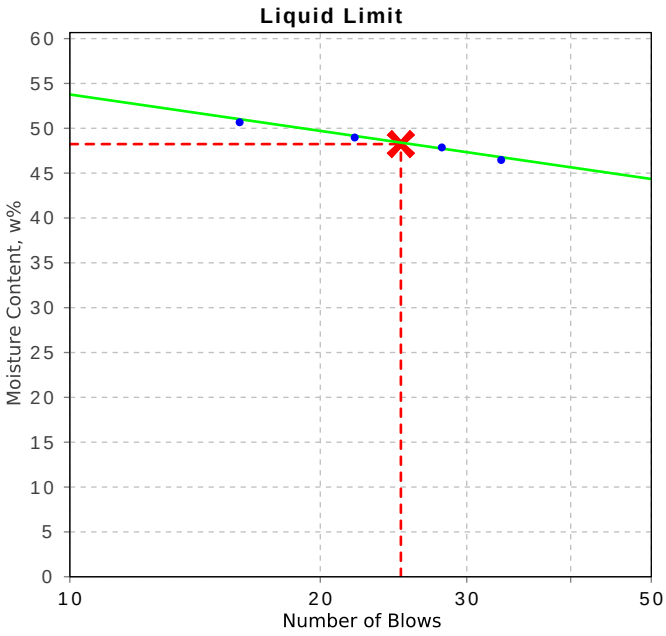
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Associate / Laboratory Manager
Laboratory Accreditation Number: 828

Report Number:	**224456.01-1**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*Amended project description*
Date Issued:	06/08/2024
Client:	School Infrastructure NSW
	Level 8, SYDNEY NSW
Contact:	Glenn Francis
Project Number:	224456.01
Project Name:	Proposed Multi-Purpose Medium Hall
Project Location:	38-54 and 66 Eton Street, Sutherland NSW
Work Request:	10923
Sample Number:	SY-10923D
Date Sampled:	03/10/2023
Dates Tested:	03/10/2023 - 10/10/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Remarks:	125mm linear shrinkage mould used
Sample Location:	**BH1 (1-1.45m)**
Material:	CLAY: red-brown and pale grey

Atterberg Limit (AS1289 3.1.1 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	48		
Plastic Limit (%)	23		
Plasticity Index (%)	**25**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**12.5**		
Cracking Crumbling Curling	None		



Material Test Report

Report Number:	**224456.01-1**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*Amended project description*
Date Issued:	06/08/2024
Client:	School Infrastructure NSW
	Level 8, SYDNEY NSW
Contact:	Glenn Francis
Project Number:	224456.01
Project Name:	Proposed Multi-Purpose Medium Hall
Project Location:	38-54 and 66 Eton Street, Sutherland NSW
Work Request:	10923
Sample Number:	SY-10923C
Date Sampled:	03/10/2023
Dates Tested:	03/10/2023 - 04/10/2023
Sampling Method:	Sampled by Engineering Department
	The results apply to the sample as received
Preparation Method:	AS 1289.1.1 - Sampling and Preparation of Soils
Sample Location:	**BH3 (0.5-0.7m)**
Material:	CLAY: red-brown and pale grey, with gravel and sand

Douglas Partners Pty Ltd
Sydney Laboratory
96 Hermitage Road West Ryde NSW 2114
Phone: (02) 9809 0666
Email: andrew.hutchings@douglaspartners.com.au

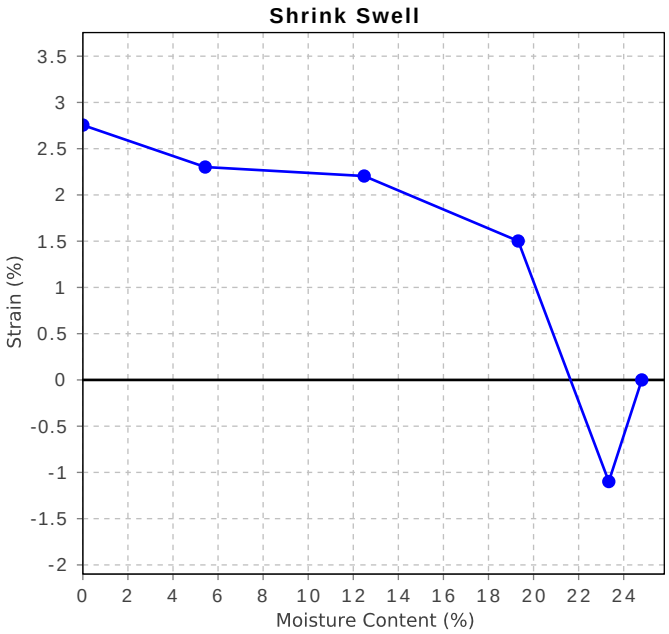
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Associate / Laboratory Manager
Laboratory Accreditation Number: 828

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**1.8**
Visual Description	CLAY: red-brown and pale grey, with gravel and sand
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	
Swell sample contains significant coarse particles, contributing to variation in core moisture and post swell moisture contents	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**2.8**
Estimated % by volume of significant inert inclusions	10
Cracking	Highly Cracked
Crumbling	No
Moisture Content (%)	24.8

Swell Test	
Initial Pocket Penetrometer (kPa)	>400
Final Pocket Penetrometer (kPa)	>400
Initial Moisture Content (%)	19.7
Final Moisture Content (%)	23.3
Swell (%)	**1.1**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



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CERTIFICATE OF ANALYSIS 334436

Client Details

Client	Douglas Partners Pty Ltd
Attention	Matthew Bennett
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**224456.01 Sutherland**
Number of Samples	6 Soil
Date samples received	03/10/2023
Date completed instructions received	03/10/2023

Analysis Details

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

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

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

Report Details

Date results requested by	10/10/2023
Date of Issue	06/10/2023

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Misc Inorg - Soil						
Our Reference		334436-1	334436-2	334436-3	334436-4	334436-5
Your Reference	UNITS	BH2	BH3	BH5	BH6	BH9
Depth		2.5-2.9	0.4-0.5	1.0-1.45	1.0-1.45	1.0-1.45
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/10/2023	05/10/2023	05/10/2023	05/10/2023	05/10/2023
Date analysed	-	05/10/2023	05/10/2023	05/10/2023	05/10/2023	05/10/2023
pH 1:5 soil:water	pH Units	4.8	7.0	4.6	4.6	5.9
Electrical Conductivity 1:5 soil:water	µS/cm	52	110	35	85	88
Chloride, Cl 1:5 soil:water	mg/kg	<10	20	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	42	20	32	86	52

Misc Inorg - Soil		
Our Reference		334436-6
Your Reference	UNITS	BH10
Depth		1.0-1.45
Type of sample		Soil
Date prepared	-	05/10/2023
Date analysed	-	05/10/2023
pH 1:5 soil:water	pH Units	4.9
Electrical Conductivity 1:5 soil:water	µS/cm	140
Chloride, Cl 1:5 soil:water	mg/kg	27
Sulphate, SO4 1:5 soil:water	mg/kg	170

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			05/10/2023	1	05/10/2023	05/10/2023		05/10/2023	[NT]
Date analysed	-			05/10/2023	1	05/10/2023	05/10/2023		05/10/2023	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	4.8	4.8	0	99	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	52	58	11	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	<10	0	104	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	42	48	13	105	[NT]

Result Definitions

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

Quality Control Definitions

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

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

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

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

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

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CERTIFICATE OF ANALYSIS 357261

Client Details

Client	Douglas Partners Pty Ltd
Attention	Matthew Bennett
Address	96 Hermitage Rd, West Ryde, NSW, 2114

Sample Details

Your Reference	**224456.01 Sutherland**
Number of Samples	3 Soil
Date samples received	23/07/2024
Date completed instructions received	23/07/2024

Analysis Details

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

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

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

Report Details

Date results requested by	30/07/2024
Date of Issue	30/07/2024

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Results Approved By
Jenny He, Senior Chemist

Authorised By
Nancy Zhang, Laboratory Manager

Misc Inorg - Soil				
Our Reference		357261-1	357261-2	357261-3
Your Reference	UNITS	BH101	BH104	BH105
Depth		0.4-0.5	0.05-0.2	1.8-2.0
Type of sample		Soil	Soil	Soil
Date prepared	-	23/07/2024	23/07/2024	23/07/2024
Date analysed	-	25/07/2024	25/07/2024	25/07/2024
pH 1:5 soil:water	pH Units	5.0	5.7	4.7
Electrical Conductivity 1:5 soil:water	µS/cm	74	41	29
Chloride, Cl 1:5 soil:water	mg/kg	<10	<10	<10
Sulphate, SO4 1:5 soil:water	mg/kg	100	27	28

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	357261-2
Date prepared	-			23/07/2024	1	23/07/2024	23/07/2024		23/07/2024	23/07/2024
Date analysed	-			25/07/2024	1	25/07/2024	25/07/2024		25/07/2024	25/07/2024
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	5.0	5.0	0	99	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	74	79	7	106	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	<10	0	111	94
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	100	110	10	110	93

Result Definitions

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NA	Test not required
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