Douglas Partners
Geotechnics / Environment / Groundwater

# Report on Geotechnical Investigation

## Epping West Public School Upgrade
96 Carlingford Road, Epping

Prepared for
School Infrastructure NSW
c/- Johnstaff Pty Ltd

Project 99674.00
April 2021

Integrated Practical Solutions

**Douglas Partners**
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# Report on Geotechnical Investigation
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## 1. Introduction

This report presents the results of a geotechnical desktop study undertaken for the master plan and concept design for proposed upgrades to the Epping West Public School (EWPS). The study was carried out under the Standard Form Agreement SINSW00650/20 dated 8 April 2020 and undertaken in accordance with Douglas Partners Pty Ltd (DP) proposal SYD200258 dated 13 March 2020.

It is understood that the proposed development will likely include construction of new school buildings up to four storeys with no basement levels. The proposed footprint of the new buildings is located near the eastern boundary of the school.

The investigation included the drilling of boreholes and laboratory testing of selected soil and rock samples. Details of the field work are presented in this report, together with comments and recommendations relevant to the design and construction.

A contamination assessment was undertaken in conjunction with the geotechnical investigation and is reported separately.

## 2. Previous Investigations

DP undertook a geotechnical investigation in October 2009 for a two-storey library and homebase building and a toilet block at EWPS (DP Project 71182.60). The investigation area was located near the western boundary of the school as shown in Figure 1.

The investigation included drilling of three boreholes to depths of between 1.8 m and 2.0 m, dynamic cone penetrometer (DCP) tests to assess the soil strengths, and collection of samples for a range of laboratory tests. Two boreholes (BH1 and BH2) were located within the library and homebase building footprint, while the other borehole (BH3) was located within the toilet block footprint. The approximate locations of the boreholes are shown in Figure 1 and the borehole logs are attached in Appendix E.

The results of the investigation generally encountered:

- **FILL:** silty clay, sandy clay and silty sand fill to depths of 0.4 m; overlying
- **RESIDUAL CLAY:** stiff to hard clay to depths of between 1.4 m and 1.9 m; overlying
- **WEATHERED SHALE:** extremely low strength shale.

Laboratory testing indicated that the residual clays were generally of high plasticity and were likely to be highly susceptible to shrink-swell movements in response to soil moisture variations.

Groundwater was not observed during the investigation.

Geotechnical inspections during construction were also carried out by DP at EWPS from May 2010 to February 2011 (DP Project 71761.00), which generally confirmed the results of the previous geotechnical investigation.

**Figure 1: Previous investigation by DP at EWPS**

## 3. Site Description

EWPS is located at 96 Carlingford Road, Epping and has an approximate site area of 3 ha. The site spans three lots, which are Lot 1 in Deposited Plan 122509, Lot 1 in Deposited Plan 161495 and Lot 11 in Deposited Plan 1099882.

The site is bounded by West Epping Park to the north, Carlingford Road to the south, Ward Street to the east and low-rise residential dwellings to the west.

The existing school grounds are currently occupied by low-rise classrooms and school buildings, demountable buildings, playing fields and grassed areas, hard surface open spaces and a car park area.

Most of the site is located on a locally elevated area (top of a ridge) and is relatively flat, as shown in Figure 2; the western side of the site slopes gently to the west and the northern side gently to the north.

The surface levels across the school grounds range between about RL 118 m and RL 122 m relative to Australian Height Datum (AHD).

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

# 4. Regional Geology and Mapping

## 4.1 Geology

Reference to the Sydney 1:100 000 Geological Series Map indicates that the site is underlain by Ashfield Shale, which typically comprises black to dark grey shale and laminite (finely interbedded sandstones and siltstones) and is part of the Wianamatta Group. An extract of the geological map is shown in Figure 3.

The Ashfield Shale overlies Mittagong Formation and then the Hawkesbury Sandstone.

The Mittagong Formation, which is often present in the Western Sydney area, is a transitional geological unit between the overlying Ashfield Shale and the underlying Hawkesbury Sandstone. The Mittagong Formation is a relatively thin formation that varies in thickness, typically between 3 m and 8 m thick. It typically comprises interbedded shale, laminite and fine-grained sandstone.

The Hawkesbury Sandstone comprises medium to coarse-grained quartz sandstone, very minor shale and laminite lenses.

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

## 4.2 Soil Landscapes

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

The Glenorie soil landscape is an erosional soil landscape and is characterised by topography of undulating to rolling hills on Wianamatta Group shales, with local relief of 50 m to 80 m and slope gradients of 5% to 20%. The soil landscape is typically represented by narrow ridges, hillcrests and valleys.

Soils in the Glenorie soil landscape are typically deep on lower slopes and along drainage lines and shallow to moderately deep on crests and upper slopes. These soils typically have a high soil erosion hazard, exhibit localised areas of impermeable highly plastic subsoil and are moderately reactive.

**Figure 4: Extract from Sydney 1:100 000 Soil Landscape Map**

## 4.3 Salinity

Regional mapping of salinity potential in Western Sydney was undertaken in 2002 by the former Department of Infrastructure, Planning and Natural Resources.

The site is located just outside the mapped area. However, the mapping indicates that the area south of Carlingford Road is within an area of moderate salinity potential, as shown in Figure 5.

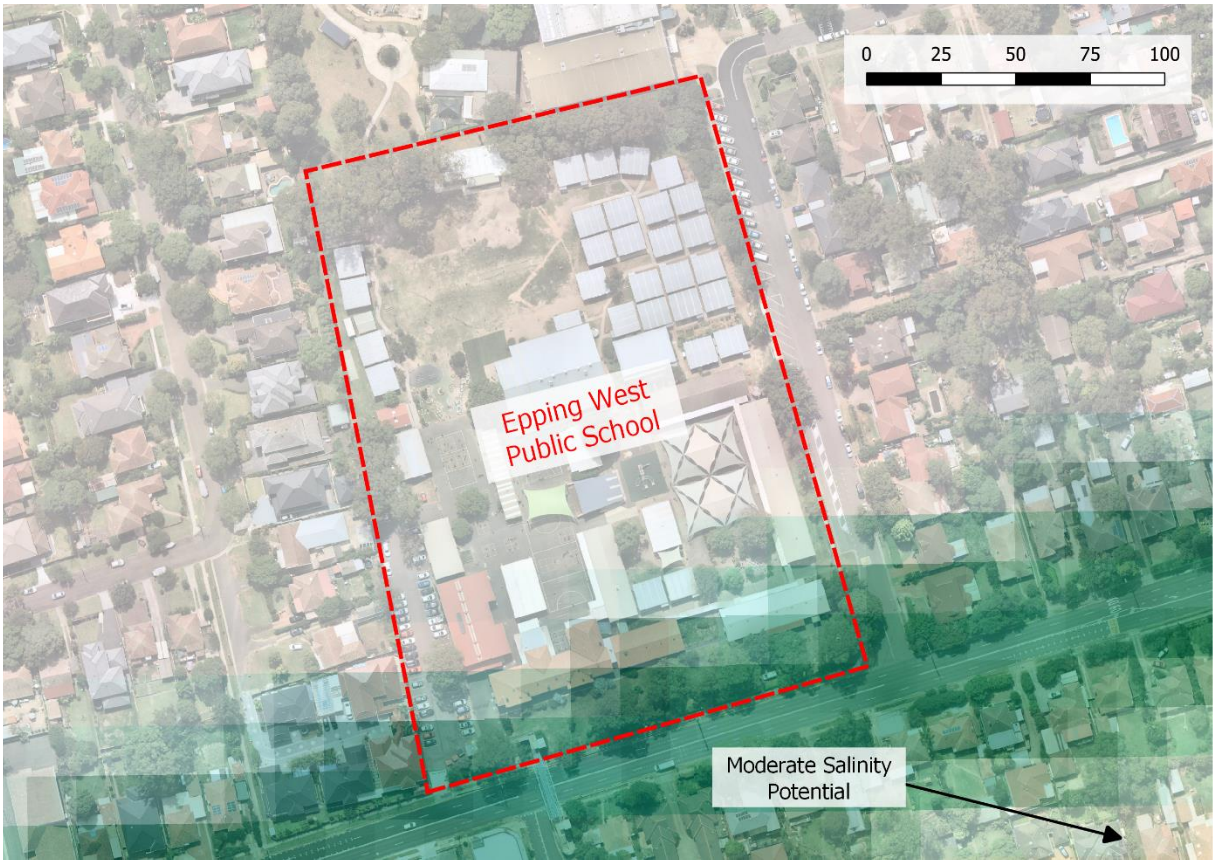

**Figure 5: Extract from Salinity Potential in Western Sydney Map (2002)**

## 4.4 Acid Sulphate Soils

Reference to the 1:25 000 Acid Sulphate Soils (ASS) Risk map indicates that the site is in an area of no known occurrence of acid sulphate soils. The nearest mapped occurrence of ASS is near Parramatta River, which is several kilometres away from EWPS.

## 4.5 Hydrogeology

No registered groundwater bores are located within 600 m of the site. There was also no groundwater observed in the previous investigation carried out on site.

## 5. Field Work Methods

The field work for the current investigation included the following:

- Drilling of four cored boreholes (BH01 to BH04) using truck-mounted and small skid-steer-mounted drilling rigs to depths of between 6.0 m and 9.6 m. Drilling was undertaken using 110 mm diameter solid flight augers and rotary wash boring 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 then extended into bedrock using NMLC diamond core drilling techniques to obtain continuous core samples of the bedrock.
- Drilling of 11 shallow boreholes (BH05 to BH15) using hand tools, a truck-mounted or small skid-steer-mounted drilling rig to depths of between 0.8 m and 2.8 m. Drilling was undertaken using a hand auger at BH05 and BH07, and 110 mm diameter solid flight augers at BH06 and BH08 to BH15. Soil samples were collected for laboratory testing in each borehole. The boreholes were terminated once residual clay was encountered.
- A dynamic cone penetrometer (DCP) test was undertaken to 1.35 m depth at BH05 to assess the soil consistency.
- Supervision of the drilling and logging of the boreholes by an experienced engineer.

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 GDA94/MGA Zone 56 format (Geocentric Datum of Australia 1994 base with Map Grid of Australia projection) and levels are relative to Australian Height Datum (AHD). The test locations are shown on Drawing 1 in Appendix B.

## 6. Field Work Results

The detailed subsurface conditions encountered are presented in the borehole logs in Appendix C. Notes defining descriptive terms and classification methods are included in Appendix A.

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

- **PAVEMENT:** asphaltic concrete was present at BH01, BH08 and BH09 to depths of 0.03 m to 0.06 m. Concrete was penetrated at BH14 to a depth of 0.1 m; overlying,
- **FILL:** Fill was encountered within all boreholes either from the ground surface or beneath the pavement to depths of between 0.2 m to 4.3 m. The fill appeared variably compacted. It included clay, silty clay, sandy clay, silty sand, clayey sand and gravelly sand with varying proportions of rootlets, roots, grass, organic matter, charcoal, wood, and igneous, shale and ironstone gravel. Inclusions of ash and glass were observed in BH11 and BH12; overlying,
- **RESIDUAL CLAY:** medium to high plasticity clay and sandy clay with varying proportions of silt, sand, ironstone and siltstone gravel. Low to high strength ironstone bands were observed within the residual clay profile. The consistency of the residual clay generally ranged from stiff to hard. BH01 to BH04 intersected residual clay down to depths of between 1.0 m to 6.0 m. BH05 to BH15 were terminated within residual clay at depths of between 0.8 m to 2.8 m; overlying

- **WEATHERED SILTSTONE & INTERLAMINATED SILTSTONE/SANDSTONE BEDROCK:** very low strength bedrock from depths of between 1.0 m and 6.0 m typically grading to low and medium strength with depth. Some weathered seams and bands of very low and low strength rock were present throughout the cored boreholes (BH01 to BH04), as well as some medium and high strength bands near the bedrock surface.

Tables 1A and 1B summarise the levels at which different materials were encountered in the boreholes. The rock classifications refer to a system developed by Pells, Douglas et al (1978) which classifies rock on the basis of strength, fracturing and defects. Class IV rock is typically very low strength and fractured whereas Class I rock is typically medium to high strength and unbroken. Lower classifications may, however, contain strong rock with significant defects and/or fracturing.

**Table 1A: Summary of Inferred Material Strata Levels**

| Stratum | Depth (m) [RL (m, AHD)] of Top of Stratum | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | BH01 | BH02 | BH03 | BH04 | BH05 | BH06 | BH07 | BH08 |
| Ground Surface (Pavement & Fill) | [119.8] | [120.0] | [120.9] | [123.1] | [120.9] | [119.6] | [119.9] | [120.2] |
| Residual Clay | 0.3<br>[119.5] | 4.3<br>[115.7] | 0.3<br>[120.7] | 0.4<br>[122.8] | 0.3<br>[120.6] | 0.7<br>[118.9] | 0.8<br>[119.1] | 0.3<br>[119.9] |
| Class IV Siltstone Bedrock | 1.0<br>[118.8] | 6.0<br>[114.0] | 3.5<br>[117.5] | 1.9<br>[121.2] | NE | NE | NE | NE |
| Class III Siltstone Bedrock | 5.3<br>[114.5] | 8.2<br>[111.8] | 5.3<br>[115.6] | 5.0<br>[118.1] | NE | NE | NE | NE |
| Base of Borehole | 6.0<br>[113.8] | 9.6<br>[110.4] | 6.9<br>[114.0] | 6.2<br>[116.9] | 0.9<br>[120.1] | 1.5<br>[118.1] | 1.0<br>[118.9] | 1.0<br>[119.2] |

Notes: NE = not encountered

**Table 1B: Summary of Inferred Material Strata Levels**

| Stratum | Depth (m) [RL (m, AHD)] of Top of Stratum | | | | | | |
|---|---|---|---|---|---|---|---|
| | BH09 | BH10 | BH11 | BH12 | BH13 | BH14 | BH15 |
| Ground Surface (Pavement & Fill) | [120.3] | [120.4] | [120.1] | [121.8] | [121.6] | [122.5] | [122.3] |
| Residual Clay | 0.4<br>[119.9] | 1.6<br>[118.8] | 2.2<br>[117.9] | 0.8<br>[121.0] | 0.3<br>[121.3] | 0.2<br>[122.3] | 0.3<br>[122.0] |
| Class IV Siltstone Bedrock | NE | NE | NE | NE | NE | NE | NE |
| Class III Siltstone Bedrock | NE | NE | NE | NE | NE | NE | NE |
| Base of Borehole | 1.0<br>[119.3] | 2.5<br>[117.9] | 2.8<br>[117.3] | 1.5<br>[120.3] | 1.0<br>[120.6] | 1.0<br>[121.5] | 1.0<br>[121.3] |

Notes: NE = not encountered

Groundwater was intersected at 2.4 m depth (RL 117.6 m AHD) during auger drilling at BH02. Free groundwater was not observed during auger drilling in any of the other boreholes. The use of drilling fluid during coring at BH01 to BH04 prevented further observations with depth.

## 7. Laboratory Testing

### 7.1 Rock

A total of 29 samples were tested for axial point load strength index ($Is_{50}$). The results ranged between 0.1 MPa and 1.5 MPa which indicate that the rock tested ranged in strength from very low to low strength to high strength. The individual results are shown on the relevant borehole logs in Appendix C.

### 7.2 Soil

Ten soil samples were sent to a NATA accredited analytical laboratory and were analysed to assess the exposure classification to steel and concrete below ground, and for assessment of soil salinity. The results for aggressivity are summarised in Table 3 and the detailed results are included in Appendix D.

**Table 3: Analytical Results for Aggressivity in Soil**

| Sample / Depth (m) | Description | pH | EC (µS/cm) | $Cl^-$ (mg/kg) | $SO_4^{2-}$ (mg/kg) | Aggressivity Classification |
|---|---|---|---|---|---|---|
| BH01 / 0.4-0.5 | CLAY | 5.1 | 200 | 45 | 270 | Mild to Concrete<br>Non-aggressive to Steel |
| BH01 / 0.9-1.0 | CLAY | 5.2 | 110 | 49 | 120 | Mild to Concrete<br>Non-aggressive to Steel |
| BH02 / 0.4-0.5 | FILL/Clayey SAND | 7.5 | 140 | <10 | 26 | Mild to Concrete<br>Non-aggressive to Steel |
| BH02 / 1.5-1.6 | FILL/CLAY | 7.9 | 56 | 22 | 55 | Non-aggressive to Concrete<br>Non-aggressive to Steel |
| BH02 / 2.5-2.95 | FILL/CLAY | 5.8 | 49 | 20 | 26 | Non-aggressive to Concrete<br>Non-aggressive to Steel |
| BH02 / 3.9-4.0 | FILL/CLAY | 5.9 | 48 | 10 | <10 | Non-aggressive to Concrete<br>Non-aggressive to Steel |
| BH03 / 0.4-0.5 | CLAY | 5.2 | 45 | 10 | 39 | Mild to Concrete<br>Non-aggressive to Steel |
| BH03 / 0.9-1.0 | CLAY | 4.8 | 70 | 10 | 66 | Mild to Concrete<br>Non-aggressive to Steel |
| BH04 / 0.4-0.5 | CLAY | 5.0 | 63 | <10 | 89 | Mild to Concrete<br>Non-aggressive to Steel |
| BH04 / 0.9-1.0 | CLAY | 5.0 | 76 | 22 | 84 | Mild to Concrete<br>Non-aggressive to Steel |

Notes: EC = electrical conductivity; $Cl^-$ = chloride ion; $SO_4^{2-}$ = sulphate ion; samples mixed with 1:5 soil:water; Aggressivity Classification per Tables 6.4.2(C) and 6.5.2(C) of AS 2159 – 2009

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 ($ECe = M \times EC_{1:5}$) 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) | Salinity Class |
|---|---|---|---|---|---|
| BH01 / 0.4-0.5 | CLAY | Medium Clay | 7 | 1.4 | Non-Saline |
| BH01 / 0.9-1.0 | CLAY | Medium Clay | 7 | 0.8 | Non-Saline |
| BH02 / 0.4-0.5 | FILL/Clayey SAND | Sandy Loam | 14 | 2.0 | Slightly Saline |
| BH02 / 1.5-1.6 | FILL/CLAY | Light-medium Clay | 8 | 0.4 | Non-Saline |
| BH02 / 2.5-2.95 | FILL/CLAY | Light Clay | 8.5 | 0.4 | Non-Saline |
| BH02 / 3.9-4.0 | FILL/CLAY | Light Clay | 8.5 | 0.4 | Non-Saline |
| BH03 / 0.4-0.5 | CLAY | Medium Clay | 7 | 0.3 | Non-Saline |
| BH03 / 0.9-1.0 | CLAY | Medium Clay | 7 | 0.5 | Non-Saline |
| BH04 / 0.4-0.5 | CLAY | Medium Clay | 7 | 0.4 | Non-Saline |
| BH04 / 0.9-1.0 | CLAY | Medium Clay | 7 | 0.5 | Non-Saline |

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 one sample for California bearing ratio (CBR), two samples 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 will be included in Appendix D.

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

| Sample / Depth (m) | Description | CBR (%) | Swell (%) | MDD ($t/m^3$) | OMC (%) | $W_P$ (%) | $W_L$ (%) | PI (%) | LS (%) | $I_{ss}$ (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| BH01 / 0.4-0.5 | CLAY | - | - | - | - | 29 | 82 | 53 | 18.5 | - |
| BH03 / 0.3-0.7 | CLAY | 5 | 0.0 | 1.63 | 21.5 | - | - | - | - | - |
| BH03 / 0.5-0.7 | CLAY | - | - | - | - | - | - | - | - | 3.0 |
| BH05 / 0.4-0.5 | CLAY | - | - | - | - | 27 | 68 | 41 | 16.0 | - |

Notes: *4-day soak, 4.5 kg surcharge, 100% Standard compaction; MDD = maximum dry density; OMC = optimum moisture content; $W_P$ = plastic limit; $W_L$ = liquid limit; PI = plasticity index; LS = linear shrinkage; $I_{ss}$ = shrink-swell index;

## 8. Geotechnical Model

The development area is underlain by variable depths of fill, typically deeper to the north-east of the site. Residual clays underlie the fill in most areas, which are derived from weathering of the Ashfield Shale and are typically stiff to hard, medium to high plasticity and moderately to highly reactive.

The fill and residual clays are underlain by a weathered Ashfield Shale profile which is initially very low strength (Class IV). The siltstone bedrock typically increases to low strength with depth (Class III) and this continued to the termination depths of the rock-cored boreholes. Defects and weathered seams were present throughout the bedrock profile, as well as bands of medium and high strength rock near the bedrock surface.

Groundwater was observed at a depth of 2.4 m (RL 117.6 m AHD) during the auger drilling at BH02, within fill. The water observed in BH02 is considered to be perched seepage within the fill rather than the regional groundwater table. 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-Sections A-A’ and B-B’ in Drawings 2 and 3 in Appendix B.

# 9. Comments

## 9.1 Proposed Development

It is understood that the proposed development will likely include construction of new school buildings up to four storeys with no basement levels. The proposed footprint of the new buildings is located near the eastern boundary of the school.

## 9.2 Site Preparation

Any existing fill that is required to support structures and pavements will need to be reworked to reduce the potential for unacceptable settlements associated with poorly or variably compacted fill. New fill should also be placed in accordance with the following specification.

The following procedure should be followed during earthworks activities:

- Strip organic-rich topsoil from areas in which new engineered fill, structures and/or pavements are proposed. A nominal depth of 0.2-0.3 m of topsoil is suggested for preliminary design estimates but this is likely to vary across the site;
- Excavate existing fill from areas in which new engineered fill, structures and/or pavements are proposed;
- Compact the exposed surface and proof-roll using a roller of 10 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. The upper 0.5 m of pavement subgrade areas should be compacted to achieve a dry density ratio of between 100% 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 above approach of complete removal and replacement of fill where pavements and structures are proposed would provide the least risk of unacceptable settlements in the fill. However, if a higher level of risk is tolerable in certain areas, specific risk assessments could be undertaken to determine whether expected settlements could be acceptable without complete removal and replacement of the fill. Alternative methods of compaction, such as impact rolling, could also be considered. Further testing in the specific areas would be necessary to inform this process. It must be noted that there will always be a higher level of risk of unacceptable differential settlement occurring for structures supported by existing fill, compared with founding within competent natural stratum or engineered fill platforms.

From a geotechnical perspective, the existing fill is likely to be suitable for re-use as engineered fill, provided that it is free of oversize particles (>100 mm) and deleterious material. The underlying residual clays are also likely to be suitable for re-use however, as they are moderately to highly reactive, it will be very important to control the moisture content of these soils 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 Excavation

Excavations might be required for services trenches or 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. It is noted that low, medium and high strength bands of siltstone and ironstone were encountered within the residual clays and weathered bedrock profile across the site. It is possible that heavy ripping equipment and/or rock hammers may be required to penetrate such layers.

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

Careful excavation near any existing buildings will be necessary to minimise ground movements and prevent damage to the buildings. The use of heavy ripping equipment and/or rock hammers 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).

## 9.4 Excavation Support

Vertical excavations within the fill, soil and weathered rock will not be stable. For slopes up to 3 m high, maximum temporary batter slopes of 1.5H:1V (Horizontal : Vertical) 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. Further advice should be sought if deeper excavations are proposed.

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

Retaining structures, if required, may be designed using the parameters in Table 6. It is suggested that preliminary design for cantilevered or walls anchored with a single row of anchors 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 $\sigma_z$ = Horizontal pressure at depth z (kPa)
$K$ = Earth pressure coefficient
$z$ = Depth (m)
$\gamma$ = Unit weight of soil or rock (kN/m$^3$)

**Table 6: Retaining Wall Design Parameters**

| Material | Unit Weight (kN/m$^3$) | Earth Pressure Coefficient | | Ultimate Passive Earth Pressure (kPa)[1] |
|---|---|---|---|---|
| | | Active ($K_a$) | At Rest ($K_0$) | |
| Fill | 20 | 0.4 | 0.7 | - |
| Very Stiff to Hard Residual Clay | 20 | 0.3 | 0.5 | 250 |
| Class IV/III Siltstone | 22 | 0.25[2] | 0.4[2] | 400[2] |

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.

The 'At Rest' coefficient ($K_0$) should be used where retaining walls are close to existing structures, to minimise ground (and wall) movements. 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. A triangular passive earth pressure distribution (increasing linearly with depth) may be assumed, starting from 0.5 m below excavation toe/base level.

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.

## 9.5 Groundwater

Groundwater was observed at a depth of 2.4 m (RL 117.6 m AHD) during the auger drilling at BH02. The regional groundwater table is expected to be deeper than the proposed excavations at the site. Some seepage along the top of bedrock and through joints and partings within the rock mass is likely.

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.

## 9.6 Foundations

Fill was encountered to depths greater than 0.4 m across the site, therefore 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.

Bored piles are also suitable for the site and these may found on weathered rock. If higher bearing pressures are required, then the rock is expected to improve with depth, but deeper 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 | 100 | - | 250 | - | 20 |
| Very Stiff to Hard Residual Clay | 200 | - | 500 | - | 35 |
| Class IV Siltstone | 1000 | 100 | 3000 | 150 | 100 |
| Class III Siltstone | 2000 | 200 | 6000 | 350 | 300 |

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

A geotechnical strength reduction factor ($\phi_g$) 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 $\phi_g$ which is based on a risk assessment. The pile designer will need to confirm a $\phi_g$ value when the piling contractor is selected, however it is suggested that a preliminary value of 0.50 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.

## 9.7 Pavements

A design California bearing ratio (CBR) of 3% is suggested for 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 should be provided to reduce the risk of the subgrade becoming saturated during the life of the pavement.

## 9.8 Salinity

The results of the laboratory testing and soil textural classification generally 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.

## 9.9 Aggressivity

The laboratory test results indicate that the samples are generally non-aggressive to mildly aggressive to buried concrete and non-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 $C_e$ are appropriate for the site.

# 10. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for this project at 96 Carlingford Road, Epping in accordance with DP’s proposal SYD200258 dated 13 March 2020. The work was carried out under the Standard Form Agreement SINSW00650/20 dated 8 April 2020. 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 DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and their agents.

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

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

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

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

The scope for work for this report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Refer to DP's Report 99674.01.R.001 for the results of the contamination assessment undertaken in conjunction with this geotechnical investigation.

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

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**Douglas Partners Pty Ltd**

# Appendix A

## About This Report

# About this Report

Douglas Partners

## Introduction

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

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

## Borehole and Test Pit Logs

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

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

## Groundwater

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

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an 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.

### Site Anomalies

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

### Information for Contractual Purposes

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

### Site Inspection

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

# Sampling Methods

## Sampling

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

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

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

## Test Pits

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

## Large Diameter Augers

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

## Continuous Spiral Flight Augers

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

## Non-core Rotary Drilling

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

## Continuous Core Drilling

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

## Standard Penetration Tests

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

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

The test results are reported in the following form.

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

  4,6,7
  N=13

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

  15, 30/40 mm

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

## Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

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

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

## Description and Classification Methods

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

## Soil Types

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

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

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

| Type | Particle size (mm) |
|---|---|
| Coarse gravel | 19 - 63 |
| Medium gravel | 6.7 - 19 |
| Fine gravel | 2.36 – 6.7 |
| Coarse sand | 0.6 - 2.36 |
| Medium sand | 0.21 - 0.6 |
| Fine sand | 0.075 - 0.21 |

Definitions of grading terms used are:

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

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

In fine grained soils (>35% fines)

| Term | Proportion of sand or gravel | Example |
|---|---|---|
| And | Specify | Clay (60%) and Sand (40%) |
| Adjective | >30% | Sandy Clay |
| With | 15 – 30% | Clay with sand |
| Trace | 0 - 15% | Clay with trace sand |

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

| Term | Proportion of fines | Example |
|---|---|---|
| And | Specify | Sand (70%) and Clay (30%) |
| Adjective | >12% | Clayey Sand |
| With | 5 - 12% | Sand with clay |
| Trace | 0 - 5% | Sand with trace clay |

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

| Term | Proportion of coarser fraction | Example |
|---|---|---|
| And | Specify | Sand (60%) and Gravel (40%) |
| Adjective | >30% | Gravelly Sand |
| With | 15 - 30% | Sand with gravel |
| Trace | 0 - 15% | Sand with trace gravel |

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

# *Soil Descriptions*

## Cohesive Soils

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

| Description | Abbreviation | Undrained shear strength (kPa) |
|---|---|---|
| Very soft | VS | <12 |
| Soft | S | 12 - 25 |
| Firm | F | 25 - 50 |
| Stiff | St | 50 - 100 |
| Very stiff | VSt | 100 - 200 |
| Hard | H | >200 |
| Friable | Fr | - |

## Cohesionless Soils

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

| Relative Density | Abbreviation | Density Index (%) |
|---|---|---|
| Very loose | VL | <15 |
| Loose | L | 15-35 |
| Medium dense | MD | 35-65 |
| Dense | D | 65-85 |
| Very dense | VD | >85 |

## Soil Origin

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

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

## Moisture Condition – Coarse Grained Soils

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

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

## Moisture Condition – Fine Grained Soils

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

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

# Rock Descriptions

## Rock Strength

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

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

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

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

## Degree of Weathering

The degree of weathering of rock is classified as follows:

| Term | Abbreviation | Description |
|---|---|---|
| Residual Soil | RS | 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. |
| Extremely weathered | XW | Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible |
| Highly weathered | HW | The whole of the rock material is discoloured, usually by iron staining or bleaching to the 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. |
| Moderately weathered | MW | The whole of the rock material is discoloured , usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock. |
| Slightly weathered | SW | Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock. |
| Fresh | FR | No signs of decomposition or staining. |
| *Note: If HW and MW cannot be differentiated use DW (see below)* | | |
| Distinctly weathered | DW | Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching or may be decreased due to deposition of weathered products in pores. |

# *Rock Descriptions*

## Degree of Fracturing

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

| Term | Description |
|---|---|
| Fragmented | Fragments of <20 mm |
| Highly Fractured | Core lengths of 20-40 mm with occasional fragments |
| Fractured | Core lengths of 30-100 mm with occasional shorter and longer sections |
| Slightly 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:

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

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

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

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

# Symbols & Abbreviations

Douglas Partners

## Introduction

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

## Drilling or Excavation Methods

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

## Water

| | |
|---|---|
| ▷ | Water seep |
| ▽ | Water level |

## Sampling and Testing

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

## Description of Defects in Rock

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

### Defect Type

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

### Orientation

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

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

### Coating or Infilling Term

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

### Coating Descriptor

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

### Shape

| | |
|---|---|
| cu | curved |
| ir | irregular |
| pl | planar |
| st | stepped |
| un | undulating |

### Roughness

| | |
|---|---|
| po | polished |
| ro | rough |
| sl | slickensided |
| sm | smooth |
| vr | very rough |

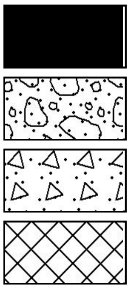
### Other

| | |
|---|---|
| fg | fragmented |
| bnd | band |
| qtz | quartz |

# *Symbols & Abbreviations*

## Graphic Symbols for Soil and Rock

### General



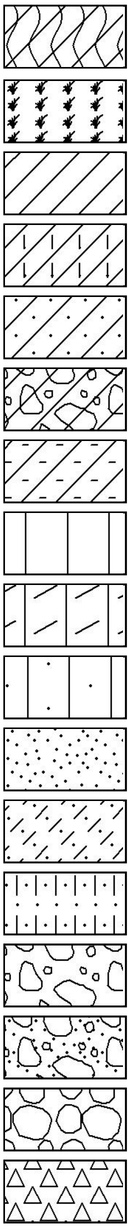
Asphalt

Road base

Concrete

Filling

### Soils



Topsoil

Peat

Clay

Silty clay

Sandy clay

Gravelly clay

Shaly clay

Silt

Clayey silt

Sandy silt

Sand

Clayey sand

Silty sand

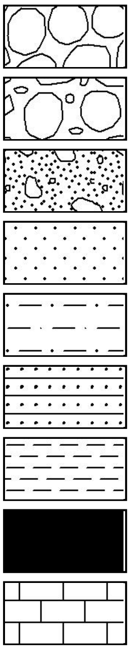
Gravel

Sandy gravel

Cobbles, boulders

Talus

### Sedimentary Rocks



Boulder conglomerate

Conglomerate

Conglomeratic sandstone

Sandstone

Siltstone

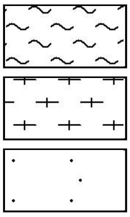
Laminite

Mudstone, claystone, shale

Coal

Limestone

### Metamorphic Rocks

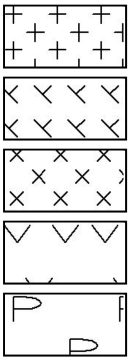


Slate, phyllite, schist

Gneiss

Quartzite

### Igneous Rocks



Granite

Dolerite, basalt, andesite

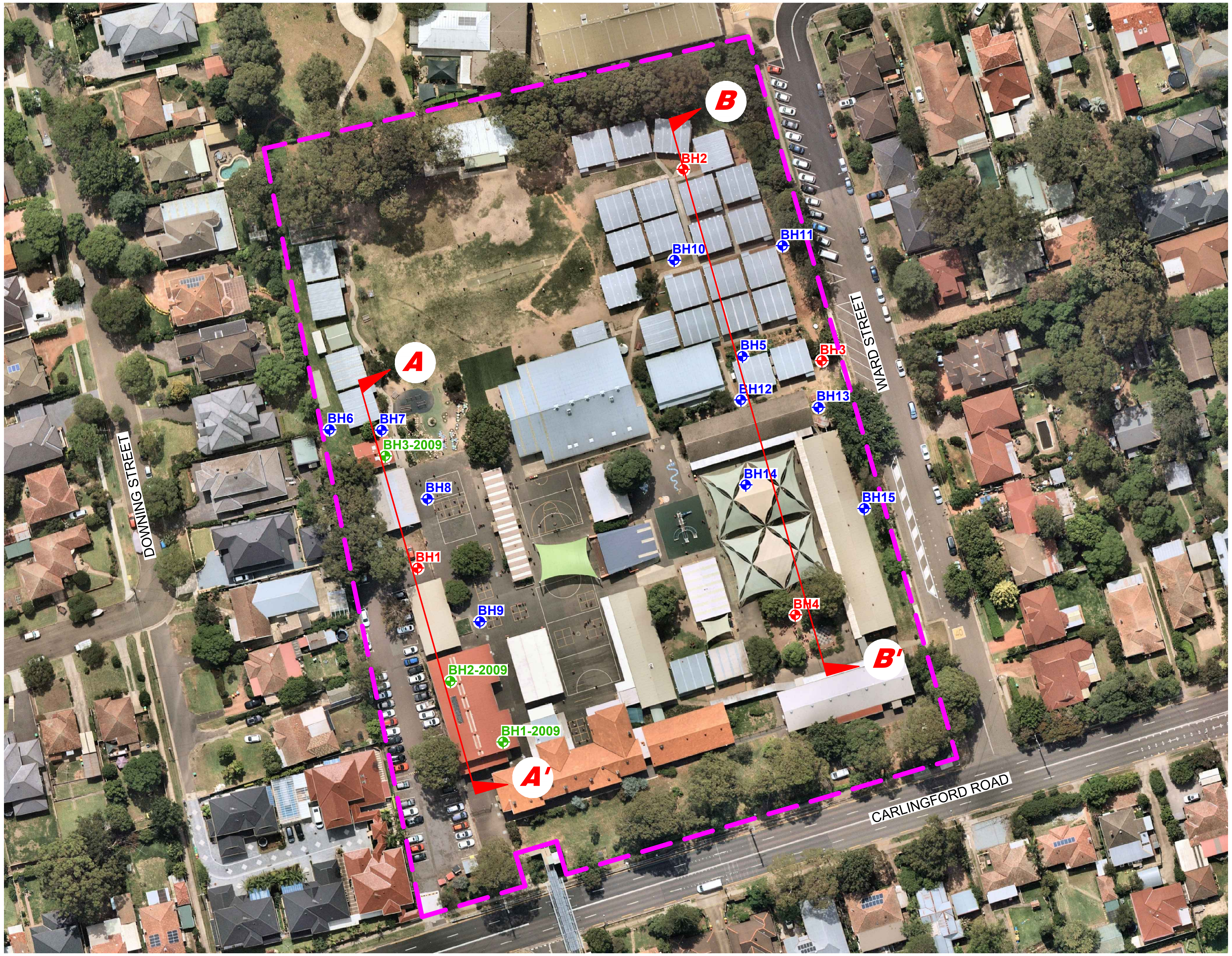
Dacite, epidote

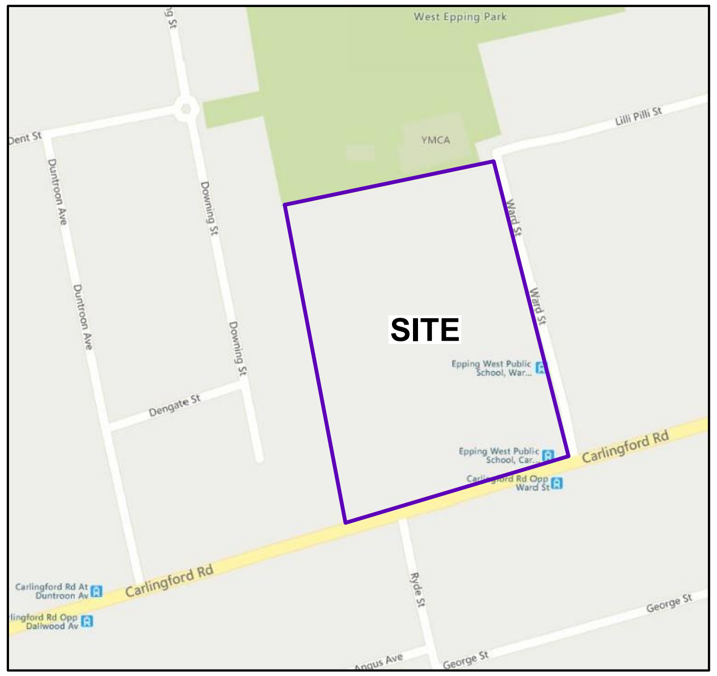
Tuff, breccia

Porphyry

# Appendix B

## Drawings





**Locality Plan**

0 5 10 20 30 40 50 75 100 125m

1:1250 @ A3

NOTE:

1: Base image from Nearmap.com (Dated 28.02.2020)

2: Borehole coordinates measured using a high-precision differential GPS

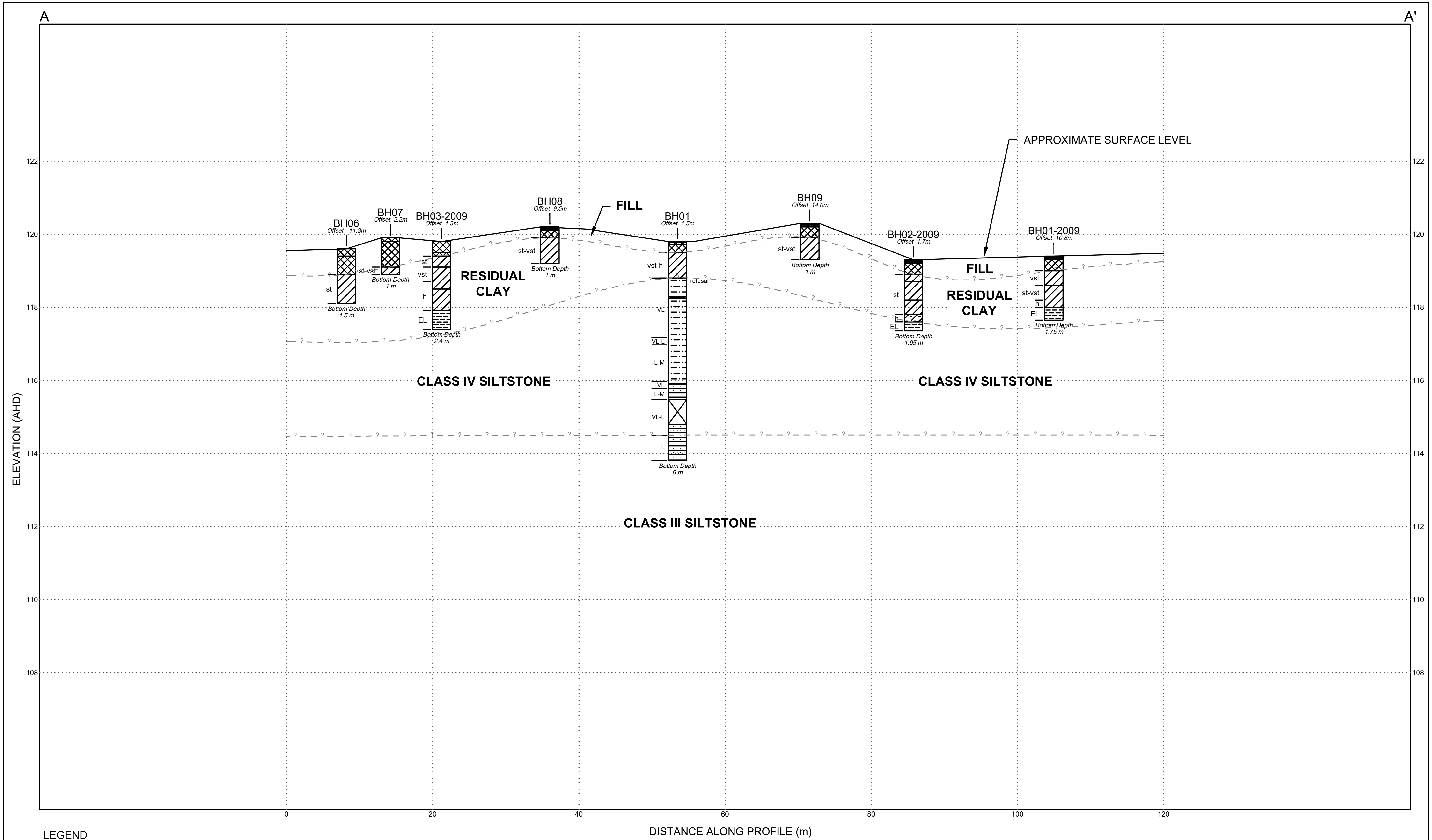
## LEGEND

- 🔴 Rock-cored Borehole
- 🔵 Augered Borehole
- 🟢 Previous Borehole (DP, 2009)
- ▬ ▬ ▬ Site Boundary
- A — A' Geotechnical Cross-section A-A'

**Douglas Partners**

*Geotechnics / Environment / Groundwater*

| | | | | |
|---|---|---|---|---|
| CLIENT: School Infrastructure NSW | | TITLE: **Borehole Location Plan** | | PROJECT No: 99674.00 |
| OFFICE: Sydney | DRAWN BY: IT | **Epping West Public School Upgrade** | N | DRAWING No: 1 |
| SCALE: 1:1250 @ A3 | DATE: 27.05.2020 | **96 Carlingford Road, Epping** | | REVISION: 0 |



LEGEND

⊠ Core Loss
■ Asphaltic Concrete
▨ Clay
▩ Filling
▤ Laminite
▤ Shale
▨ Shaly Clay
▤ Siltstone

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.

ROCK STRENGTH

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

SOIL CONSISTENCY

f - Firm
st - Stiff
vst - Very Stiff
h - Hard

TESTS / OTHER

N - Standard penetration test value
— ? — — - Interpreted geotechnical boundary
▽ - Water level

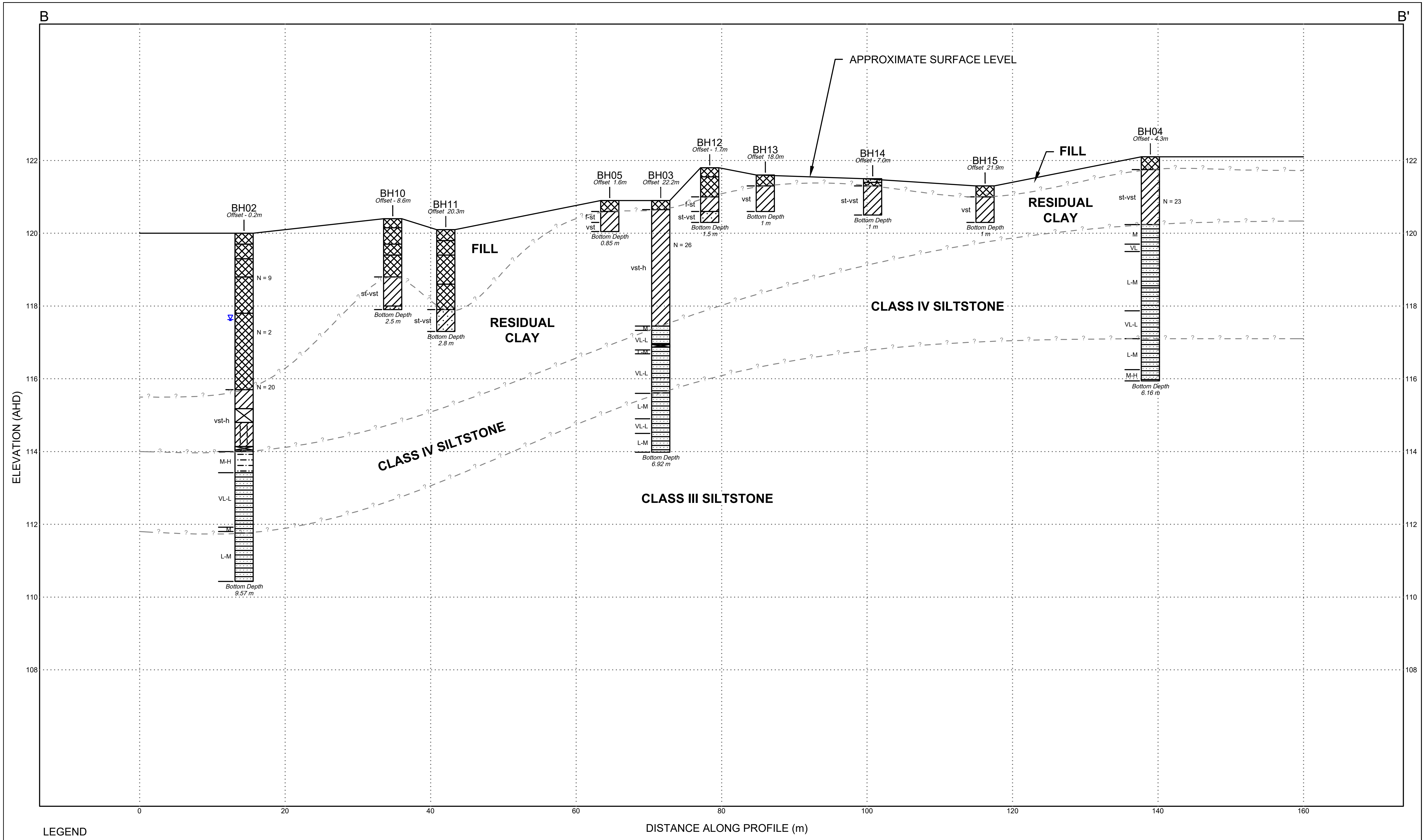
0 10
Horizontal Scale (metres)
Vertical Exaggeration = 5.0

**Douglas Partners**
Geotechnics / Environment / Groundwater

CLIENT: School Infrastructure NSW
OFFICE: Sydney
DRAWN BY: IT
SCALE: 1:500 (H) 1:100 (V) @ A3
DATE: 28.05.2020

TITLE: **Interpreted Geotechnical Cross-Section A-A'**
**Epping West School Upgrade**
**96 Carlingford Road, Epping**

PROJECT No: 99674.00
DRAWING No: 2
REVISION: 0



LEGEND

- ⊠ Core Loss
- ▨ Clay
- ▦ Concrete
- ▩ Filling
- ▤ Laminite
- ▨ Sandy Clay
- ▤ Siltstone
- ▥ Silty Clay

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.

ROCK STRENGTH

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

SOIL CONSISTENCY

f - Firm
st - Stiff
vst - Very Stiff
h - Hard

TESTS / OTHER

N - Standard penetration test value
— ? — — - Interpreted geotechnical boundary
▽ - Water level

0 10
Horizontal Scale (metres)
Vertical Exaggeration = 5.0

**Douglas Partners**
Geotechnics / Environment / Groundwater

CLIENT: School Infrastructure NSW
OFFICE: Sydney
DRAWN BY: IT
SCALE: 1:500 (H) 1:100 (V) @ A3
DATE: 28.05.2020

TITLE: **Interpreted Geotechnical Cross-Section B-B'**
**Epping West School Upgrade**
**96 Carlingford Road, Epping**

PROJECT No: 99674.00
DRAWING No: 3
REVISION: 0

# Appendix C

## Results of Field Work

# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

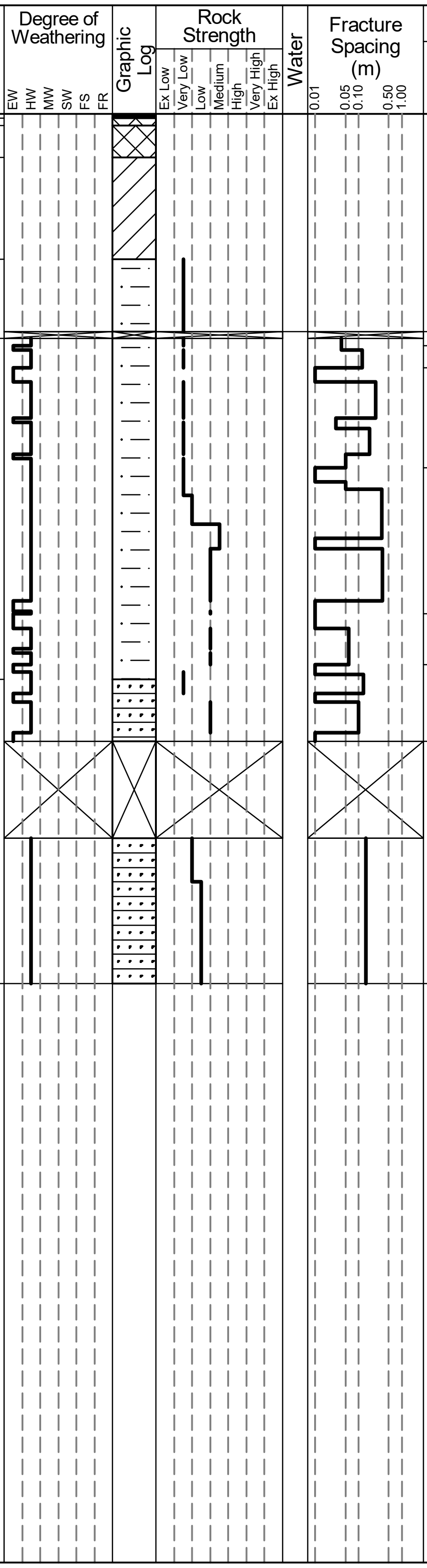
**SURFACE LEVEL:** 119.8 AHD
**EASTING:** 321050
**NORTHING:** 6261334
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH01
**PROJECT No:** 99674.00
**DATE:** 4/5/2020
**SHEET** 1 OF 1

| Depth (m) | Description of Strata |
|---|---|
| 0.03<br>0.08 | ASPHALTIC CONCRETE |
| 0.3 | FILL/Silty CLAY: low to medium plasticity, dark brown, trace igneous gravel, w<PL |
| 1.0 | FILL/CLAY: high plasticity, orange-brown, trace shale gravel and silt, apparently moderately compacted |
| 1.55 | CLAY CH: high plasticity, orange-brown, trace fine, sub-angular ironstone gravel, w<PL, apparently very stiff to hard, residual |
| | SILTSTONE: pale grey, very low strength, with clay bands, highly weathered, Ashfield Shale |
| | SILTSTONE: pale grey and orange-brown, with some clay bands, very low strength with some medium to high strength ironstone bands, highly weathered, fractured, Ashfield Shale<br>2.63m: grading to low to medium strength |
| 3.9 | INTERLAMINATED SILTSTONE AND SANDSTONE: dark grey siltstone (60%) interlaminated with fine grained, pale grey and orange-brown sandstone (40%), very low to low strength, highly weathered, fractured, Ashfield Shale |
| 5.0 | |
| 6.0 | Bore discontinued at 6.0m<br>Target depth reached |

| RL | 119 | 118 | 117 | 116 | 115 | 114 | 113 | 112 | 111 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|

| Depth | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|



**Discontinuities**

B - Bedding J - Joint
S - Shear F - Fault

Note: Unless otherwise stated, discontinuities are beddings dipping at 0°, planar and smooth with a clay coating to 10mm or iron staining

1.5m: CORE LOSS: 50mm
1.6m: Cs, 30mm
1.75m: Cs, 100mm
2.1m: Cs, 30mm
2.35m: Cs, 30mm
2.44-2.54m: fg
2.93-3m: fg
3.36m: Cs, 70mm
3.45m: Cs, 100mm
3.69m: Cs, 30mm
3.8m: Cs, 50mm
4m: Cs, 60mm
4.27m: Cs, 60mm
4.33m: CORE LOSS: 670mm
5.7m: J40-70°

**Sampling & In Situ Testing**

| Type | Core Rec. % | RQD % | Test Results & Comments |
|---|---|---|---|
| A/E | | | PID=1ppm |
| A/E<br>B | | | PID=1ppm |
| A/E<br>S | | | PID<1ppm<br>30,B<br>refusal |
| C | 95 | 0 | PL(A) = 1.5 |
| C | 100 | 50 | PL(A) = 0.1<br>PL(A) = 0.7 |
| C | 61 | 12 | PL(A) = 0.3<br>PL(A) = 0.3 |
| C | 100 | 70 | PL(A) = 0.2<br>PL(A) = 0.3 |

**RIG:** Scout 4 **DRILLER:** RKE **LOGGED:** IT **CASING:** HW to 1.0m, HQ to 1.5m
**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.0m, rotary (water) to 1.5m, NMLC coring to 6.0m
**WATER OBSERVATIONS:** No free groundwater observed whilst augering
**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

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

**Douglas Partners**
Geotechnics / Environment / Groundwater

**BORE: 1** **PROJECT: Epping West Public School Upgrade** **May 2020**

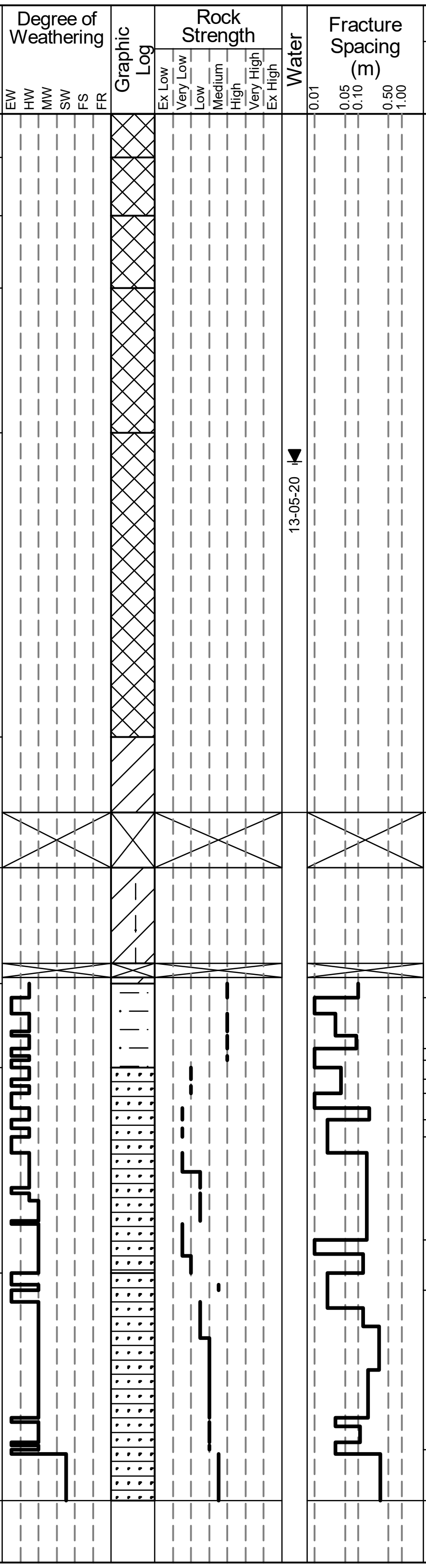
**1.50 – 6.00 m**

# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 120.0 AHD
**EASTING:** 321122
**NORTHING:** 6261442
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH02
**PROJECT No:** 99674.00
**DATE:** 13/5/2020
**SHEET** 1 OF 1



| RL | Depth (m) | Description of Strata | Water | Discontinuities<br>B - Bedding J - Joint<br>S - Shear F - Fault | Type | Core Rec. % | RQD % | Test Results & Comments |
|---|---|---|---|---|---|---|---|---|
| 120 | 0.3 | FILL/Silty SAND: fine to medium, dark grey, trace grass and rootlets, moist, apparently poorly compacted | | | A/E | | | PID=2ppm |
| | 0.7 | FILL/Clayey SAND: fine to medium, dark brown, trace silt and rootlets, w~PL, apparently poorly compacted | | | A/E | | | PID=2ppm |
| 119 | 1.2 | FILL/Silty CLAY: low plasticity, brown, with sand, igneous gravel and ironstone gravel, w~PL, apparently moderately compacted | | | A/E<br>S | | | PID=2ppm<br>3,3,6 N = 9 |
| 118 | 2.2 | FILL/CLAY: medium plasticity, orange-brown and pale grey, with ironstone and shale gravel, w~PL, apparently moderately compacted<br>1.8m: pale orange-brown and pale grey, trace siltstone gravel | | | A/E<br>A/E | | | PID=3ppm<br>PID=3ppm |
| 117<br>116 | 4.3 | FILL/CLAY: low to medium plasticity, grey-brown, with ironstone gravel, trace silt, w>PL, apparently poorly compacted<br>3.6m: dark grey and orange-brown<br>4.0m: apparently moderately compacted | 13-05-20 | | A/E<br>S<br>A/E<br>A<br>A<br>S | | | PID=2ppm<br>1,1,1 N = 2<br>PID=2ppm<br><br><br>2,5,15 N = 20 |
| 115 | 5.2 | CLAY CI: medium plasticity, pale grey and orange-brown, with low to medium strength ironstone bands, very stiff to hard, residual | | Note: Unless otherwise stated, discontinuities are beddings dipping at 0°, planar and smooth with a clay coating to 10mm or iron staining<br>4.82m: CORE LOSS: 380mm | | | | |
| | 5.96<br>6.0 | Silty CLAY CI: medium plasticity, pale grey and orange-brown, with very low to low strength siltstone bands and medium to high strength ironstone bands, very stiff to hard, extremely weathered siltstone | | 5.86m: CORE LOSS: 100mm | C | 63 | 0 | PL(A) = 1.3 |
| 114 | 6.58 | SILTSTONE: pale grey and orange-brown, very low to low strength with medium to high strength ironstone bands, highly weathered, highly fractured to fractured, Ashfield Shale | | 6.1m: Cs, 110mm<br>6.33m: Cs, 30mm<br>6.45m: Cs, 50mm<br>6.53m: Cs, 50mm | C | 92 | 8 | PL(A) = 1.4<br>PL(A) = 0.1 |
| 113 | 8.0 | INTERLAMINATED SILTSTONE AND SANDSTONE: dark grey siltstone (60%) interlaminated with fine grained, pale grey and orange-brown sandstone (40%), very low to low strength, highly weathered to moderately weathered, fractured, Ashfield Shale | | 6.66m: Cs, 50mm<br>6.76m: Cs, 100mm<br>6.94m: Cs, 60mm<br>7.06m: Cs, 110mm<br>7.41m: Cs, 40mm<br>7.64m: Cs, 20mm<br>7.77m: Ds, 100mm | | | | PL(A) = 0.2 |
| 112<br>111 | 9.57 | INTERLAMINATED SILTSTONE AND SANDSTONE: dark grey siltstone (80%) interlaminated with fine grained, pale grey and orange-brown sandstone (20%), low to medium strength, highly weathered to moderately weathered, fractured to slightly fractured, Ashfield Shale<br>9.25m: medium strength and slightly weathered | | 8m: Cs, 80mm<br>8.12m: Cs, 80mm<br>8.67m: J60°, cly vn<br>9m: Cs, 30mm<br>9.17m: Cs, 20mm<br>9.22m: Cs, 30mm | C | 100 | 63 | PL(A) = 0.4<br>PL(A) = 0.3<br>PL(A) = 0.4 |
| | | Bore discontinued at 9.57m<br>Target depth reached | | | | | | |

**RIG:** Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** HW to 4.0m, HQ to 4.82m

**TYPE OF BORING:** Solid flight auger (TC-bit) to 4.0m, rotary (water) to 4.82m, NMLC coring to 9.57m

**WATER OBSERVATIONS:** Groundwater measured at 2.4m

**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

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

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**BORE: 2 PROJECT: Epping West Public School Upgrade May 2020**

**4.82 – 9.00 m**

**BORE: 2 PROJECT: Epping West Public School Upgrade May 2020**

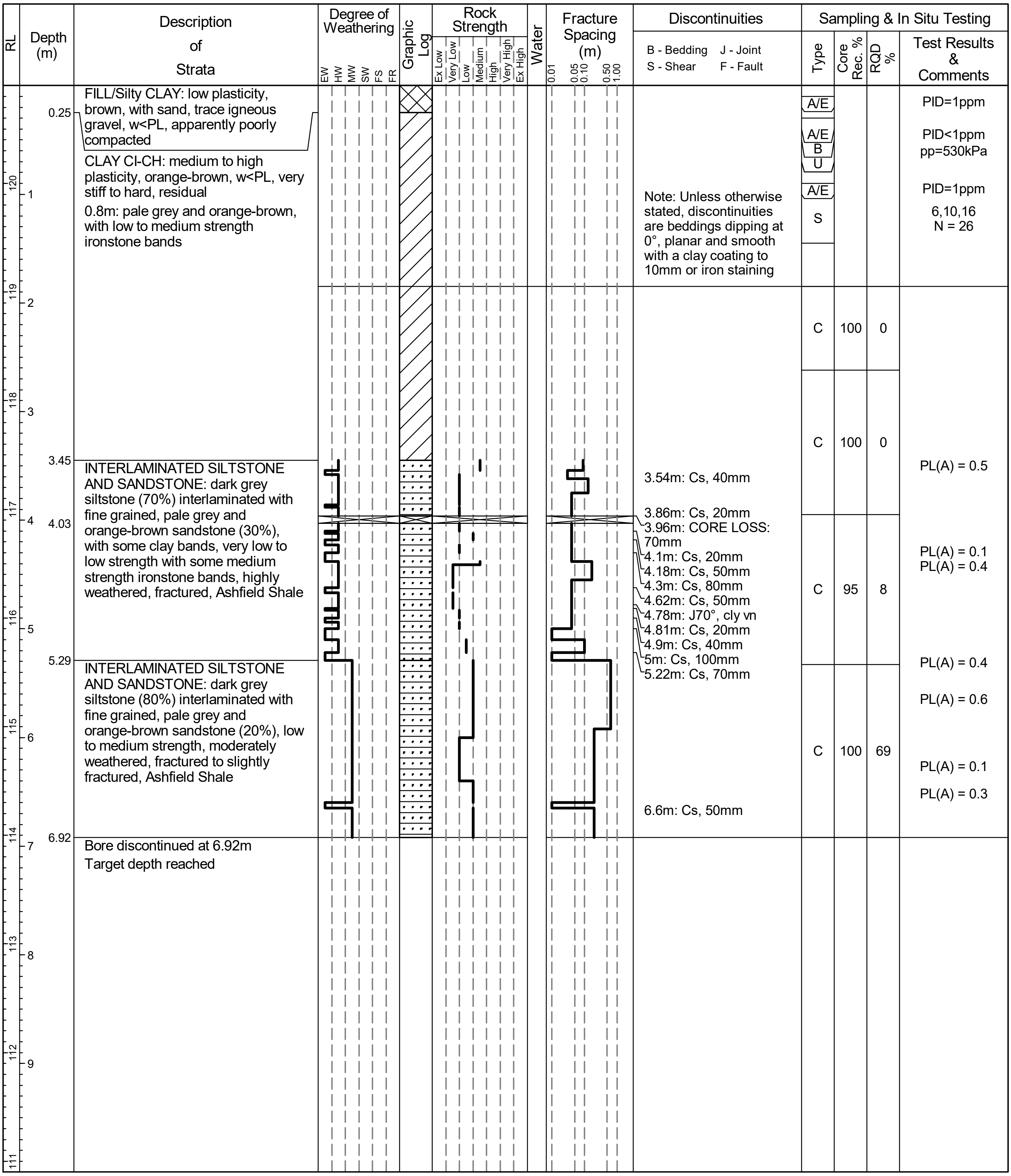
**9.00 – 9.57 m**

# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 120.9 AHD
**EASTING:** 321160
**NORTHING:** 6261390
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH03
**PROJECT No:** 99674.00
**DATE:** 12 - 13/5/2020
**SHEET** 1 OF 1



| Depth (m) | Description of Strata |
|---|---|
| | FILL/Silty CLAY: low plasticity, brown, with sand, trace igneous gravel, w<PL, apparently poorly compacted |
| 0.25 | CLAY CI-CH: medium to high plasticity, orange-brown, w<PL, very stiff to hard, residual<br>0.8m: pale grey and orange-brown, with low to medium strength ironstone bands |
| 3.45 | INTERLAMINATED SILTSTONE AND SANDSTONE: dark grey siltstone (70%) interlaminated with fine grained, pale grey and orange-brown sandstone (30%), with some clay bands, very low to low strength with some medium strength ironstone bands, highly weathered, fractured, Ashfield Shale |
| 4.03 | |
| 5.29 | INTERLAMINATED SILTSTONE AND SANDSTONE: dark grey siltstone (80%) interlaminated with fine grained, pale grey and orange-brown sandstone (20%), low to medium strength, moderately weathered, fractured to slightly fractured, Ashfield Shale |
| 6.92 | Bore discontinued at 6.92m<br>Target depth reached |

**Discontinuities**

B - Bedding J - Joint
S - Shear F - Fault

Note: Unless otherwise stated, discontinuities are beddings dipping at 0°, planar and smooth with a clay coating to 10mm or iron staining

3.54m: Cs, 40mm
3.86m: Cs, 20mm
3.96m: CORE LOSS: 70mm
4.1m: Cs, 20mm
4.18m: Cs, 50mm
4.3m: Cs, 80mm
4.62m: Cs, 50mm
4.78m: J70°, cly vn
4.81m: Cs, 20mm
4.9m: Cs, 40mm
5m: Cs, 100mm
5.22m: Cs, 70mm
6.6m: Cs, 50mm

**Sampling & In Situ Testing**

| Type | Core Rec. % | RQD % | Test Results & Comments |
|---|---|---|---|
| A/E | | | PID=1ppm |
| A/E | | | PID<1ppm |
| B | | | |
| U | | | pp=530kPa |
| A/E | | | PID=1ppm |
| S | | | 6,10,16<br>N = 26 |
| C | 100 | 0 | |
| C | 100 | 0 | PL(A) = 0.5 |
| C | 95 | 8 | PL(A) = 0.1<br>PL(A) = 0.4 |
| C | 100 | 69 | PL(A) = 0.4<br>PL(A) = 0.6<br>PL(A) = 0.1<br>PL(A) = 0.3 |

**RIG:** Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** HW to 1.0m, HQ to 1.85m

**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.0m, rotary (water) to 1.85m, NMLC coring to 6.92m

**WATER OBSERVATIONS:** No free groundwater observed whilst augering

**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

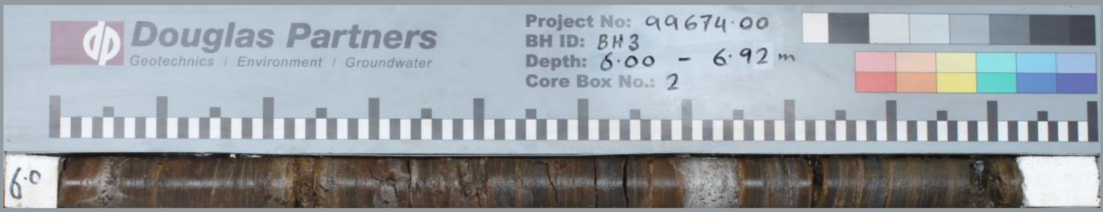
| | | | | | |
|---|---|---|---|---|---|
| A | Auger sample | G | Gas sample | PID | Photo ionisation detector (ppm) |
| B | Bulk sample | P | Piston sample | PL(A) | Point load axial test Is(50) (MPa) |
| BLK | Block sample | $U_x$ | Tube sample (x mm dia.) | PL(D) | Point load diametral test Is(50)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

**Douglas Partners**
Geotechnics / Environment / Groundwater

**BORE: 3** **PROJECT: Epping West Public School Upgrade** **May 2020**

**1.85 – 6.00 m**

**BORE: 3** **PROJECT: Epping West Public School Upgrade** **May 2020**



**6.00 – 6.92 m**

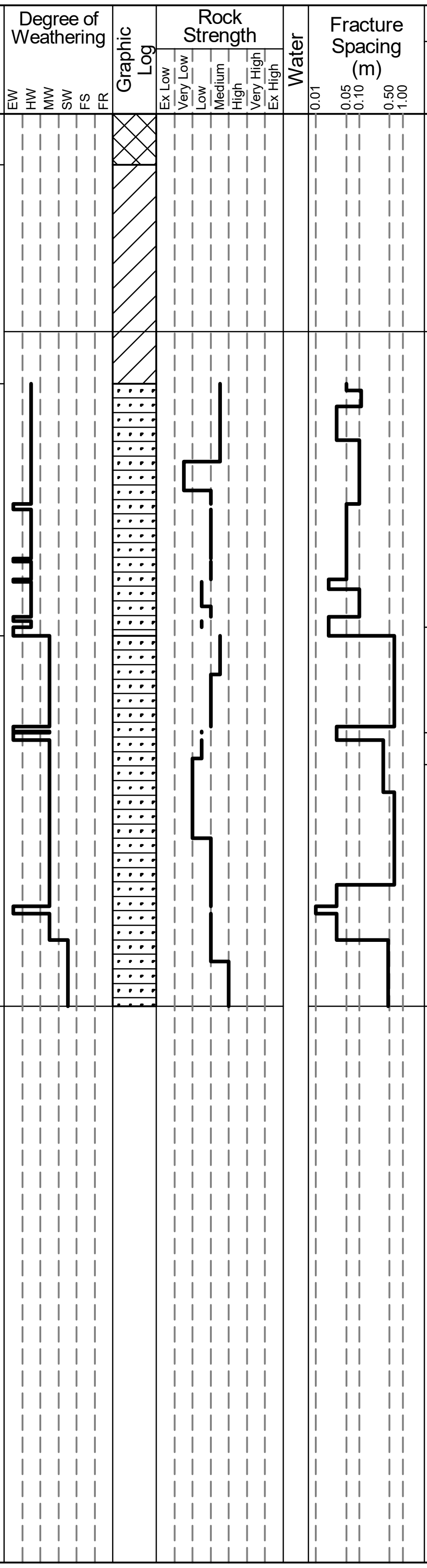
# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 123.1 AHD
**EASTING:** 321152
**NORTHING:** 6261321
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH04
**PROJECT No:** 99674.00
**DATE:** 12/5/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Discontinuities<br>B - Bedding J - Joint<br>S - Shear F - Fault | Type | Core Rec. % | RQD % | Test Results & Comments |
|---|---|---|---|---|---|---|---|
| 123 | | FILL/Silty SAND: fine to coarse, dark grey and pale brown, with fine igneous gravel, trace rootlets, clay and wood, dry, apparently poorly compacted | | A/E | | | PID<1ppm |
| | 0.35 | CLAY CI-CH: medium to high plasticity, orange-brown, with low to medium strength ironstone bands, trace silt, w<PL, stiff to very stiff, residual | Note: Unless otherwise stated, discontinuities are beddings dipping at 0°, planar and smooth with a clay coating to 10mm or iron staining | A/E | | | PID<1ppm |
| | | | | U | | | pp=400kPa |
| 122 | 1 | | | A/E | | | PID<1ppm |
| | | | | S | | | 5,8,15<br>N = 23 |
| 121 | 1.86 | SILTSTONE: pale grey and orange-brown, low to medium strength with some very low strength bands, highly weathered, fractured, Ashfield Shale | 1.86-1.95m: J90°, st<br>2.21m: J70°, st, cly vn<br>2.69m: Cs, 40mm<br>2.85-2.94m: fg, cly vn | C | 100 | 22 | PL(A) = 0.4<br>PL(A) = 0.2 |
| 120 | 3 | | 3.07m: Cs, 20mm<br>3.21m: Cs, 20mm<br>3.47m: Cs, 30mm | C | 100 | 18 | PL(A) = 0.4 |
| 119 | 3.6 | INTERLAMINATED SILTSTONE AND SANDSTONE: dark grey siltstone (70%) interlaminated with fine grained, pale grey and orange-brown sandstone (30%), low to medium strength with some very low to low strength bands, moderately weathered, slightly fractured, Ashfield Shale | 3.54m: Cs, 60mm<br>4.23m: Cs, 30mm<br>4.27m: Cs, 50mm<br>4.49-4.87m: J80-90°, ro, cly vn | C | 100 | 59 | PL(A) = 0.3<br>PL(A) = 0.2 |
| 118 | 5 | | | | | | PL(A) = 0.2 |
| 117 | | 5.70m: slightly weathered<br>5.85m: medium to high strength | 5.47m: Cs, 50mm | C | 100 | 52 | PL(A) = 0.3<br>PL(A) = 1.2 |
| | 6.16 | Bore discontinued at 6.16m<br>Target depth reached | | | | | |
| 116 | 7 | | | | | | |
| 115 | 8 | | | | | | |
| 114 | 9 | | | | | | |



**RIG:** Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** HW to 1.0m, HQ to 1.5m
**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.0m, rotary (water) to 1.5m, NMLC coring to 6.16m
**WATER OBSERVATIONS:** No free groundwater observed whilst augering
**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

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

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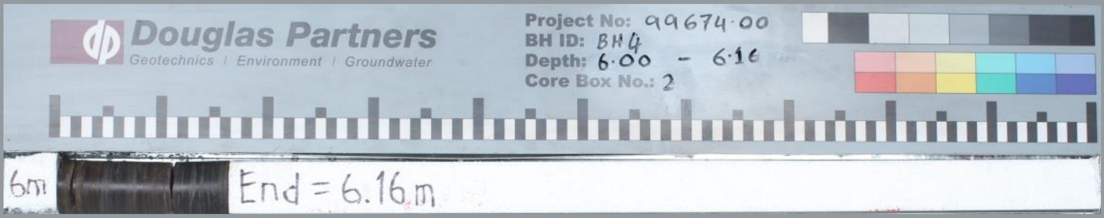
**BORE: 4 PROJECT: Epping West Public School Upgrade May 2020**

**1.50 – 6.00 m**

**BORE: 4 PROJECT: Epping West Public School Upgrade May 2020**



**6.00 – 6.16 m**

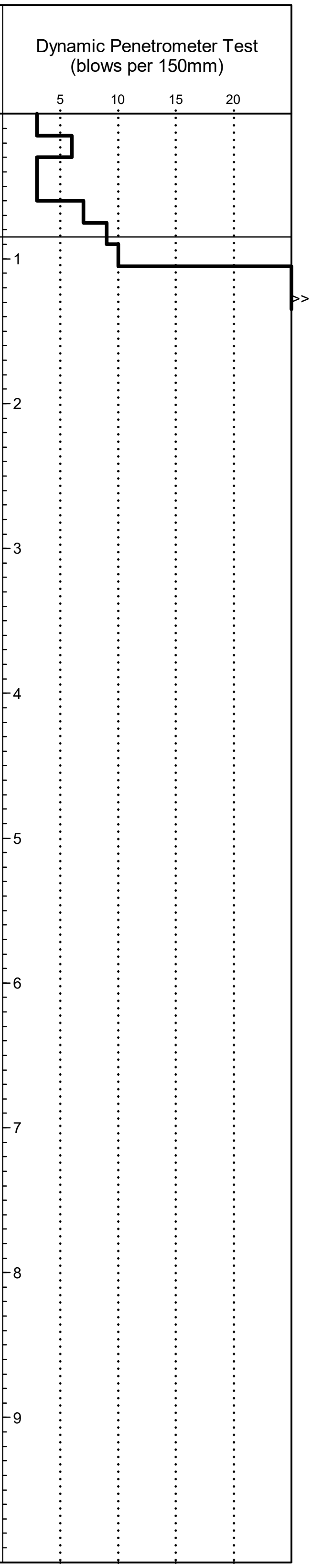
# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 120.9 AHD
**EASTING:** 321138
**NORTHING:** 6261392
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH05
**PROJECT No:** 99674.00
**DATE:** 13/5/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Sampling & In Situ Testing: Depth | Sampling & In Situ Testing: Sample | Sampling & In Situ Testing: Results & Comments | Water |
|---|---|---|---|---|---|---|---|---|
| | 0.3 | FILL/Sandy CLAY: low plasticity, brown, fine to medium sand, with fine ironstone gravel, wood and grass, trace rootlets and cloth, w<PL, apparently poorly compacted | ☒ | A/E | 0.1<br>0.2 | | PID<1ppm | |
| | 0.85 | CLAY CH: high plasticity, orange-brown, trace silt, w<PL, firm to stiff, residual<br>0.6m: very stiff | ▨ | A/E<br>A/E | 0.4<br>0.5<br>0.75<br>0.85 | | PID<1ppm<br>PID<1ppm | |
| 120 | 1 | Bore discontinued at 0.85m<br>Practical refusal in very stiff clay | | | | | | |



**RIG:** Hand tools **DRILLER:** IT **LOGGED:** IT **CASING:** Uncased
**TYPE OF BORING:** Hand auger to 0.85m
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** Location coordinates are in MGA94 Zone 56.

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

**SAMPLING & IN SITU TESTING LEGEND**

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

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# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 119.6 AHD
**EASTING:** 321026
**NORTHING:** 6261372
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH06
**PROJECT No:** 99674.00
**DATE:** 4/5/2020
**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 |
|---|---|---|---|---|---|---|---|---|---|
| | 0.2 | FILL/Silty CLAY: low plasticity, dark brown, with fine to medium sand, trace grass and rootlets, dry, apparently poorly compacted | ▩ | A/E | 0.1<br>0.2 | | PID=1ppm | | |
| | 0.7 | FILI/Gravelly SAND: fine to medium sand, dark grey, fine to medium igneous gravel, trace clay, dry, apparently poorly to moderately compacted | ▩ | A/E | 0.4<br>0.5 | | PID<1ppm | | |
| | 1.5 | CLAY CI-CH: medium to high plasticity, pale grey and orange-brown, trace silt and fine ironstone gravel, w<PL, apparently stiff, residual | ▨ | A/E<br>A/E | 0.9<br>1.0<br>1.4<br>1.5 | | PID<1ppm<br>PID<1ppm | | |
| | | Bore discontinued at 1.5m<br>Target depth reached | | | | | | | |

**RIG:** Bobcat **DRILLER:** RKE **LOGGED:** IT **CASING:** Uncased
**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.5m
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** Location coordinates are in MGA94 Zone 56. *Replicate sample BD2/IT/040520 from 0.1-0.2m

**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:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 119.9 AHD
**EASTING:** 321040
**NORTHING:** 6261372
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH07
**PROJECT No:** 99674.00
**DATE:** 4/5/2020
**SHEET** 1 OF 1

| Depth (m) | Description of Strata |
|---|---|
| 0.1 | FILL/Silty CLAY: low plasticity, dark brown, with fine to medium sand, trace grass and rootlets, dry, apparently poorly compacted |
| 0.8 | FILL/CLAY: medium to high plasticity, orange-brown, trace charcoal, w<PL, apparently moderately compacted |
| 1.0 | CLAY CI-CH: medium to high plasticity, orange-brown and pale grey, trace fine ironstone gravel, w<PL, apparently stiff to very stiff, residual |
|  | Bore discontinued at 1.0m<br>Target depth reached |

Sampling & In Situ Testing

| Type | Depth | Sample | Results & Comments |
|---|---|---|---|
| A/E | 0.0<br>0.1 |  | PID=1ppm |
| A/E | 0.15<br>0.2 |  | PID=1ppm |
| A/E | 0.4<br>0.5 |  | PID=1ppm |
| A/E | 0.9<br>1.0 |  | PID=1ppm |

**RIG:** Hand tools **DRILLER:** IT **LOGGED:** IT **CASING:** Uncased
**TYPE OF BORING:** Hand auger to 1.0m
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

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

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# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 120.2 AHD
**EASTING:** 321053
**NORTHING:** 6261353
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH08
**PROJECT No:** 99674.00
**DATE:** 4/5/2020
**SHEET** 1 OF 1

| Depth (m) | Description of Strata |
|---|---|
| 0.06 | ASPHALTIC CONCRETE |
| 0.11 | |
| 0.3 | FILL/Silty CLAY: low to medium plasticity, brown, trace fine to medium igneous gravel, w<PL |
| | FILL/CLAY: low to medium plasticity, dark grey and orange-brown, trace silt, fine sand, fine ironstone gravel and charcoal, apparently moderately compacted |
| 1.0 | CLAY CH: high plasticity, orange-brown, trace fine ironstone gravel and silt, w<PL, apparently stiff to very stiff, residual<br>0.7m: pale grey and orange-brown |
| | Bore discontinued at 1.0m<br>Target depth reached |

| Type | Depth | Sample | Results & Comments |
|---|---|---|---|
| A/E | 0.15<br>0.2 | | PID=1ppm |
| A/E | 0.4<br>0.5 | | PID=1ppm |
| A/E | 0.9<br>1.0 | | PID=1ppm |

**RIG:** Bobcat **DRILLER:** RKE **LOGGED:** IT **CASING:** Uncased
**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.0m
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** Location coordinates are in MGA94 Zone 56. *Replicate sample BD1/IT/040520 from 0.4-0.5m

**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:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 120.3 AHD
**EASTING:** 321067
**NORTHING:** 6261320
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH09
**PROJECT No:** 99674.00
**DATE:** 4/5/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing: Type | Sampling & In Situ Testing: Depth | Sampling & In Situ Testing: Sample | Sampling & In Situ Testing: Results & Comments | Water | Well Construction Details |
|---|---|---|---|---|---|---|---|---|---|
| | 0.05 | ASPHALTIC CONCRETE | | | | | | | |
| | 0.1 | FILL/Silty CLAY: low to medium plasticity, brown, trace fine to medium igneous gravel, w<PL | | A/E | 0.1<br>0.2 | | PID=1ppm | | |
| | 0.4 | FILL/CLAY: low to medium plasticity, dark grey and orange-brown, trace silt and fine ironstone gravel, w<PL, apparently moderately compacted | | A/E | 0.4<br>0.5 | | PID=1ppm | | |
| | 1.0 | CLAY CH: high plasticity, orange-brown, trace silt, w<PL, apparently stiff to very stiff, residual<br>0.8m: pale grey and orange-brown | | A/E | 0.9<br>1.0 | | PID<1ppm | | |
| | | Bore discontinued at 1.0m<br>Target depth reached | | | | | | | |

**RIG:** Bobcat **DRILLER:** RKE **LOGGED:** IT **CASING:** Uncased
**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.0m
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

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

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# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 120.4 AHD
**EASTING:** 321120
**NORTHING:** 6261418
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH10
**PROJECT No:** 99674.00
**DATE:** 13/5/2020
**SHEET** 1 OF 1

| Depth (m) | Description of Strata |
|---|---|
| 0.25 | FILL/Silty SAND: fine to medium sand, dark grey, with fine igneous gravel, trace clay, grass and rootlets, moist, apparently poorly compacted |
| 0.7 | FILL/Sandy CLAY: medium plasticity, dark grey-brown, fine to medium sand, with fine igneous gravel, trace rootlets, w~PL, apparently poorly to moderately compacted |
| 1.0 | FILL/CLAY: medium to high plasticity, orange-brown, trace charcoal, w~PL, apparently moderately to well compacted |
| 1.6 | FILL/CLAY: low to medium plasticity, grey-brown, with fine igneous gravel, trace fine sand, w~PL, apparently moderately compacted |
| 2.4 | CLAY CH: high plasticity, orange-brown, trace fine ironstone gravel, w~PL, apparently stiff to very stiff, residual |
| 2.5 | Sandy CLAY CL: low plasticity, pale grey, fine sand, with silt, trace fine siltstone gravel, residual |
| | Bore discontinued at 2.5m<br>Target depth reached |

| Type | Depth | Sample | Results & Comments |
|---|---|---|---|
| A/E | 0.1<br>0.2 | | PID=3ppm |
| A/E | 0.4<br>0.5 | | PID=2ppm |
| A/E | 0.9<br>1.0 | | PID=3ppm |
| A/E | 1.4<br>1.5 | | PID=2ppm |
| A/E | 1.9<br>2.0 | | PID=2ppm |

**RIG:** Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** Uncased
**TYPE OF BORING:** Solid flight auger (TC-bit) to 2.5m
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

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

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# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 120.1 AHD
**EASTING:** 321149
**NORTHING:** 6261422
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH11
**PROJECT No:** 99674.00
**DATE:** 13/5/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Type | Depth | Sample | Results & Comments | Water | Well Construction Details |
|---|---|---|---|---|---|---|---|---|
| 120 | | FILL/Silty SAND: fine sand, dark grey, trace clay, glass and rootlets, dry, apparently poorly compacted | A/E | 0.1<br>0.2 | | PID=2ppm | | |
| | 0.3 | FILL/Sandy CLAY: low plasticity, grey-brown, fine to medium sand, with silt and fine igneous gravel, trace charcoal, gravel and rootlets, w<PL, apparently poorly compacted | A/E | 0.4<br>0.5 | | PID=2ppm | | |
| 119 | 0.7 | FILL/Silty CLAY: low plasticity, grey and orange-brown, with fine sand and fine to medium ironstone and shale gravel, w<PL, apparently well compacted | A/E<br>A/E | 0.9<br>1.0<br>1.4<br>1.5 | | PID=2ppm<br>PID=2ppm | | |
| 118 | 1.5 | FILL/CLAY: low plasticity, dark grey, with silt and fine sand, w<PL, apparently poorly to moderately compacted | A/E | 1.9<br>2.0 | | PID=2ppm | | |
| | 2.2 | Sandy CLAY CI: medium plasticity, grey and orange-brown, with fine ironstone gravel, w<PL, residual<br>2.4m: with silstone gravel<br>2.7m: grading to extremely weathered siltstone | A/E | 2.4<br>2.5 | | PID=1ppm | | |
| 117 | 2.8 | Bore discontinued at 2.8m<br>Refusal of auger on weathered siltstone<br>Target depth reached | | | | | | |

**RIG:** Bobcat
**DRILLER:** JE
**LOGGED:** IT
**CASING:** Uncased
**TYPE OF BORING:** Solid flight auger (TC-bit) to 2.8m
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** Location coordinates are in MGA94 Zone 56. *Replicate sample BD5/IT/130520 from 1.9-2.0m

**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:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 121.8 AHD
**EASTING:** 321138
**NORTHING:** 6261380
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH12
**PROJECT No:** 99674.00
**DATE:** 12/5/2020
**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 |
|---|---|---|---|---|---|---|---|---|---|
| | 0.25 | FILL/Silty CLAY: low plasticity brown, with fine ironstone gravel and fine to medium sand, trace rootlets, w<PL, apparently poorly compacted | | A/E | 0.1<br>0.2 | | PID=1ppm | | |
| | 0.8 | FILL/CLAY: medium to high plasticity, orange-brown, with ash, trace fine sand, w<PL, apparently well compacted | | A/E | 0.4<br>0.5 | | PID=1ppm | | |
| 121 | 1.2 | CLAY CI: medium plasticity, pale grey and orange, trace fine sand, w<PL, apparently firm to stiff, residual | | A/E | 0.9<br>1.0 | | PID<1ppm | | |
| | 1.5 | Sandy CLAY CL: low plasticity, pale grey, fine to medium sand, trace fine to medium ironstone and siltstone gravel, w<PL, extremely weathered siltstone | | A/E | 1.4<br>1.5 | | PID<1ppm | | |
| 120 | | Bore discontinued at 1.5m<br>Target depth reached | | | | | | | |

**RIG:** Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** Uncased
**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.5m
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** Location coordinates are in MGA94 Zone 56. *Replicate sample BD4/IT/120520 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:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 121.6 AHD
**EASTING:** 321159
**NORTHING:** 6261378
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH13
**PROJECT No:** 99674.00
**DATE:** 12/5/2020
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing | | | | Water | Well Construction Details |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Type | Depth | Sample | Results & Comments | | |
| | | FILL/Clayey SAND: fine to coarse sand, pale brown, with fine to medium igneous and ironstone gravel, trace rootlets and silt, dry, apparently poorly compacted | ☒ | A/E | 0.1<br>0.2 | | PID<1ppm | | |
| 121 | 0.3 | CLAY CI: medium plasticity, orange-brown and pale grey, with fine sand and silt, trace fine siltstone and ironstone gravel, w<PL, apparently very stiff, residual | ▨ | A/E | 0.4<br>0.5 | | PID<1ppm | | |
| | 1 1.0 | Bore discontinued at 1.0m<br>Target depth reached | | | | | | | 1 |
| 120 | 2 | | | | | | | | 2 |
| 119 | 3 | | | | | | | | 3 |
| 118 | 4 | | | | | | | | 4 |
| 117 | 5 | | | | | | | | 5 |
| 116 | 6 | | | | | | | | 6 |
| 115 | 7 | | | | | | | | 7 |
| 114 | 8 | | | | | | | | 8 |
| 113 | 9 | | | | | | | | 9 |
| 112 | | | | | | | | | |

**RIG:** Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** Uncased

**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.0m

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

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

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# BOREHOLE LOG

**CLIENT:** School Infrastructure NSW
**PROJECT:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 122.5 AHD
**EASTING:** 321139
**NORTHING:** 6261357
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH14
**PROJECT No:** 99674.00
**DATE:** 12/5/2020
**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 | CONCRETE | | | | | | | |
| 122 | 0.2 | FILL/Silty CLAY: low to medium plasticity, dark brown, trace igneous gravel, w<PL, apparently moderately compacted | | A/E<br>A/E | 0.2<br>0.3<br>0.4<br>0.5 | | PID<1ppm<br>PID<1ppm | | |
| | 1   1.0 | CLAY CI-CH: medium to high plasticity, orange-brown and red-brown, trace fine ironstone gravel, w>PL, apparently stiff to very stiff, residual<br>0.7m: pale grey, trace siltstone gravel | | A/E | 0.9<br>1.0 | | PID<1ppm | | 1 |
| 121 | | Bore discontinued at 1.0m<br>Target depth reached | | | | | | | |

**RIG:** Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** Uncased

**TYPE OF BORING:** Diacore to 0.15m, solid flight auger (TC-bit) to 1.0m

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Location coordinates are in MGA94 Zone 56. *Replicate sample BD3/IT/120520 from 0.2-0.3m

**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:** Epping West Public School Upgrade
**LOCATION:** 96 Carlingford Road, Epping

**SURFACE LEVEL:** 122.3 AHD
**EASTING:** 321171
**NORTHING:** 6261350
**DIP/AZIMUTH:** 90°/--

**BORE No:** BH15
**PROJECT No:** 99674.00
**DATE:** 12/5/2020
**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 |
|---|---|---|---|---|---|---|---|---|---|
| 122 | 0.3 | FILL/Silty CLAY: low plasticity, brown, trace fine to medium sand, rootlets and grass, w<PL, apparently poorly compacted | ☒ | A/E | 0.1<br>0.2 | | PID<1ppm | | |
| | 1.0 | CLAY CI: medium plasticity, orange-brown and pale grey, trace fine ironstone gravel, w<PL, apparently very stiff, residual | ▨ | A/E | 0.4<br>0.5 | | PID<1ppm | | |
| 121 | | Bore discontinued at 1.0m<br>Target depth reached | | | | | | | |

**RIG:** Bobcat **DRILLER:** JE **LOGGED:** IT **CASING:** Uncased

**TYPE OF BORING:** Solid flight auger (TC-bit) to 1.0m

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** Location coordinates are in MGA94 Zone 56.

**SAMPLING & IN SITU TESTING LEGEND**

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

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Geotechnics / Environment / Groundwater

# Appendix D

## Laboratory Test Results

# Material Test Report

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

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Andrew Hutchings
Laboratory Manager
NATA Accredited Laboratory Number: 828

**Report Number:** **99674.00-1**
**Issue Number:** 1
**Date Issued:** 09/06/2020
**Client:** School Infrastructure New South Wales (SINSW)
Level 7, 259 George Street, Sydney NSW 2000
**Contact:** Gina Gou
**Project Number:** 99674.00
**Project Name:** Proposed Epping West Public School Upgrade
**Project Location:** 96 Carlingford Road, EPPING
**Work Request:** 6120
**Sample Number:** SY-6120A
**Date Sampled:** 04/05/2020
**Dates Tested:** 19/05/2020 - 20/05/2020
**Sampling Method:** Sampled by Engineering Department
*The results apply to the sample as received*
**Sample Location:** **BH1 (0.4-0.5m)**
**Material:** FILL/CLAY: high plasticity, orange-brown, trace shale gravel and silt

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|---|---|---|---|
| Sample History | Oven Dried | | |
| Preparation Method | Dry Sieve | | |
| Liquid Limit (%) | 82 | | |
| Plastic Limit (%) | 29 | | |
| **Plasticity Index (%)** | **53** | | |

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

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NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Andrew Hutchings
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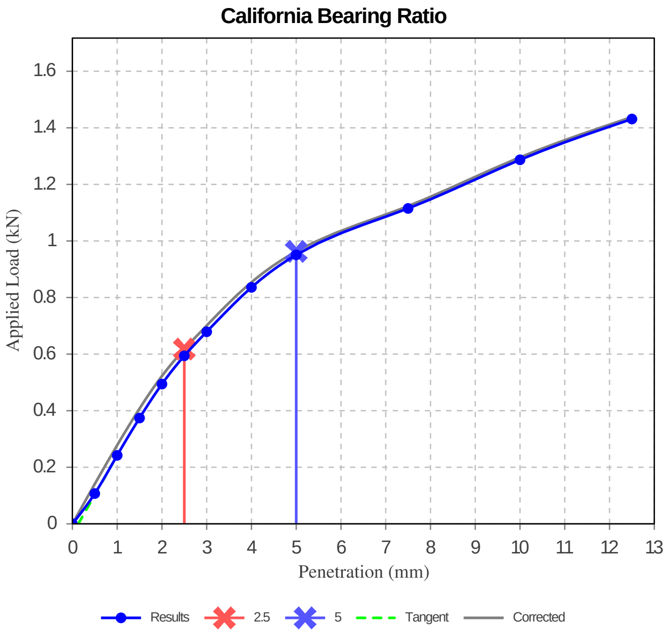
**Report Number:** **99674.00-1**
**Issue Number:** 1
**Date Issued:** 09/06/2020
**Client:** School Infrastructure New South Wales (SINSW)
Level 7, 259 George Street, Sydney NSW 2000
**Contact:** Gina Gou
**Project Number:** 99674.00
**Project Name:** Proposed Epping West Public School Upgrade
**Project Location:** 96 Carlingford Road, EPPING
**Work Request:** 6120
**Sample Number:** SY-6120B
**Date Sampled:** 04/05/2020
**Dates Tested:** 19/05/2020 - 05/06/2020
**Sampling Method:** Sampled by Engineering Department
*The results apply to the sample as received*
**Sample Location:** **BH3 (0.3-0.7m)**
**Material:** CLAY CI-CH: medium to high plasticity, orange-brown

| California Bearing Ratio (AS 1289 6.1.1 & 2.1.1) | | Min | Max |
|---|---|---|---|
| CBR taken at | 5 mm | | |
| CBR % | **5.0** | | |
| Method of Compactive Effort | Standard | | |
| Method used to Determine MDD | AS 1289 5.1.1 & 2.1.1 | | |
| Method used to Determine Plasticity | Visual Assessment | | |
| Maximum Dry Density (t/m$^3$) | 1.63 | | |
| Optimum Moisture Content (%) | 21.5 | | |
| Laboratory Density Ratio (%) | 100.0 | | |
| Laboratory Moisture Ratio (%) | 101.5 | | |
| Dry Density after Soaking (t/m$^3$) | 1.63 | | |
| Field Moisture Content (%) | 21.1 | | |
| Moisture Content at Placement (%) | 21.9 | | |
| Moisture Content Top 30mm (%) | 25.8 | | |
| Moisture Content Rest of Sample (%) | 23.1 | | |
| Mass Surcharge (kg) | 4.5 | | |
| Soaking Period (days) | 4 | | |
| Curing Hours | 120.5 | | |
| Swell (%) | 0.0 | | |
| Oversize Material (mm) | 19 | | |
| Oversize Material Included | Excluded | | |
| Oversize Material (%) | 1.9 | | |



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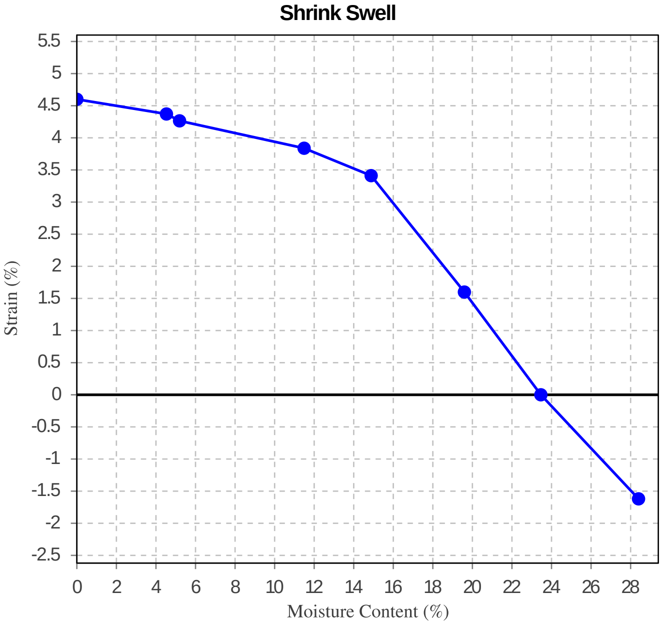
**Client:** School Infrastructure New South Wales (SINSW)
Level 7, 259 George Street, Sydney NSW 2000
**Contact:** Gina Gou
**Project Number:** 99674.00
**Project Name:** Proposed Epping West Public School Upgrade
**Project Location:** 96 Carlingford Road, EPPING
**Work Request:** 6120
**Sample Number:** SY-6120C
**Date Sampled:** 04/05/2020
**Dates Tested:** 19/05/2020 - 19/05/2020
**Sampling Method:** Sampled by Engineering Department
*The results apply to the sample as received*
**Sample Location:** **BH3 (0.5-0.7m)**
**Material:** CLAY CI-CH: medium to high plasticity, orange-brown

| Shrink Swell Index (AS 1289 7.1.1 & 2.1.1) | |
|---|---|
| **Iss (%)** | **3.0** |
| Visual Description | CLAY : orange-brown |
| * Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction. | |

| Core Shrinkage Test | |
|---|---|
| **Shrinkage Strain - Oven Dried (%)** | **4.6** |
| Estimated % by volume of significant inert inclusions | 1 |
| Cracking | Slightly Cracked |
| Crumbling | No |
| Moisture Content (%) | 23.5 |

| Swell Test | |
|---|---|
| Initial Pocket Penetrometer (kPa) | 320 |
| Final Pocket Penetrometer (kPa) | 260 |
| Initial Moisture Content (%) | 23.1 |
| Final Moisture Content (%) | 28.4 |
| **Swell (%)** | **1.6** |
| * NATA Accreditation does not cover the performance of pocket penetrometer readings. | |



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NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Andrew Hutchings
Laboratory Manager
NATA Accredited Laboratory Number: 828

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|---|---|
| **Report Number:** | **99674.00-1** |
| **Issue Number:** | 1 |
| **Date Issued:** | 09/06/2020 |
| **Client:** | School Infrastructure New South Wales (SINSW)<br>Level 7, 259 George Street, Sydney NSW 2000 |
| **Contact:** | Gina Gou |
| **Project Number:** | 99674.00 |
| **Project Name:** | Proposed Epping West Public School Upgrade |
| **Project Location:** | 96 Carlingford Road, EPPING |
| **Work Request:** | 6120 |
| **Sample Number:** | SY-6120D |
| **Date Sampled:** | 04/05/2020 |
| **Dates Tested:** | 19/05/2020 - 20/05/2020 |
| **Sampling Method:** | Sampled by Engineering Department<br>*The results apply to the sample as received* |
| **Sample Location:** | **BH5 (0.4-0.5m)** |
| **Material:** | CLAY CH: high plasticity, orange-brown, trace silt |

| Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1) | | Min | Max |
|---|---|---|---|
| Sample History | Oven Dried | | |
| Preparation Method | Dry Sieve | | |
| Liquid Limit (%) | 68 | | |
| Plastic Limit (%) | 27 | | |
| **Plasticity Index (%)** | **41** | | |

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

**Envirolab Services Pty Ltd**
ABN 37 112 535 645
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www.envirolab.com.au

# CERTIFICATE OF ANALYSIS 243223

## Client Details

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

## Sample Details

| | |
|---|---|
| **Your Reference** | **99674.00, Epping West Public School** |
| **Number of Samples** | 9 SOIL |
| **Date samples received** | 19/05/2020 |
| **Date completed instructions received** | 19/05/2020 |

## Analysis Details

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

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

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

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

## Report Details

| | |
|---|---|
| **Date results requested by** | 26/05/2020 |
| **Date of Issue** | 26/05/2020 |

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

**Results Approved By**
Priya Samarawickrama, Senior Chemist

**Authorised By**

Nancy Zhang, Laboratory Manager

| Misc Inorg - Soil | | | | | | |
|---|---|---|---|---|---|---|
| Our Reference | | 243223-1 | 243223-2 | 243223-3 | 243223-4 | 243223-5 |
| Your Reference | UNITS | BH1 | BH2 | BH2 | BH2 | BH2 |
| Depth | | 0.4-0.5 | 0.4-0.5 | 1.5-1.6 | 2.5-2.95 | 3.9-4.0 |
| Date Sampled | | 04/05/2020 | 13/05/2020 | 13/05/2020 | 13/05/2020 | 13/05/2020 |
| Type of sample | | SOIL | SOIL | SOIL | SOIL | SOIL |
| Date prepared | - | 21/05/2020 | 21/05/2020 | 21/05/2020 | 21/05/2020 | 21/05/2020 |
| Date analysed | - | 21/05/2020 | 21/05/2020 | 21/05/2020 | 21/05/2020 | 21/05/2020 |
| pH 1:5 soil:water | pH Units | 5.1 | 7.5 | 7.9 | 5.8 | 5.9 |
| Electrical Conductivity 1:5 soil:water | µS/cm | 200 | 140 | 56 | 49 | 48 |
| Chloride, Cl 1:5 soil:water | mg/kg | 45 | <10 | 22 | 20 | 10 |
| Sulphate, SO4 1:5 soil:water | mg/kg | 270 | 26 | 55 | 26 | <10 |

| Misc Inorg - Soil | | | | | |
|---|---|---|---|---|---|
| Our Reference | | 243223-6 | 243223-7 | 243223-8 | 243223-9 |
| Your Reference | UNITS | BH3 | BH3 | BH4 | BH4 |
| Depth | | 0.4-0.5 | 0.9-1.0 | 0.4-0.5 | 0.9-1.0 |
| Date Sampled | | 12/05/2020 | 12/05/2020 | 12/05/2020 | 12/05/2020 |
| Type of sample | | SOIL | SOIL | SOIL | SOIL |
| Date prepared | - | 21/05/2020 | 21/05/2020 | 21/05/2020 | 21/05/2020 |
| Date analysed | - | 21/05/2020 | 21/05/2020 | 21/05/2020 | 21/05/2020 |
| pH 1:5 soil:water | pH Units | 5.2 | 4.8 | 5.0 | 5.0 |
| Electrical Conductivity 1:5 soil:water | µS/cm | 45 | 70 | 63 | 76 |
| Chloride, Cl 1:5 soil:water | mg/kg | 10 | 10 | <10 | 22 |
| Sulphate, SO4 1:5 soil:water | mg/kg | 39 | 66 | 89 | 84 |

| 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.<br>Alternatively determined by colourimetry/turbidity using Discrete Analyser. |

## Client Reference: 99674.00, Epping West Public School

| QUALITY CONTROL: Misc Inorg - Soil | | | | | Duplicate | | | | Spike Recovery % | |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Description | Units | PQL | Method | Blank | # | Base | Dup. | RPD | LCS-1 | 243223-5 |
| Date prepared | - | | | 21/05/2020 | 1 | 21/05/2020 | 21/05/2020 | | 21/05/2020 | 26/05/2020 |
| Date analysed | - | | | 21/05/2020 | 1 | 21/05/2020 | 21/05/2020 | | 21/05/2020 | 26/05/2020 |
| pH 1:5 soil:water | pH Units | | Inorg-001 | [NT] | 1 | 5.1 | 5.0 | 2 | 101 | [NT] |
| Electrical Conductivity 1:5 soil:water | µS/cm | 1 | Inorg-002 | <1 | 1 | 200 | 190 | 5 | 102 | [NT] |
| Chloride, Cl 1:5 soil:water | mg/kg | 10 | Inorg-081 | <10 | 1 | 45 | 37 | 20 | 89 | 95 |
| Sulphate, SO4 1:5 soil:water | mg/kg | 10 | Inorg-081 | <10 | 1 | 270 | 260 | 4 | 101 | 99 |

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

## Quality Control Definitions

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

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

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

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

## Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

## Report Comments

pH/EC

Samples were out of the recommended holding time for this analysis.

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customerservice@envirolab.com.au
www.envirolab.com.au

# CERTIFICATE OF ANALYSIS 242433-A

## Client Details

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

## Sample Details

| | |
|---|---|
| **Your Reference** | **99674.01, Epping West** |
| **Number of Samples** | 7 soil |
| **Date samples received** | 07/05/2020 |
| **Date completed instructions received** | 19/05/2020 |

## Analysis Details

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

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

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

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

## Report Details

| | |
|---|---|
| **Date results requested by** | 26/05/2020 |
| **Date of Issue** | 26/05/2020 |

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**Results Approved By**
Priya Samarawickrama, Senior Chemist

**Authorised By**

Nancy Zhang, Laboratory Manager

| Misc Inorg - Soil | | |
|---|---|---|
| Our Reference | | 242433-A-1 |
| Your Reference | UNITS | 1 |
| Depth | | 0.9-1 |
| Date Sampled | | 04/05/2020 |
| Type of sample | | soil |
| Date prepared | - | 21/05/2020 |
| Date analysed | - | 21/05/2020 |
| pH 1:5 soil:water | pH Units | 5.2 |
| Electrical Conductivity 1:5 soil:water | µS/cm | 110 |
| Chloride, Cl 1:5 soil:water | mg/kg | 49 |
| Sulphate, SO4 1:5 soil:water | mg/kg | 120 |

| 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.<br>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 | - | | | 21/05/2020 | [NT] | [NT] | [NT] | [NT] | 21/05/2020 | [NT] |
| Date analysed | - | | | 21/05/2020 | [NT] | [NT] | [NT] | [NT] | 21/05/2020 | [NT] |
| pH 1:5 soil:water | pH Units | | Inorg-001 | [NT] | [NT] | [NT] | [NT] | [NT] | 101 | [NT] |
| Electrical Conductivity 1:5 soil:water | µS/cm | 1 | Inorg-002 | <1 | [NT] | [NT] | [NT] | [NT] | 101 | [NT] |
| Chloride, Cl 1:5 soil:water | mg/kg | 10 | Inorg-081 | <10 | [NT] | [NT] | [NT] | [NT] | 89 | [NT] |
| Sulphate, SO4 1:5 soil:water | mg/kg | 10 | Inorg-081 | <10 | [NT] | [NT] | [NT] | [NT] | 101 | [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. |
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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

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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.

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

## Report Comments

pH/EC
Samples were out of the recommended holding time for this analysis.

# Appendix E

## Borehole Logs from Previous Investigation

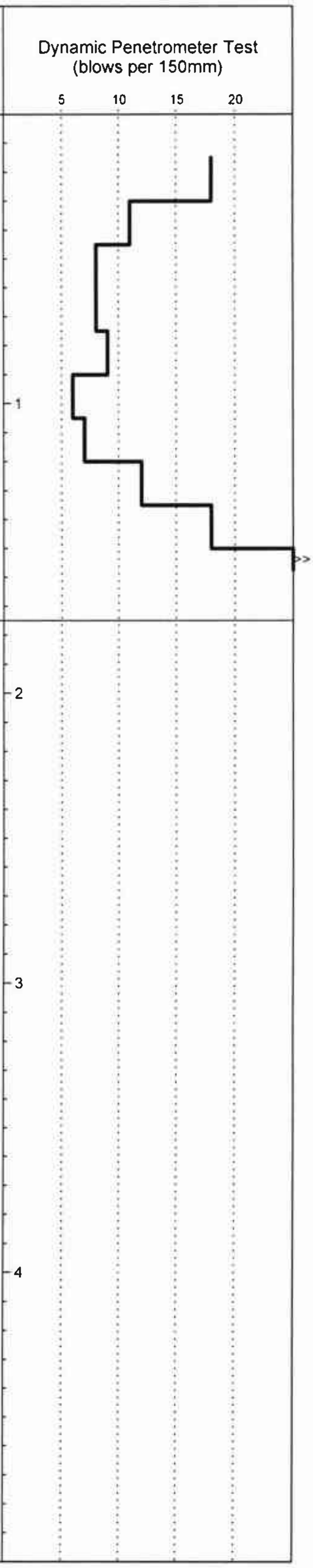
# BOREHOLE LOG

**CLIENT:** Bovis Lend Lease
**PROJECT:** Building The Education Revolution
**LOCATION:** Epping West Public School, Epping

**SURFACE LEVEL:** 119.4 AHD*
**EASTING:**
**NORTHING:**
**DIP/AZIMUTH:** 90°/--

**BORE No:** 1
**PROJECT No:** 71182.60
**DATE:** 24 Sep 09
**SHEET** 1 **OF** 1

| RL | Depth (m) | Description of Strata | Graphic Log | Type | Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|---|
| | | ASPHALTIC CONCRETE | ■ | | | | | |
| | 0.1 | FILLING - dark brown, silty clay filling with trace of gravel and rootlets, damp | ▨ | E | 0.1<br>0.2 | | | |
| 119 | 0.4 | CLAY - very stiff, mottled brown clay with trace of ironstone gravel, damp | ▨ | E | 0.4<br>0.5 | | | |
| | | | | A | 0.5<br>0.6 | | | |
| | 0.8 | CLAY - stiff to very stiff, grey mottled brown and red clay, with trace of ironstone gravel, moist | ▨ | E/A | 0.9<br>1.0 | | | |
| | | 1.2m: becoming hard | | | | | | |
| 118 | 1.4 | SHALE - extremely low strength, light grey and red brown, shale with grey clay bands, moist<br>- becoming grey ironstained red | ▤ | A | 1.4<br>1.5 | | | |
| | | | | A | 1.6<br>1.7 | | | |
| | 1.75 | Bore discontinued at 1.75m<br>- refusal on extremely low strength shale | | | | | | |



**RIG:** Bobcat
**DRILLER:** S Gregor
**LOGGED:** AHP
**CASING:** Uncased
**TYPE OF BORING:** 100mm diameter solid flight auger with TC-bit
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** E = Environmental sample
*Surface level interpolated from survey drawing

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

**SAMPLING & IN SITU TESTING LEGEND**

| | | | |
|---|---|---|---|
| A | Auger sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | PID | Photo ionisation detector |
| B | Bulk sample | S | Standard penetration test |
| $U_x$ | Tube sample (x mm dia.) | PL | Point load strength Is(50) MPa |
| W | Water sample | V | Shear Vane (kPa) |
| C | Core drilling | ▷ | Water seep |
| | | ▼ | Water level |

CHECKED
Initials: AV
Date: 21.10.09

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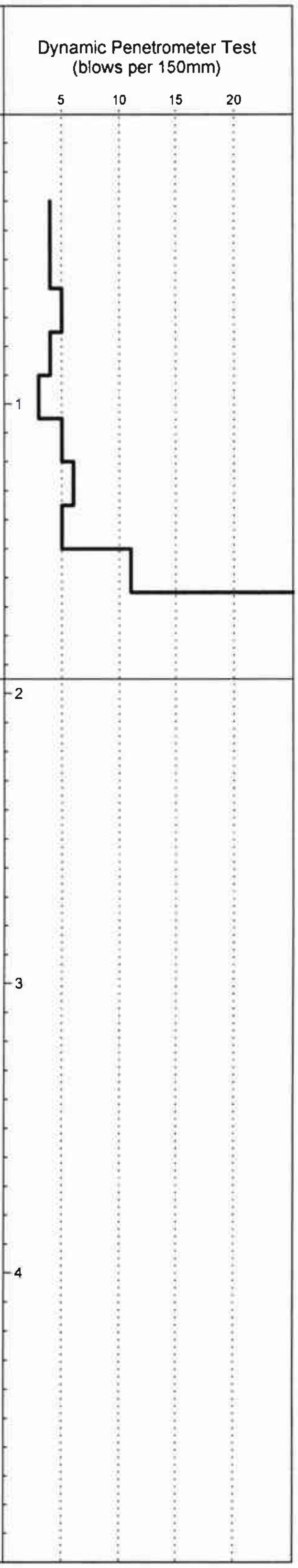
# BOREHOLE LOG

**CLIENT:** Bovis Lend Lease
**PROJECT:** Building The Education Revolution
**LOCATION:** Epping West Public School, Epping

**SURFACE LEVEL:** 119.3 AHD*
**EASTING:**
**NORTHING:**
**DIP/AZIMUTH:** 90°/--

**BORE No:** 2
**PROJECT No:** 71182.60
**DATE:** 24 Sep 09
**SHEET** 1 OF 1

| Depth (m) | Description of Strata | Sampling & In Situ Testing | | | | Water |
|---|---|---|---|---|---|---|
| | | Type | Depth | Sample | Results & Comments | |
| | ASPHALTIC CONCRETE | | | | | |
| 0.1 | FILLING - dark grey, silty gravelly sand filling with some slag gravel, humid | E | 0.1<br>0.2 | | | |
| 0.4 | CLAY - stiff, red brown clay with trace of rootlets and dark grey organic matter, humid | E/A | 0.4<br>0.5 | | | |
| 0.6 | CLAY - stiff, grey mottled brown and red clay, with trace of ironstone gravel, damp | E/A | 0.9<br>1.0 | | | |
| 1.1 | CLAY - stiff, grey mottled dark grey and red clay, moist | A | 1.4<br>1.5 | | | |
| 1.5 | SHALY CLAY - hard, grey shaly clay | | | | | |
| 1.7 | SHALE - extremely low strength, grey shale | A | 1.8<br>1.9 | | | |
| 1.95 | Bore discontinued at 1.95m<br>- refusal on extremely low strength shale | | | | | |



**RIG:** Bobcat **DRILLER:** S Gregor **LOGGED:** AHP **CASING:** Uncased
**TYPE OF BORING:** 100mm diameter solid flight auger with TC-bit
**WATER OBSERVATIONS:** No free groundwater observed
**REMARKS:** E = Environmental sample
*Surface level interpolated from survey drawing

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

**SAMPLING & IN SITU TESTING LEGEND**

| | | | |
|---|---|---|---|
| A | Auger sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | PID | Photo ionisation detector |
| B | Bulk sample | S | Standard penetration test |
| U$_x$ | Tube sample (x mm dia.) | PL | Point load strength Is(50) MPa |
| W | Water sample | V | Shear Vane (kPa) |
| C | Core drilling | ▷ | Water seep ▼ Water level |

CHECKED
Initials: PAY
Date: 21.10.09

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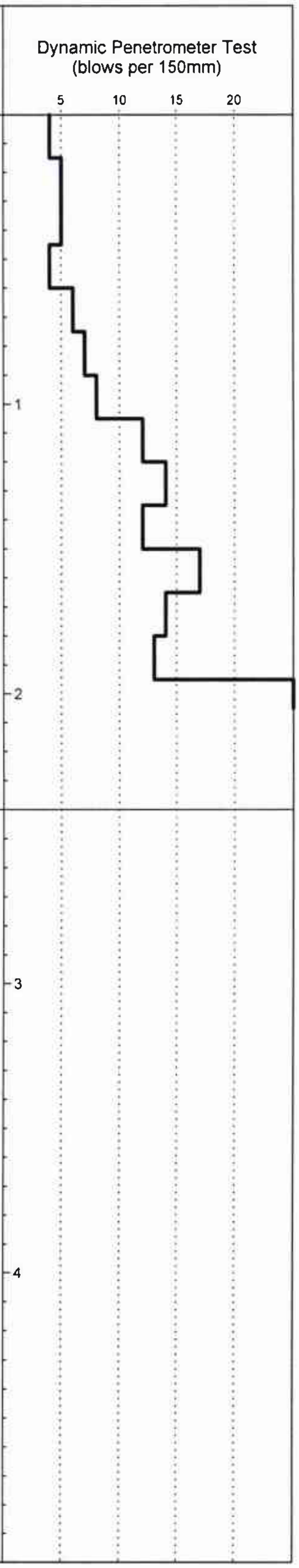
# BOREHOLE LOG

**CLIENT:** Bovis Lend Lease
**PROJECT:** Building The Education Revolution
**LOCATION:** Epping West Public School, Epping

**SURFACE LEVEL:** 119.8 AHD*
**EASTING:**
**NORTHING:**
**DIP/AZIMUTH:** 90°/--

**BORE No:** 3
**PROJECT No:** 71182.60
**DATE:** 24 Sep 09
**SHEET** 1 OF 1

| RL | Depth (m) | Description of Strata | Graphic Log | Sampling & In Situ Testing Type | Depth | Sample | Results & Comments | Water |
|---|---|---|---|---|---|---|---|---|
| | | FILLING - silty sand filling, with some clay inclusions with a trace of rootlets | | E | 0.1<br>0.2 | | | |
| | 0.3 | FILLING - red brown, sandy clay filling with trace of rootlets | | | | | | |
| | 0.4 | CLAY - stiff, red brown clay with trace of rootlets and ironstone gravel, damp | | E/A | 0.4<br>0.5 | | | |
| 119 | 0.7 | CLAY - very stiff, grey mottled brown and red grey clay, with trace of rootlets<br>- becoming hard at 1.1m | | A | 0.9<br>1.0 | | | |
| | 1.3 | CLAY - hard, grey mottled red clay | | A | 1.4<br>1.5 | | | |
| 118 | 1.9 | SHALE - extremely low strength, grey shale | | A<br>A | 1.9<br>2.0<br>2.3<br>2.35 | | | |
| 117 | 2.4 | Bore discontinued at 2.4m<br>- refusal on extremely low strength shale | | | | | | |
| 116 | | | | | | | | |
| 115 | | | | | | | | |



**RIG:** Bobcat **DRILLER:** S Gregor **LOGGED:** AHP **CASING:** Uncased

**TYPE OF BORING:** 100mm diameter solid flight auger with TC-bit

**WATER OBSERVATIONS:** No free groundwater observed

**REMARKS:** E = Environmental sample
*Surface level interpolated from survey drawing

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

**SAMPLING & IN SITU TESTING LEGEND**

| | | | |
|---|---|---|---|
| A | Auger sample | pp | Pocket penetrometer (kPa) |
| D | Disturbed sample | PID | Photo ionisation detector |
| B | Bulk sample | S | Standard penetration test |
| U, | Tube sample (x mm dia.) | PL | Point load strength Is(50) MPa |
| W | Water sample | V | Shear Vane (kPa) |
| C | Core drilling | ▷ | Water seep ▼ Water level |

CHECKED
Initials: 21.10.09
Date: AV

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# RESULTS OF DYNAMIC PENETROMETER TESTS

| | | | |
|---|---|---|---|
| CLIENT | Bovis Lend Lease | DATE | 24/09/09 |
| PROJECT | Building The Education Revolution | PROJECT NO | 71182.60 |
| LOCATION | Epping West Public School, Epping | PAGE NO | 1 of 1 |

| TEST LOCATIONS | 1 | 2 | 3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| RL OF TEST (AHD*) | 119.4 | 119.3 | 119.8 | | | | | | | |
| DEPTH m | PENETRATION RESISTANCE BLOWS/150mm | | | | | | | | | |
| 0.00 - 0.15 | E | E | 4 | | | | | | | |
| 0.15 - 0.30 | 18 | E | 5 | | | | | | | |
| 0.30 - 0.45 | 11 | 4 | 5 | | | | | | | |
| 0.45 - 0.60 | 8 | 4 | 4 | | | | | | | |
| 0.60 - 0.75 | 8 | 5 | 6 | | | | | | | |
| 0.75 - 0.90 | 9 | 4 | 7 | | | | | | | |
| 0.90 - 1.05 | 6 | 3 | 8 | | | | | | | |
| 1.05 - 1.20 | 7 | 5 | 12 | | | | | | | |
| 1.20 - 1.35 | 12 | 6 | 14 | | | | | | | |
| 1.35 - 1.50 | 18 | 5 | 12 | | | | | | | |
| 1.50 - 1.65 | 15/75 | 11/110 | 17 | | | | | | | |
| 1.65 - 1.80 | B | B | 14 | | | | | | | |
| 1.80 - 1.95 | | | 13 | | | | | | | |
| 1.95 - 2.10 | | | 17/100 | | | | | | | |
| 2.10 - 2.25 | | | B | | | | | | | |
| 2.25 - 2.40 | | | | | | | | | | |
| 2.40 - 2.55 | | | | | | | | | | |
| 2.55 - 2.70 | | | | | | | | | | |
| 2.70 - 2.85 | | | | | | | | | | |
| 2.85 - 3.00 | | | | | | | | | | |

**TEST METHOD** AS 1289.6.3.2, CONE PENETROMETER ✓
~~AS 1289.6.3.3, FLAT END PENETROMETER~~

**TESTED BY:** PH
**CHECKED BY:** PAV

**REMARKS**
B = BOUNCING
E = EXCAVATED
15/75 = 15 BLOWS FOR 75mm PENETRATION
*SURFACE LEVELS INTERPOLATED FROM SURVEY DRAWING

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