ASSET GEOTECHNICAL
geotechnical engineering consultants

**Asset Geotechnical Engineering Pty Ltd**
ABN 24 093 381 107

**Email & Web**
info@assetgeotechnical.com.au
www.assetgeotechnical.com.au

**Sydney**
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Phone: 02 9878 6005

Coronation Property Co. Pty Ltd

# Proposed Mixed-Use Development
# 20 Shepherd Street, Liverpool, NSW

Report on
Geotechnical Investigation, Salinity & Acid Sulfate Management Plan

2606-R2 Rev2
10 November 2015

## DOCUMENT AUTHORISATION

**Proposed Mixed-Use Development**
**20 Shepherd Street, Liverpool, NSW**

Report on Geotechnical Investigation, Salinity & Acid Sulfate Management Plan

Prepared for Coronation Property Co. Pty Ltd

Prepared by Asset Geotechnical Engineering Pty Ltd

2606-R2 Rev2
10 November 2015

For and on behalf of
**Asset Geotechnical Engineering Pty Ltd**

**Mark Bartel**
BE MEngSc GMQ RPEQ MIEAust CPEng NPER (Civil)
Managing Director / Senior Principal Geotechnical Engineer

## DOCUMENT CONTROL

### Distribution Register

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| **1** | Secure PDF | Emily Raleigh (emily@coronationproperty.com.au) | Coronation Property Co. Pty Ltd |
| **2** | Secure PDF | Mark Bartel | Asset Geotechnical Engineering |
| | | | |

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# 1. INTRODUCTION

## 1.1 General

This report presents the results of a geotechnical investigation for the above project. The investigation was commissioned on 5 August 2014 by Mr Scott Gordon of Coronation Property Co. Pty Ltd. The work was carried out in accordance with a proposal by Asset Geotechnical Engineering Pty Ltd (Asset) dated 1st August 2014, reference 2606-P1.

An additional Geotechnical Investigation was carried out by Asset with the subsequent report issued on 7 August 2015, reference 2606-1-R1.

Drawings supplied to us for this investigation comprised:

- Architectural plans by Woods Bagot (Project No. 120530, Drawing Nos. A2099-Rev A, A2100-Rev K, A2101-Rev M, A2102-Rev R, A2103-Rev K, A3401-Rev F, A3405-Rev D, Dated 28 October 2015)

Based on the supplied drawings, it is understood that the project involves the construction of a new development adjacent to the Georges River, comprising two residential apartment blocks extending over nine to fifteen storeys in height. Excavation of up to about 10m depth is anticipated for the proposed three basement levels.

## 1.2 Scope of Work

The objective of the investigation is to provide information on the surface and subsurface conditions for design of the proposed structures, and to provide comments and recommendations relating to:

- Excavation conditions, methodology and monitoring, with reference to Council's requirements
- Subgrade preparation and earthworks
- Suitable foundations and founding stratum
- Allowable bearing pressure (and shaft adhesion for piles)
- Batter slopes
- Excavation support design parameters
- Groundwater and dewatering issues
- A preliminary acid sulphate soil assessment in accordance with ASSMAC[1] recommendations.
- Comment on the requirement for an Acid Sulphate Soil Management Plan (ASSMP).
- If required, preparation of an ASSMP.
- Discussion of preliminary salinity assessment results as per Council's DCP (2012) and 'Site Investigation for Urban Salinity (DLWC, 2002).
- Requirements for a Salinity Management plan and additional investigation/testing at the site if applicable.

In order to achieve the project objectives, the following scope of work was carried out:

### *Geotechnical*

- Review of available reports and maps held within our files.
- Walkover observations of site conditions.

[1] Stone, Y, Ahern CR, and Blunden B (1998). Acid Sulfate Soils Manual 1998. Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia.

- Drilling and logging of 5 boreholes to a target depth of about 3m into rock. Drilling was carried out by auger drilling then washbore drilling to refusal, and then coring to the target depth. Standard Penetration Testing was carried out in soils as appropriate to the subsurface conditions.
- Installation of groundwater monitoring wells in two of the boreholes. These wells were purged of drilling water and readings taken approximately one week after the investigation.
  Laboratory testing, comprising point load strength index testing on recovered rock core at 1m nominal depth intervals.

### *Acid Sulphate Soil Assessment/Management Plan*

- Sampling of soils at nominal 0.5m depth intervals and transport to a NATA registered laboratory under refrigerated chain-of-custody protocols;
- Preliminary screening for acid sulphate soils by pH and pH in $H_2O_2$

### *Salinity Assessment*

- Desktop salinity assessment.
- Walkover observations of site conditions including salinity indicators.
- Urban salinity assessment - laboratory testing

### *Reporting*

- Engineering assessment and reporting

This report should be read in conjunction with the attached Information Sheets. Particular attention is drawn to the limitations inherent in site investigations and the importance of verifying the subsurface conditions inferred herein.

## 2. FIELDWORK AND LABORATORY TESTING

### 2.1 Borehole Investigation

The investigation was carried out between 14th to 21st August 2014 under the supervision of a Geotechnical Engineer from this office. A total of five boreholes (BH1 to BH5) were drilled using a track-mounted drilling rig. Drilling was carried out by auger drilling then washbore drilling to refusal on bedrock, and then coring to the target depth. Standard Penetration Testing was carried out in soils as appropriate to the subsurface conditions.

On completion of logging and sampling, a 50mm diameter PVC standpipe piezometer was installed in borehole BH2 and BH3 to depths of 16.6m and 12.7m respectively. The piezometer construction comprised machine-slotted screening over the bottom 6m, then backfilling the annulus with sand to 1m above the screen and then a 0.5m thick bentonite plug on top of the sand to prevent surface water directly entering the piezometer. The hole above the bentonite was backfilled with spoil from the drilling, and a cast-iron road box concreted flush with the adjacent ground surface. The remaining boreholes were backfilled with the drilling spoil after logging and sampling.

The borehole locations were set out by our engineer relative to existing site features and site access constraints. The subsurface conditions encountered were recorded during the progress of the excavations. Surface levels at the test locations were estimated by interpolation from the survey plan provided (SDG Land Development Solutions, Ref: 6352, Dated 27 August 2014).

Engineering logs and explanatory notes are attached to this report. The test locations are shown on the attached Figure 2.

### 2.2 Laboratory Testing

In order to aid with the Acid Sulphate Soil and Salinity assessment, soils were sampled at nominal 0.5m depth intervals in BH1, BH4 and BH5 and were transport to a NATA registered laboratory under refrigerated chain-of-custody protocols. Test results are attached and presented in Section 4.3. Testing was carried out generally in accordance with AS1289 “Methods of Testing Soil for Engineering Purposes” or as described in the laboratory test results.

Rock core samples recovered during the fieldwork were delivered to a NATA registered laboratory and tested for point load strength index. Test results are attached.

## 3. SITE DESCRIPTION

The site is located along the eastern side of Shepherd Street and southern side of Atkinson Street in the suburb of Liverpool, as shown in Figure 1. It has a frontage to Atkinson Street of about 110m wide and is about 80m to 125m deep. The site is bounded to the northeast, east, and south by the Georges River. The entire site compromises a total area of approximately 9873m$^2$ with a building area of 3560m$^2$.

Topographically, the site is located within a low-lying broad and generally flat terrain with the Georges River as a local low point running along the eastern site boundary. In the site vicinity, the natural ground surface generally slopes upward toward north and west at 1 to 2°.

At the time of the investigation, the existing development comprises a large factory warehouse in the south-western corner of the block. A brick house exists in the north-western corner of the site which is unoccupied. A large amount of logged trees, timbers, and other construction materials are scattered along the eastern side (adjacent to Georges River) on the site. The rest of the site is flat open space covered by asphalt, and the entire site is bounded by electric fences.

All site structures appeared to be in overall fair conditions with no visible sign of cracking or structural damage. All existing neighbouring developments are reasonably distant from the site and are not anticipated to include basement levels.

Vegetation comprises various shrubs and grass covering the banks of Georges River, adjacent to the eastern site boundary.

Drainage across the site mainly occurs via overland flow towards north via a stormwater drainage connecting the gutter on the end of Atkinson Street.

## 4. SUBSURFACE CONDITIONS

### 4.1 Geology

The 1:100,000 Penrith Geological Map indicates the site is underlain by alluvial soils comprising clayey quartzose Sand, and Clay. The site is also located near the boundary with Bringelly Shale away from the river, which includes shale, carbonaceous claystone, laminite, fine to medium-grained lithic sandstone and rare coal. These rocks typically weather to form residual clay soils of medium to high plasticity.

## 4.2 Stratigraphy

The following summary description is provided for the conditions observed at the test locations for this investigation. The detailed conditions at each test location are recorded on the attached logs. For specific design input, reference should be made to the logs and/or the specific test results, in lieu of the following summary.

**Table 1 – Generalised Subsurface Profile**

| Layer | Description | BH1 (m) | BH2 (m) | BH3 (m) | BH4 (m) | BH5 (m) |
|---|---|---|---|---|---|---|
| | ***Ground Surface Level (m AHD)*** | ***RL 10.3*** | ***RL 9.9*** | ***RL 10.1*** | ***RL 9.5*** | ***RL 10.1*** |
| **Pavement** | Asphalt | 0 – 0.1 | 0 – 0.2 | 0 – 0.1 | -- | 0 – 0.1 |
| **Fill** | Clayey/Sandy GRAVEL, fine to coarse grained. Dark grey, well graded | 0.2 – 1.4 | 0.2 – 0.6 | -- | 0 - 0.4 | -- |
| | Gravelly CLAY, low to medium plasticity mottled grey and brown | -- | -- | 0.1 - 0.5 | 0.4 - 1.7 | 0.3 - 1.0 |
| | Clayey/SAND, fine to coarse grained, brown, well graded | 1.4 - 2.4 | | 0.5 - 1.0 | 1.7 - 2.0<br>4.2 - 5.7 | 0.1 - 0.3<br>1.0 - 1.6 |
| | Sandy CLAY, low to medium plasticity, brown mottled grey | 2.4 - 3.5 | 0.6 - 3.8 | 1.0 - 2.6 | 2.0 - 4.2<br>5.7 - 6.9 | -- |
| **Alluvium** | SAND, fine to medium grained, brown | 3.5 - 8.3 | 5.3 - 8.3 | -- | 6.9 - 11 | 1.6 - 3.3 |
| | Sandy CLAY, low plasticity, grey mottled brown | 8.3 - 10.3 | 3.8 - 5.3 | 2.6 - 6.8 | 11 - 12.9 | 3.3 - 5.5 |
| | Clayey SAND, fine to coarse grained, brown | -- | -- | 6.8 - 9.7 | -- | 5.5 - 9.5 |
| | Sandy CLAY, low plasticity, grey mottled brown with fine to medium grained sand | -- | 8.3 - 12.0 | -- | -- | 9.5 - 11.4 |
| **Bedrock** | SHALE, dark grey, highly to extremely weathered, distinct lamination, thinly to medium bedded (assessed Class 4 Shale[2]) | 11.2-11.7 | -- | -- | 15.0-15.3 | 11.4-12.7<br>13.6-14.0 |
| | SHALE, dark grey, moderately weathered, distinct lamination, thinly to medium bedded (assessed Class 3 Shale) | 10.3-11.2<br>11.7-14.75 | 12-13.4 | -- | -- | 12.7-13.6<br>14.0-14.32 |
| | SHALE, dark grey, moderately to slightly weathered (assessed Class 3/2 Shale) | -- | -- | 9.7-11.6 | 12.9-15.0<br>15.3-16.08 | -- |
| | SHALE, dark grey, distinct lamination, thinly to medium bedded (assessed Class 2 Shale) | -- | 13.4-16.75 | 11.6-12.83 | -- | -- |

[2] Pells, P.J.N., Mostyn, G & Walker, B.F., *Foundations on Sandstone and Shale in the Sydney Region*, Australian Geomechanics Journal, December 1998

### 4.3 Groundwater

Groundwater seepage was observed during drilling at a depth of 7m in BH1. It is noted that groundwater observation may have been made before water levels had stabilised.

Two monitoring wells were installed in boreholes BH2 and BH3 to depths of 16.6m and 12.7m respectively after drilling, and water was bailed out immediately after the installation. Groundwater levels were measured in the piezometers on 28 August 2014 and indicate groundwater depths of **6.5m** and **6.4m** (RLs **3.4m** and **3.7m** AHD) in boreholes BH2 and BH3 respectively.

### 4.4 Laboratory Test Results

Results from the laboratory testing undertaken on selected soil samples for Salinity and Acid Sulphate Soil are summarised in Table 2A and Table 2B, with discussions in Section 5.1.

Results for Point Load Strength Index on recovered rock core are attached in this report.

**Table 2A – Laboratory Test Results: Salinity**

| Test Location & Depth (m) | Resistivity (Ωm) | Salinity (EC 1:5 dS/m) | Na (mg/kg) | Chloride (mg/kg) | Sulphate ($mgSO_4$/kg) | EC mS/cm | pH in $H_2O$ | pH in CaCl2 | Exchangeable Sodium % | Calculated ECe (dS/m) |
|---|---|---|---|---|---|---|---|---|---|---|
| **BH1 3.5m** | 26.94 | 0.14 | 61.7 | 5.1 | 180 | 0.14 | 6.7 | 6.2 | 4.5 | 1.2 |
| **BH1 6.5m** | 161.24 | 0.04 | 13.6 | 25.3 | 20 | 0.04 | 7.1 | 6.4 | 3.2 | 0.9 |
| **BH4 4.0m** | 6.66 | 0.45 | 205 | 52.2 | 600 | 0.45 | 5.7 | 5.3 | 10.3 | 3.9 |
| **BH4 7.0m** | 39.3 | 0.03 | 606 | 13.4 | 20 | 0.03 | 7.8 | 6.5 | 6 | 0.7 |

**Table 2B – Laboratory Test Results: Acid Sulphate Soils**

| Test Location & Depth | Test Results | | |
|---|---|---|---|
| | pH | pH in $H_2O_2$ | Drop in pH |
| **BH1 0.5m** | 8.25 | 8.67 | -0.42 (increase) |
| **BH1 1.0m** | 8.22 | 7.7 | 0.52 |
| **BH1 1.5m** | 6.56 | 5.37 | 1.19 |
| **BH1 2.0m** | 7.94 | 6.61 | 1.33 |
| **BH1 2.5m** | 7.53 | 6.8 | 0.73 |
| **BH1 3.5m** | 6.66 | 6.22 | 0.44 |
| **BH1 4.0m** | 6.85 | 5.38 | 1.47 |
| **BH1 4.5m** | 7.14 | 6.65 | 0.49 |
| **BH1 5.0m** | 6.79 | 5.65 | 1.14 |
| **BH1 5.5m** | 6.65 | 5.53 | 1.12 |
| **BH1 6.0m** | 6.53 | 4.95 | 1.58 |
| **BH1 6.5m** | 6.66 | 6.8 | -0.14 (increase) |
| **BH1 7.0m** | 6.82 | 5.51 | 1.31 |
| **BH4 0.5m** | 8.51 | 8.65 | -0.14 (increase) |
| **BH4 1.0m** | 8.1 | 8.06 | 0.04 |
| **BH4 1.5m** | 7.88 | 7.69 | 0.19 |
| **BH4 2.0m** | 8.06 | 7.08 | 0.98 |
| **BH4 2.5m** | 8.08 | 7.51 | 0.57 |
| **BH4 3.0m** | 6.62 | 6.59 | 0.03 |
| **BH4 4.0m** | 7.24 | 6.56 | 0.68 |
| **BH5 3.5m** | 7.25 | 7.48 | -0.23 (increase) |
| **BH5 4.0m** | 7.25 | 7.57 | -0.32 (increase) |
| **BH5 5.0m** | 7.03 | 7.05 | -0.02 (increase) |
| **BH5 5.5m** | 7.4 | 4.99 | 2.41 |
| **BH5 6.0m** | 6.83 | 5.78 | 1.05 |
| **BH5 7.0m** | 6.92 | 5.78 | 1.14 |
| **BH5 7.5m** | 7.12 | 5.73 | 1.39 |
| **BH4 8.0m** | 6.4 | 4.72 | 1.68 |

## 5. DISCUSSIONS & RECOMMENDATIONS

Based on the lower basement finished floor level of **RL 0.700m AHD**, and from the results of this investigation, it is assessed that the basement level will be up to about 3m below the observed groundwater level, and would be within alluvial soils and shale bedrock of variable strength.

Key geotechnical constraints to the development include groundwater control, excavation support, excavation and foundation conditions. Recommendations for design and construction of the development are provided in the following sections.

### 5.1 Salinity

According to the then DIPNR[3], the site lies within an area mapped as having a Moderate Salinity Potential.

The laboratory test results indicate that the tested soils are classified as non-saline (AS2870-2011 Table 5.1) with a calculated ECe of ≤4dS/m in all tests. Therefore, no Salinity Management Plan is required for this project, and no further investigation is required for salinity assessment purposes.

However, given that the site is within an area mapped as having a Moderate salinity potential, it is recommended that design and construction of structures be carried out in accordance with "Building in a Saline Environment" 2nd edition by DIPNR (2008), or more recent, relevant publications.

### 5.2 Acid Sulphate Soils

In accordance with ASSMAC, pH values of less than or equal to 4 indicate that actual acid sulphate soils (AASS) are present. Potential acid sulphate soils (PASS) are indicated where pH in $H_2O_2$ values are less than 3.5 (preferably 3), and where the pH drop is more than 1 unit.

The results of the testing found that no sample had a pH of less than 4 or a pH in $H_2O_2$ of less than 3.5. From this, AASS or PASS is unlikely to be present in the site soils within the proposed depth of excavation. Although 12 samples exhibited a pH drop of more than 1 unit with the addition of $H_2O_2$, the final pH was higher than the indicator cut-off values for both AASS and PASS.

Considering that the material at the site is not classified as AASS or PASS, we assess that an Acid Sulphate Soil Management Plan (ASSMP) is not required for this project.

### 5.3 Aggressivity to Steel and Concrete

The laboratory test results indicate that the soils are classified as "Non-aggressive" with respect to concrete piles and steel piles (as per AS2159-2009) for all except two tests. "Moderate" and "Mild" aggressivity classifications were assessed for resistivity tests at BH4 (4m depth) and BH4 (7m depth) respectively.

For a 50 year design life, minimum concrete strength of 32MPa and a minimum cover to reinforcement of 45mm (cast-in-place piles) is recommended for a "Non-Aggressive" environment in AS2159-2009 for concrete piles. However, the more onerous test results from BH4 indicate that an increased concrete strength (40MPa) and cover to reinforcement (65mm) may be required in some areas. Further testing may be required to delineate the affected area, unless the higher concrete strength and cover is adopted throughout.

[3] Department of Infrastructure, Planning and Natural Resources, "Salinity Potential in Western Sydney", 2002

## 5.4 Temporary and Permanent Shoring

It is understood that permanent batter slopes are not proposed for the development. The proposed depth of excavation and the potential lack of clearance between the basement and boundary would preclude temporary batters, and therefore temporary shoring will be required. Depending on the design of the shoring, it could also be incorporated into the permanent foundation and retaining works.

Design of retaining walls will need to consider both long–term (i.e. permanent) and short–term (i.e. during construction) loading conditions, as well as the possible impact on adjoining developments. A number of possible temporary shoring systems could be considered for the site. These are summarised in Table 3 following, together with advantages and disadvantages.

**Table 3 – Summary of Shoring Options**

| Option | Method | Advantages | Disadvantages |
|---|---|---|---|
| 1 | Soldier piles (bored) and steel walers (or shotcrete infill panels) | Relatively low cost.<br>Can include strip drainage behind infill panels. | Risk of instability and loss of ground<br>Forms a poor seal against groundwater. |
| 2 | Steel sheet pile (driven or hydraulically installed) | Rapid installation.<br>Lower cost that Option 3.<br>Low permeability water barrier.<br>Amenable to joint caulking. | Vibration may not be acceptable for adjoining developments.<br>Permanent wall required.<br>Will require soil anchors.<br>Shallow rock may limit driving depth |
| 3 | Contiguous or secant bored piles | Can form part of the permanent structure.<br>Minimum noise and vibration.<br>Can maximise site building space as no temporary wall is required.<br>Permanent water proofing can be incorporated.<br>Low permeability water barrier (secant piling very low permeability compared to contiguous piling) | For secant piles, ensuring complete contact of all piles over full pile length may be difficult.<br>Additional finishing may be required following excavation if a ‘smooth’ internal wall is required.<br>Relatively high cost.<br>May require soil anchors along boundaries where high level footings are located. |
| 4 | Cutter Soil Mix (CSM) | Can form part of the permanent structure.<br>Minimum noise and vibration.<br>Can maximise site building space as no temporary wall is required.<br>Permanent water proofing can be incorporated.<br>Low permeability water barrier | Additional finishing may be required following excavation if a ‘smooth’ internal wall is required.<br>Relatively high cost.<br>May require soil anchors along boundaries where high level footings are located. |

### *5.4.1 Temporary Shoring*

Based on the advantages and disadvantages listed in Table 3, we recommend a contiguous or secant bored pile wall (Option 3) or a CSM wall (Option 4) for the basement excavation. This wall could be incorporated into the permanent retaining and foundation works. Options 1 and 2 are not likely to be suitable due to the depth of excavation support required and presence of groundwater.

For retained heights of up to 6 or 7m or where control of lateral deflections is required due to adjacent buildings, temporary rock anchors are likely to be required. Rock anchors should be inclined below horizontal to ensure anchorage in bedrock and should be designed to have a free length that extends beyond an imaginary line drawn upwards at an angle of 45° from the toe of the wall. The minimum free length should be

3 m. Anchor holes should be clean and adequately flushed, with grouting and other installation procedures carried out carefully and in accordance with normal good anchoring practice.

It is anticipated that rock anchors will be temporary only and that the structure will provide permanent restraint of the retaining walls. It may be necessary to obtain permission from the controlling authorities prior to installing temporary anchors around the perimeter of the site. In addition, care should be taken to avoid damaging buried services or pipes, during anchor installation.

### *5.4.2 Permanent Retaining Walls*

It is assumed that permanent retaining walls will have permanent lateral restraint provided by the basement floors and roof level and may be designed as braced retaining walls. Depending on the sensitivity of adjacent structures to lateral movement, it may be necessary to provide ground anchors to provide further resistance against lateral earth pressures and control horizontal movement. Further advice should be sought once the pile loads and layout are known.

### *5.4.3 Design Approach – Earth Pressure*

Cantilever walls may be designed for a triangular earth pressure distribution using a lateral earth pressure coefficient ($K_a$) of 0.5 where it is desired to minimise deflections (e.g. where adjacent to existing structures), and 0.4 elsewhere. Rock anchors should also be considered where it is required to minimise lateral deflection of temporary shoring (e.g. where adjacent to high level footings or buried services adjoining the site).

Braced retaining walls may be designed for a uniform lateral earth pressure of $0.65 * \gamma * H * K_a$ where $\gamma$ = unit weight of retained soil (say 18kN/m$^3$), H = height of wall, and $K_a$ = earth pressure coefficient (0.4 or 0.5 as noted above). It is expected that 2m embedment of piles in alluvial sand and clay, below basement level, would provide the required “kick-in” resistance until the slab is poured. However where shoring piles are required to provide long-term vertical bearing capacity (e.g. secant piles), it is considered that these soils would not provide adequate bearing for the structural loads. Such piles should therefore be socketed at least 0.75m into bedrock to provide toe “kick-in” resistance as well as providing the required bearing capacity.

Assessed Class 3 Shale or better is likely to provide adequate overturning resistance for the socketed piles. For assessment of passive restraint for piles embedded below excavation level, we recommend a triangular pressure distribution with a preliminary coefficient of passive pressure ($K_p$) of 2.5 for the soils and 10 for Class 3 shale up to a maximum of 200kPa.

Appropriate surcharge loading at the finished surface level should also be considered during the design of the wall.

Detailed construction supervision, monitoring and inspections will be required during the piling and subsequent bulk excavation to ensure and adequate standard of workmanship and to minimise potential problems.

### *5.4.4 Design Approach – Soil/Structure Interaction*

Analysis and design using a simplistic earth-pressure approach may yield an overly-conservative shoring design, and in some cases may be unconservative. We recommend that consideration be given to carrying out a more rigorous soil/structure interaction analysis using appropriate methodology (e.g. 2D FEM modelling), and with appropriate geotechnical parameters for the various strata. This should be carried out by an experienced Geotechnical Engineer.

## 5.5 Dewatering

In order to construct the basement, it will be necessary to dewater to about 0.5m below the proposed bulk excavation level. Where lift pits or other local excavations extend below the bulk excavation level, it would be necessary to locally dewater not less than about 0.5m below such local excavations.

Temporary lowering of the groundwater level can cause settlement of the soil profile due to a change in the stress regime. The magnitude of settlement depends on the soil type and condition, draw down depth and duration, and historical water levels.

Contiguous or secant piles to bedrock, or CSM walls, together with internal dewatering would minimise the potential risks and should provide adequate control of groundwater for construction purposes. The development should be designed to minimise the risk of settlement induced by groundwater lowering by designing the basement structure as a "tanked" excavation (i.e. with impermeable retaining walls and floor structure) to at least 1m above the groundwater fluctuations at the site. In the absence of adequate long-term groundwater monitoring records, it is suggested that a groundwater level nominally 1.5 m above the level measured in investigation (i.e. RL 5.2 m AHD) be adopted for preliminary design of the basement. Permanent dewatering is not recommended.

The quantity of seepage expected to flow into the excavation during construction is unknown. It will depend on the in-situ permeability of the sandy clay/ clayey sand soils, the jointing / fracturing of the underlying shale bedrock, the flow path length, and the type and adequacy of construction of the temporary shoring adopted (e.g. contiguous versus secant piling versus CMS wall). At this stage no in situ or laboratory permeability tests of the site subsurface profile has been undertaken. However, based on the borehole soil description of the sandy clays and with reference to empirical charts, we anticipate that the permeability of the sandy clays would be in the order of $10^{-4}$ to $10^{-7}$ cm/sec. The mass permeability of the underlying bedrock could be of a similar order to the sandy clays.

Only experienced dewatering subcontractors with appropriate monitoring systems should be considered. We recommend further involvement of an experienced Geotechnical Engineer and Hydro geologist during the design, construction and operation / monitoring of groundwater control systems.

## 5.6 Earthworks

### *5.6.1 Excavation*

The bulk excavation for the proposed development is anticipated to be mostly through fill and alluvial sand/clay, and partially into shale bedrock. It is anticipated that the soils and low strength bedrock (i.e. Class 5 and 4 Shale) could be readily excavated using conventional earthmoving equipment (e.g. hydraulic excavator bucket).

Excavation within medium or higher strength bedrock (i.e. Class 3 and above Shale) will likely require use of ripper tooth fitted to a hydraulic excavator bucket, a dozer fitted with ripper tooth, or a hydraulic hammer fitted to an excavator, possibly supplemented by rock saw and rock splitting techniques.

### *5.6.2 Vibration Management*

Australian Standard AS 2187: Part 2-2006 recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2” as they “are applicable to Australian conditions”. The standard sets guide values for building vibration

based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

Sources of vibration that are considered in the standard include demolition, blasting (carried out during mineral extraction or construction excavation), piling, ground treatments (e.g. compaction), construction equipment, tunnelling, road and rail traffic and industrial machinery.

For residential structures, BS 7385 recommends vibration criteria of 7.5 mm/s to 10 mm/s for frequencies between 4 Hz and 15 Hz, and 10 mm/s to 25 mm/s for frequencies between 15 Hz to 40 Hz and above. These values would normally be applicable for new residential structures or residential structures in good condition. Higher values would normally apply to commercial structures, and more conservative criteria would normally apply to heritage structures.

However, structures can withstand vibration levels significantly higher than those required to maintain comfort for their occupants. Human comfort is therefore likely to be the critical factor in vibration management.

Excavation methods should be adopted which limit ground vibrations at the adjoining developments to not more than 10mm/sec. Vibration monitoring is recommended to verify that this is achieved. However, if the contractor adopts methods and / or equipment in accordance with the recommendations in Table 4 for a ground vibration limit of 5mm/sec, vibration monitoring may not be required.

The limits of 5mm/sec and 10mm/sec are expected to be achievable if rock breaker equipment or other excavation methods are restricted as indicated in Table 4.

**Table 4 – Recommendations for Rock Breaking Equipment**

| Distance from adjoining structure (m) | Maximum Peak Particle Velocity 5mm/sec | | Maximum Peak Particle Velocity 10mm/sec* | |
|---|---|---|---|---|
| | Equipment | Operating Limit (% of Maximum Capacity) | Equipment | Operating Limit (% of Maximum Capacity) |
| **1.5 to 2.5** | Hand operated jackhammer only | 100 | 300 kg rock hammer | 50 |
| **2.5 to 5.0** | 300 kg rock hammer | 50 | 300 kg rock hammer<br>or<br>600 kg rock hammer | 100<br><br>50 |
| **5.0 to 10.0** | 300 kg rock hammer<br>or<br>600 kg rock hammer | 100<br><br>50 | 600 kg rock hammer<br>or<br>900 kg rock hammer | 100<br><br>50 |

* Vibration monitoring is recommended for 10mm/sec vibration limit.

At all times, the excavation equipment must be operated by experienced personnel, according to the manufacturer's instructions, and in a manner consistent with minimising vibration effects.

Use of other techniques (e.g. chemical rock splitting, rock sawing), although less productive, would reduce or possibly eliminate risks of damage to adjoining property through vibration effects transmitted via the ground. Such techniques may be considered if an alternative to rock breaking is necessary. If rock sawing is carried out around excavation boundaries in not less than 1m deep lifts, a 900 kg rock hammer could be used at up to 100% maximum operating capacity with an assessed peak particle velocity not exceeding 5

mm/sec, subject to observation and confirmation by a Geotechnical Engineer at the commencement of excavation.

It is pointed out that the rock classification system used in Table 1 is intended primarily for use in design of foundations, and is not intended to be used to directly assess rock excavation characteristics. Excavation contractors should refer to the detailed engineering logs, core photographs, laboratory strength tests, and inspection of rock core, and should not rely solely on the rock classifications presented in geotechnical engineering reports, when assessing the suitability of their excavation equipment for the proposed development. Further geotechnical advice must be sought if rock excavation characteristics are critical to the proposed development.

It should be noted that vibrations that are below threshold levels for building damage may be experienced at adjoining developments. Rock excavation methodology should also take into account acceptable noise limits as per the “Interim Construction Noise Guideline” (NSW EPA).

### *5.6.3 Subgrade Preparation*

The following general recommendations are provided for subgrade preparation for earthworks, pavements, slab-on-ground construction, and minor structures:

- Strip topsoil and fill. Remove unsuitable materials from site (e.g. concrete and material containing deleterious matter). Stockpile remainder for re-use as landscaping material or remove from site.
- Excavate alluvial soils, stockpiling for re-use as engineered fill or remove to spoil.
- Where soil is exposed at bulk excavation level, compact the upper 150mm depth to a dry density ratio (AS1289.5.4.1–2007) not less than 100% Standard. Areas which show visible heave under compaction equipment should be over-excavated a further 0.3m and replaced with approved fill compacted to a dry density ratio not less than 100%.

Further advice should be sought where the depth of filling beneath pavements and/or structures exceeds that noted above, or where filling is required to support major structures.

Any waste soils being removed from the site must be classified in accordance with current regulatory authority requirements to enable appropriate disposal to an appropriately licensed landfill facility. Further advice should be sought from a specialist environmental consultant if required.

### *5.6.4 Filling*

Where filing is required, place in horizontal layers not more than 0.3m loose thickness over prepared subgrade and compact to a dry density ratio not less than 95% Standard beneath pavements and 98% Standard beneath structures. The moisture content during compaction should be maintained at ±2% of Standard Optimum. Compact the upper 150mm of subgrade to a dry density ratio not less than 100% Standard.

Filling within 1.5m of the rear of retaining walls should be compacted using lightweight equipment (e.g. hand-operated plate compactor or ride-on compactor not more than 3 tonnes static weight) in order to limit compaction-induced lateral pressures. The layer thickness should be reduced to 0.2m maximum loose thickness.

Any soils to be imported onto the site for the purpose of back-filling and re-instatement of excavated areas should be free of contamination and deleterious material, and should include appropriate validation

documentation in accordance with current regulatory authority requirements which confirms its suitability for the proposed land use. Further advice should be sought from a specialist environmental consultant if required.

### *5.6.5 Batter Slopes*

Recommended maximum slopes for permanent and temporary batters are presented in Table 5 below:

**Table 5 – Recommended Maximum Batter Slopes**

| Unit | Maximum Batter Slope (H : V) | |
|---|---|---|
| | Permanent | Temporary |
| **Fill** | 2.5 : 1 | 1.5 : 1 |
| **Alluvial soils** | 2 : 1 | 1.5 : 1 |

## 5.7 Foundations

Bulk excavation is likely to expose variable strength alluvial soils and shale bedrock at lower basement level. Suitable footings are therefore likely to comprise a slab on ground for the basement area with piling required to support internal columns and walls. All piles should extend to and be founded on similar strength shale bedrock to avoid differential movements due to these variable founding conditions.

Construction joints should be considered to accommodate differential settlements that may occur as a result of variable ground conditions. Slab design should also incorporate connecting dowels or shear keys at construction or expansion joints between adjoining slabs to minimise differential settlements between slab panels.

Edge beams for slab, pad footings and rock-socketed piles may be designed for the parameters in Table 6.

**Table 6 – Footing Design Parameters**

| Founding Stratum | Maximum Allowable (Serviceability) Values (kPa) | | | Ultimate Strength Limit State Values* (kPa) | | |
|---|---|---|---|---|---|---|
| | End Bearing | Shaft Friction – Compression | Shaft Friction – Tension | End Bearing | Shaft Friction - Compression | Shaft Friction - Tension |
| **Class 4 Shale** | 1,000 | 100 | 60 | 3,000 | 150 | 100 |
| **Class 3 Shale** | 2,000 | 200 | 125 | 10,000 | 350 | 200 |
| **Class 2 Shale** | 4,500 | 450 | 300 | 30,000 | 600 | 400 |

* To be used with Geotechnical Strength Reduction Factor of 0.75

Although current observations indicate that groundwater levels are expected to be slightly below basement level, it would be prudent to consider the potential for future elevated groundwater levels occurring as a result of seasonal variations, leaking services or inundation. It is therefore recommended that waterproofing of the basement floor slab and nominally 1m up the walls, is provided, and should be designed to withstand hydrostatic pressures. In the absence of long-term monitoring of groundwater levels to establish an appropriate design water level, it is suggested that a groundwater level nominally 1.5m above the level measured in the piezometers be considered (i.e. RL 5.2m AHD).

Options for piles include:

**Driven piles.** Driven piles are not considered suitable because environmental factors including noise and vibration are likely to be unacceptable for the adjacent developments.

**Bored Piles**. Piezometers indicate the potential presence of groundwater at this site. Bored piles are unlikely to be suitable due to the likelihood of collapse of the sidewalls, or significant dewatering requirements.

**Continuous Flight Auger (CFA) Piles**. CFA piles are constructed by drilling a hollow stemmed continuous flight auger to the required founding depth. Concrete is then injected under pressure through the auger stem as the auger is extracted from the soil. The reinforcing cage is then inserted upon completion of the concreting process. Pile diameters vary from 300mm to 1200mm. Drilled spoil is produced during CFA piling, and must subsequently be removed from site. CFA piles are considered non-displacement piles as defined in AS2159. Examples of CFA piles are Frankipile “Atlas” type piles, or Vibropile “Omega” type piles.

Groundwater may be expected within bored pile holes and dewatering by down-hole pump may be required. CFA piles may be more suitable for the high groundwater conditions. However, the piling rig would need to be powerful enough to penetrate through the Class 3 or Class 2 shale rock, if required for bearing capacity.

An experienced geotechnical engineer should review footing designs to check that the recommendations of the geotechnical report have been included, and should assess footing excavations to confirm the design assumptions.

## 6. LIMITATIONS

In addition to the limitations inherent in site investigations (refer to the attached Information Sheets), it must be pointed out that the recommendations in this report are based on assessed subsurface conditions from limited investigations. In order to confirm the assessed soil and rock properties in this report, further investigation would be required such as coring and strength testing of rock, and should be carried out if the scale of the development warrants, or if any of the properties are critical to the design, construction or performance of the development.

It is recommended that a qualified and experienced Geotechnical Engineer be engaged to provide further input and review during the design development; including site visits during construction to verify the site conditions and provide advice where conditions vary from those assumed in this report. Development of an appropriate inspection and testing plan should be carried out in consultation with the Geotechnical Engineer.

This report may have included geotechnical recommendations for design and construction of temporary works (e.g. temporary batter slopes or temporary shoring of excavations). Such temporary works are expected to perform adequately for a relatively short period of time only, which could range from a few days (for temporary batter slopes) up to six months (for temporary shoring). This time period depends on a range of factors including but not limited to: site geology; groundwater conditions; weather conditions; design criteria; and level of care taken during construction. If there are factors which prevent temporary works from being completed and/or which require temporary works to function for periods longer than originally designed, further advice must be sought from the Geotechnical Engineer and Structural Engineer.

This report and details for the proposed development must be submitted to relevant regulatory authorities that have an interest in the property (e.g. Council) or are responsible for services that may be within or adjacent to the site (e.g. Sydney Water, Sydney Trains, Roads and Maritime Services), for their review prior to commencement of construction.

The document “Important Information about your Geotechnical Report” in Appendix A provides additional information about the uses and limitations of this report.

# FIGURES

Figure 1 – Site Locality
Figure 2 – Test Locations


0 1:4000 250m

APPROXIMATE ONLY – SUBJECT TO DETAIL SURVEY.

SOURCE: "Google Maps"

THIS DRAWING IS USED TO ILLUSTRATE TEST LOCATIONS ONLY, AND MUST NOT BE USED FOR ANY OTHER PURPOSE. COPYRIGHT OF SOURCE DRAWING REMAINS WITH Google Maps

| issue | date | description |
|---|---|---|
| | | |
| | | |
| A | 18.08.14 | INITIAL ISSUE |

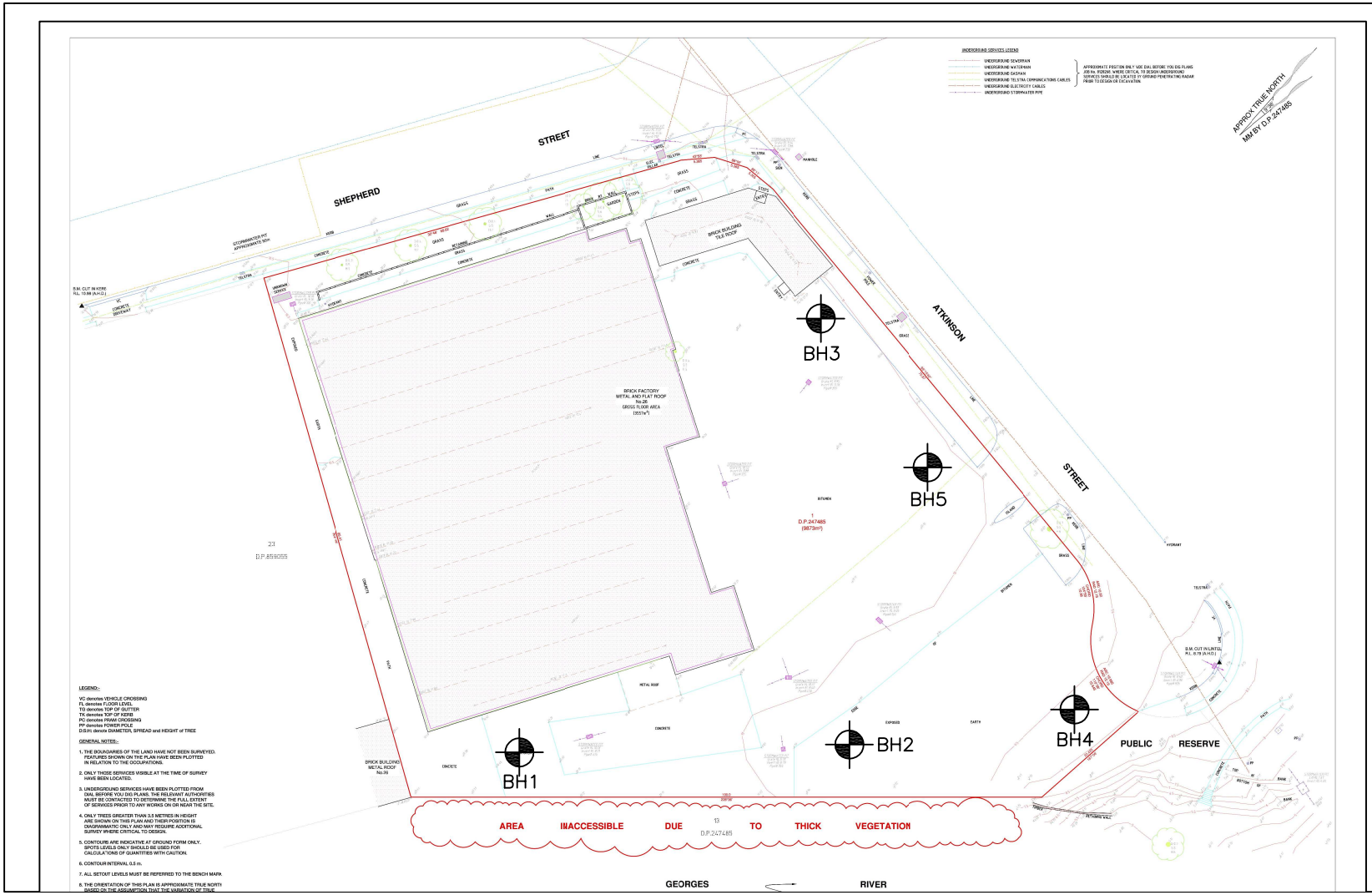
**ASSET** GEOTECHNICAL
geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

SITE LOCALITY

**drawn:** JZ
**date:** 18.08.14
**checked:** MAB
**scale:** 1:4000 A4

**job no.:** 2606
**fig:** 1
**issue:** A




APPROXIMATE ONLY – SUBJECT TO DETAIL SURVEY.

SOURCE: "SDG Land Development Solutions"

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0 1:1000 50m

| issue | date | description |
|---|---|---|
| B | 05.11.14 | Survey Plan based Figure |
| A | 22.08.14 | INITIAL ISSUE |

**ASSET** GEOTECHNICAL
geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

TEST LOCATIONS

**drawn:** JZ
**date:** 05.11.14
**checked:** MAB
**scale:** 1:1000 A4

**job no.:** 2606
**fig:** 2
**issue:** B

# APPENDIX A

Important Information about your Geotechnical Report

ASSET GEOTECHNICAL
geotechnical engineering consultants

# Important Information about your Geotechnical Report

## SCOPE OF SERVICES

The geotechnical report ("the report") has been prepared in accordance with the scope of services as set out in the contract, or as otherwise agreed, between the Client and Asset Geotechnical Engineering Pty Ltd ("Asset"), for the specific site investigated. The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

The report should not be used if there have been changes to the project, without first consulting with Asset to assess if the report's recommendations are still valid. Asset does not accept responsibility for problems that occur due to project changes if they are not consulted.

## RELIANCE ON DATA

Asset has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. Asset has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, Asset will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Asset.

## GEOTECHNICAL ENGINEERING

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared for a specific client, for a specific project and to meet specific needs, and may not be adequate for other clients or other purposes (e.g. a report prepared for a consulting civil engineer may not be adequate for a construction contractor). The report should not be used for other than its intended purpose without seeking additional geotechnical advice. Also, unless further geotechnical advice is obtained, the report cannot be used where the nature and/or details of the proposed development are changed.

## LIMITATIONS OF SITE INVESTIGATION

The investigation programme undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation programme and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

Therefore, the recommendations in the report can only be regarded as preliminary. Asset should be retained during the project implementation to assess if the report's recommendations are valid and whether or not changes should be considered as the project proceeds.

## SUBSURFACE CONDITIONS ARE TIME DEPENDENT

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. Asset should be kept appraised of any such events, and should be consulted to determine if any additional tests are necessary.

## VERIFICATION OF SITE CONDITIONS

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that Asset be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

## REPRODUCTION OF REPORTS

 Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimize the likelihood of misinterpretation from logs.

## REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the Client and no other party. Asset assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Asset or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

## DATA MUST NOT BE SEPARATED FROM THE REPORT

The report as a whole presents the site assessment, and must not be copied in part or altered in any way.

Logs, figures, drawings, test results etc. included in our reports are developed by professionals based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These data should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

## PARTIAL USE OF REPORT

Where the recommendations of the report are only partially followed, there may be significant implications for the project and could lead to problems. Consult Asset if you are not intending to follow all of the report recommendations, to assess what the implications could be. Asset does not accept responsibility for problems that develop where the report recommendations have only been partially followed if they have not been consulted.

## OTHER LIMITATIONS

Asset will not be liable to update or revise the report to take into account any events or emergent circumstances or fact occurring or becoming apparent after the date of the report.

# APPENDIX B

Soil & Rock Explanation Sheets
Borehole Logs

ASSET GEOTECHNICAL
geotechnical engineering consultants

# Soil and Rock Explanation Sheets (1 of 2)

## LOG ABBREVIATIONS AND NOTES

**METHOD**

| *borehole logs* | | *excavation logs* | |
|---|---|---|---|
| AS | auger screw * | NE | natural excavation |
| AD | auger drill * | HE | hand excavation |
| RR | roller / tricone | BH | backhoe bucket |
| W | washbore | EX | excavator bucket |
| CT | cable tool | DZ | dozer blade |
| HA | hand auger | R | ripper tooth |
| D | diatube | | |
| B | blade / blank bit | | |
| V | V-bit | | |
| T | TC-bit | | |

* bit shown by suffix e.g. ADV

***coring***
NMLC, NQ, PQ, HQ

**SUPPORT**

| *borehole logs* | | *excavation logs* | |
|---|---|---|---|
| N | nil | N | nil |
| M | mud | S | shoring |
| C | casing | B | benched |
| NQ | NQ rods | | |

**CORE—LIFT**

casing installed

barrel withdrawn

**NOTES, SAMPLES, TESTS**

| | |
|---|---|
| D | disturbed |
| B | bulk disturbed |
| U50 | thin-walled sample, 50mm diameter |
| HP | hand penetrometer (kPa) |
| SV | shear vane test (kPa) |
| DCP | dynamic cone penetrometer (blows per 100mm penetration) |
| SPT | standard penetration test |
| N* | SPT value (blows per 300mm)<br>* denotes sample taken |
| Nc | SPT with solid cone |
| R | refusal of DCP or SPT |

**USCS SYMBOLS**

| | |
|---|---|
| GW | Well graded gravels and gravel-sand mixtures, little or no fines. |
| GP | Poorly graded gravels and gravel-sand mixtures, little or no fines. |
| GM | Silty gravels, gravel-sand-silt mixtures. |
| GC | Clayey gravels, gravel-sand-clay mixtures. |
| SW | Well graded sands and gravelly sands, little or no fines. |
| SP | Poorly graded sands and gravelly sands, little or no fines. |
| SM | Silty sand, sand-silt mixtures. |
| SC | Clayey sand, sand-clay mixtures. |
| ML | Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands. |
| CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays. |
| OL | Organic silts and organic silty clays of low plasticity. |
| MH | Inorganic silts of high plasticity. |
| CH | Inorganic clays of high plasticity. |
| OH | Organic clays of medium to high plasticity. |
| PT | Peat muck and other highly organic soils. |

**MOISTURE CONDITION**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| Wl | liquid limit |

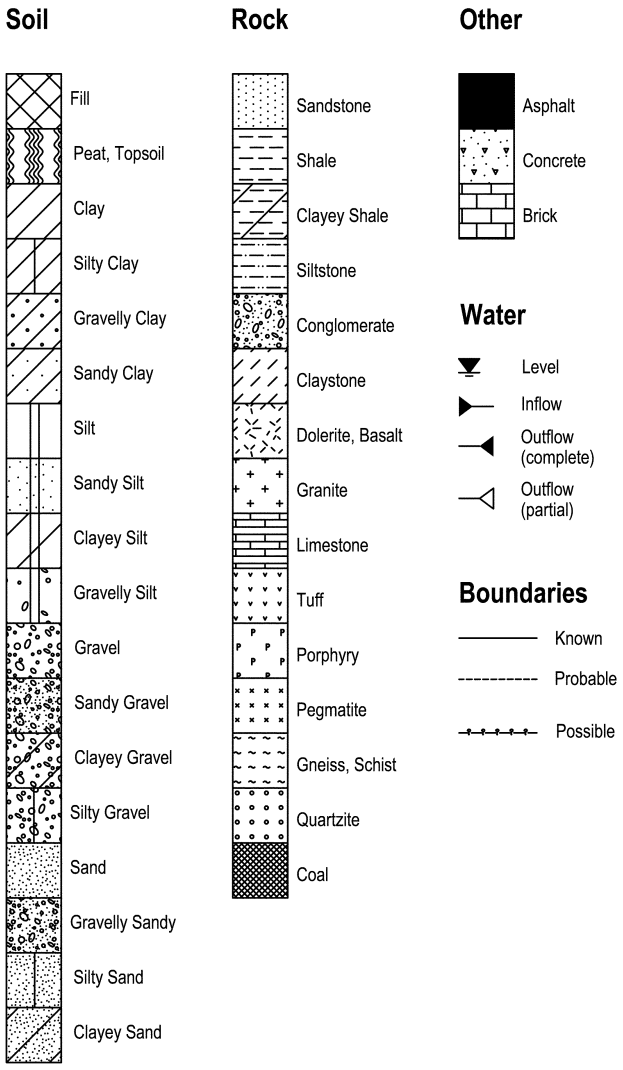
**CONSISTENCY**

| | |
|---|---|
| VS | very soft |
| S | soft |
| F | firm |
| St | stiff |
| VSt | very stiff |
| H | hard |
| Fb | friable |

**DENSITY INDEX**

| | |
|---|---|
| VL | very loose |
| L | loose |
| MD | medium dense |
| D | dense |
| VD | very dense |

**GRAPHIC LOG**




**WEATHERING**

| | |
|---|---|
| XW | extremely weathered |
| HW | highly weathered |
| MW | moderately weathered |
| SW | slightly weathered |
| FR | fresh |

**STRENGTH**

| | |
|---|---|
| EL | extremely low |
| VL | very low |
| L | low |
| M | medium |
| H | high |
| VH | very high |
| EH | extremely high |

**RQD (%)**

= $\frac{\text{sum of intact core pieces > 2 x diameter}}{\text{total length of section being evaluated}}$ x 100

**DEFECTS**

| *type* | | *coating* | |
|---|---|---|---|
| JT | joint | cl | clean |
| PT | parting | st | stained |
| SZ | shear zone | ve | veneer |
| SM | seam | co | coating |

| *shape* | | **roughness** | |
|---|---|---|---|
| pl | planar | po | polished |
| cu | curved | sl | slickensided |
| un | undulating | sm | smooth |
| st | stepped | ro | rough |
| ir | irregular | vr | very rough |

***inclination***
measured above axis and perpendicular to core

# Soil and Rock Explanation Sheets (2 of 2)

## AS1726-1993

Soils and rock are described in the following terms, which are broadly in accordance with AS1726-1993.

## SOIL

### MOISTURE CONDITION

| Term | Description |
|---|---|
| Dry | Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through the hand. |
| Moist | Feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere. |
| Wet | As for moist, but with free water forming on hands when handled. |

Moisture content of cohesive soils may also be described in relation to plastic limit ($W_P$) or liquid limit ($W_L$) [>> much greater than, > greater than, < less than, << much less than].

### CONSISTENCY OF COHESIVE SOILS

| Term | Su (kPa) | Term | Su (kPa) |
|---|---|---|---|
| Very soft | < 12 | Very Stiff | 100 – 200 |
| Soft | 12 – 25 | Hard | > 200 |
| Firm | 25 – 50 | Friable | – |
| Stiff | 50 – 100 | | |

### DENSITY OF GRANULAR SOILS

| Term | Density Index(%) | Term | Density Index (%) |
|---|---|---|---|
| Very Loose | < 15 | Dense | 65 – 85 |
| Loose | 15 – 35 | Very Dense | >85 |
| Medium Dense | 35 – 65 | | |

### PARTICLE SIZE

| Name | Subdivision | Size (mm) |
|---|---|---|
| Boulders | | > 200 |
| Cobbles | | 63 – 200 |
| Gravel | coarse | 20 – 63 |
| | medium | 6 – 20 |
| | fine | 2.36 – 6 |
| Sand | coarse | 0.6 – 2.36 |
| | medium | 0.2 – 0.6 |
| | fine | 0.075 – 0.2 |
| Silt & Clay | | < 0.075 |

### MINOR COMPONENTS

| Term | Proportion by Mass | |
|---|---|---|
| | coarse grained | fine grained |
| Trace | ≤ 5% | ≤ 15% |
| Some | 5 – 2% | 15 – 30% |

### SOIL ZONING

| | |
|---|---|
| Layers | Continuous exposures. |
| Lenses | Discontinuous layers of lenticular shape. |
| Pockets | Irregular inclusions of different material. |

### SOIL CEMENTING

| | |
|---|---|
| Weakly | Easily broken up by hand. |
| Moderately | Effort is required to break up the soil by hand. |

### USCS SYMBOLS

| Symbol | Description |
|---|---|
| GW | Well graded gravels and gravel-sand mixtures, little or no fines. |
| GP | Poorly graded gravels and gravel-sand mixtures, little or no fines. |
| GM | Silty gravels, gravel-sand-silt mixtures. |
| GC | Clayey gravels, gravel-sand-clay mixtures. |
| SW | Well graded sands and gravelly sands, little or no fines. |
| SP | Poorly graded sands and gravelly sands, little or no fines. |
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| CH | Inorganic clays of high plasticity. |
| OH | Organic clays of medium to high plasticity. |
| PT | Peat muck and other highly organic soils. |

## ROCK

### SEDIMENTARY ROCK TYPE DEFINITIONS

| Rock Type | Definition (more than 50% of rock consists of .....) |
|---|---|
| Conglomerate | ... gravel sized (>2mm) fragments. |
| Sandstone | ... sand sized (0.06 to 2mm) grains. |
| Siltstone | ... silt sized (<0.06mm) particles, rock is not laminated. |
| Claystone | ... clay, rock is not laminated. |
| Shale | ... silt or clay sized particles, rock is laminated. |

### LAYERING

| Term | Description |
|---|---|
| Massive | No layering apparent. |
| Poorly Developed | Layering just visible. Little effect on properties. |
| Well Developed | Layering distinct. Rock breaks more easily parallel to layering. |

### STRUCTURE

| Term | Spacing (mm) | Term | Spacing |
|---|---|---|---|
| Thinly laminated | <6 | Medium bedded | 200 – 600 |
| Laminated | 6 – 20 | Thickly bedded | 600 – 2,000 |
| Very thinly bedded | 20 – 60 | Very thickly bedded | > 2,000 |
| Thinly bedded | 60 – 200 | | |

### STRENGTH

| Term | Is50 (MPa) | Term | Is50 (MPa) |
|---|---|---|---|
| Extremely Low | <0.03 | High | 1.0 – 3.0 |
| Very low | 0.03 – 0.1 | Very High | 3.0 – 10.0 |
| Low | 0.1 – 0.3 | Extremely High | >10.0 |
| Medium | 0.3 – 1.0 | | |

NOTE: Is50 = Point Load Strength Index

### WEATHERING

| Term | Description |
|---|---|
| Residual Soil | Soil derived from weathering of rock; the mass structure and substance fabric are no longer evident. |
| Extremely ..... | Rock is weathered to the extent that it has soil properties (either disintegrates or can be remoulded). Fabric of original rock is still visible. |
| Highly ..... | Rock strength usually highly changed by weathering; rock may be highly discoloured. |
| Moderately ..... | Rock strength usually moderately changed by weathering; rock may be moderately discoloured. |
| Slightly ..... | Rock is slightly discoloured but shows little or no change of strength from fresh rock. |
| Fresh | Rock shows no signs of decomposition or staining. |

### DEFECT DESCRIPTION

**Type**

| | |
|---|---|
| Joint | A surface or crack across which the rock has little or no tensile strength. May be open or closed. |
| Parting | A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering/ bedding. May be open or closed. |
| Sheared Zone | Zone of rock substance with roughly parallel, near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. |
| Seam | Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed). |

**Shape**

| | |
|---|---|
| Planar | Consistent orientation. |
| Curved | Gradual change in orientation. |
| Undulating | Wavy surface. |
| Stepped | One or more well defined steps. |
| Irregular | Many sharp changes in orientation. |

**Roughness**

| | |
|---|---|
| Polished | Shiny smooth surface. |
| Slickensided | Grooved or striated surface, usually polished. |
| Smooth | Smooth to touch. Few or no surface irregularities. |
| Rough | Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper. |
| Very Rough | Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper. |

**Coating**

| | |
|---|---|
| Clean | No visible coating or discolouring. |
| Stained | No visible coating but surfaces are discolored. |
| Veneer | A visible coating of soil or mineral, too thin to measure; may be patchy |
| Coating | Visible coating ≤1mm thick. Thicker soil material described as seam. |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 1 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | | | | | | -- | Asphalt | -- | -- | | Asphalt |
| | | | | 10.0 | 0.2 | | GW | Sandy GRAVEL, fine to coarse grained, dark grey, well graded | D | VL | | Fill |
| | | | D | | 0.5 | | | | | | | |
| | | | | 9.5 | 0.6 | | GW | Clayey Sandy GRAVEL, fine to coarse grained, mottled brown and dark grey, trace of sandstone fragments, trace of ballast materials | | L | | |
| | | | D | | 1.0 | | | | | | | |
| | | | SPT 2,2,1 N*=3 | 9.0 | | | | | | | | |
| | | | | | 1.4 | | SW | SAND, fine to coarse grained, brown, well graded | M | | | |
| | | | | 8.5 | 1.5 | | | | | | | |
| | | | D | | 2.0 | | | | | | | |
| | | | | 8.0 | | | | | | | | |
| | | | D | | 2.4 | | CL | Sandy CLAY, low to medium plasticity, brown mottled grey, fine grained sand | >Wp | St | | |
| | M | | | | 2.5 | | | | | | × 200 | |
| | | | SPT 2,3,3 N*=6 | 7.5 | | | | | | | | |
| | | | | | 3.0 | | | | | | | |
| | | | | 7.0 | | | | | | | | |
| | | | D | | 3.5 | | | | | | | |
| | | | | | 3.5 | | SP | SAND, fine to medium grained, brown, poorly graded | M | L | | Alluvial |
| | | | | 6.5 | | | | | | | | |
| | | | D | | 4.0 | | | | | | | |
| | | | SPT 2,3,3 N*=6 | 6.0 | | | | | | | | |
| | | | D | | 4.5 | | | | | | | |
| | | | | 5.5 | | | | | | | | |
| | | | D | | 5.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 2 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | M | | | | | | SP | SAND, fine to medium grained, brown, poorly graded *(continued)* | M | L | | |
| | | | D | 5.0 | 5.5 | | | | | | | |
| | | | SPT 4,4,6 N*=10 | 4.5 | 6.0 | | | | | | | |
| | | | D | | | | | | | | | |
| | | | | 4.0 | 6.5 | | | | | | | |
| | | | D | | | | | | | | | |
| | | | | 3.5 | | | | | | | | |
| | | | D | | 7.0 | | | | W | | | |
| | | ~ 12.00pm ▼ | SPT 2,2,2 N*=4 | 3.0 | 7.5 | | | | | | | |
| WB | | | | 2.5 | 8.0 | | | | | | | |
| | | | | 2.0 | 8.3 | | CL | Sandy CLAY, low plasticity, grey mottled brown, with iron staining | >Wp | St | × 100 | |
| | | | SPT 3,6,10 N*=16 | 1.5 | 8.5 | | | | | VSt | × 200 | |
| | | | | 1.0 | 9.0 | | | | | | | |
| | | | | 0.5 | 9.5 | | | | | | | |
| | | | | | 10.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 3 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | | | | | | CL | Sandy CLAY, low plasticity, grey mottled brown, with iron staining *(continued)* | >Wp | VSt | | |
| | | | R | 0.0 | 10.5 | | | Borehole No: BH1 continued as cored hole from 10.2m | | | | TC Refusal |
| | | | | -0.5 | 11.0 | | | | | | | |
| | | | | -1.0 | 11.5 | | | | | | | |
| | | | | -1.5 | 12.0 | | | | | | | |
| | | | | -2.0 | 12.5 | | | | | | | |
| | | | | -2.5 | 13.0 | | | | | | | |
| | | | | -3.0 | 13.5 | | | | | | | |
| | | | | -3.5 | 14.0 | | | | | | | |
| | | | | -4.0 | 14.5 | | | | | | | |
| | | | | -4.5 | 15.0 | | | | | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 4 of 5 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial o | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating — specific / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.5 | 10.0 | | Continued from non-cored borehole from 10.2m | | | | | | |
| NMLC | | | 0.0 | 10.2 | | SHALE, grey, well developed bedding, thinly laminated | HW / SW | | D=0.42 A=0.8 | | | JT 10° pl ro cl; JT 45° cu ro cl; Caused by vibration from drilling rig |
| | | | -0.5 | 10.5 | | | | | | | | |
| | | | -1.0 | 11.0 | | | | | | | | |
| | | | -1.5 | 11.5 | | | | | | | | |
| | | | -2.0 | 12.0 | | | | | D=0.06 A=0.63 | | | CZ ro cl |
| | | | -2.5 | 12.5 | | | | | | | | BP 0-5° pl ro co/cl |
| | | | -3.0 | 13.0 | | | | | D=0.44 A=0.62 | | | JT 45° pl ro cl; JT 30° pl ro cl; JT 45° pl ro cl |
| | | | -3.5 | 13.5 | | | | | | | | |
| | | | -4.0 | 14.0 | | | | | D=0.39 A=0.84 | | | |
| | | | | 14.5 | | | | | D=0.83 | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 5 of 5 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

| drilling information | | | | | material information | | | | | rock mass defects | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description<br>rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description<br>type, inclination, thickness, shape, roughness, coating<br>specific / general |
| NMLC | | | | | | SHALE, grey, well developed bedding, thinly laminated *(continued)* | SW | | A=1.24 | | | JT 80° pl ro cl |
| | | | -4.5 | 14.75 | | BH1 terminated at 14.75m | | | | | | |
| | | | | 15.0 | | | | | | | | |
| | | | -5.0 | | | | | | | | | |
| | | | | 15.5 | | | | | | | | |
| | | | -5.5 | | | | | | | | | |
| | | | | 16.0 | | | | | | | | |
| | | | -6.0 | | | | | | | | | |
| | | | | 16.5 | | | | | | | | |
| | | | -6.5 | | | | | | | | | |
| | | | | 17.0 | | | | | | | | |
| | | | -7.0 | | | | | | | | | |
| | | | | 17.5 | | | | | | | | |
| | | | -7.5 | | | | | | | | | |
| | | | | 18.0 | | | | | | | | |
| | | | -8.0 | | | | | | | | | |
| | | | | 18.5 | | | | | | | | |
| | | | -8.5 | | | | | | | | | |
| | | | | 19.0 | | | | | | | | |
| | | | -9.0 | | | | | | | | | |
| | | | | 19.5 | | | | | | | | |


| issue | date | description |
|---|---|---|
| | | |
| | | |
| A | 18.08.14 | INITIAL ISSUE |

**ASSET** GEOTECHNICAL
geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH1

**drawn:** JZ
**date:** 18.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 1 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.9 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | | | | | | -- | Asphalt | -- | -- | | Asphalt |
| | | | | | 0.2 | | GW | Sandy GRAVEL, fine to coarse grained, dark grey mottled pale grey, trace of ballast materials | M | L | | Fill |
| | | | | 9.5 | 0.5 | | | | | | | |
| | | | | | 0.6 | | CL | Sandy CLAY, low plasticity, brown mottled grey, with fine to medium grained sand | >Wp | | | |
| | | | | | 0.8 | | CH | CLAY, high plasticity, mottled dark grey and brown, trace of fine to medium grained gravel, trace of fine to medium grained sand | >>Wp | St | | |
| | | | | 9.0 | 1.0 | | | | | | × 210 | |
| | | | SPT 4,6,6 N*=12 | 8.5 | 1.5 | | | | | | | |
| | | | | 8.0 | 2.0 | | | | | | | |
| | | | | 7.5 | 2.5 | | | | | | | |
| WB | M | | SPT 2,3,3 N*=6 | 7.0 | 3.0 | | | | | F | × 100 | |
| | | | | 6.5 | 3.5 | | | | | | | |
| | | | | | 3.8 | | CL | Sandy Silty CLAY, low plasticity, dark grey, fine grained sand, trace of fine grained gravel | >Wp | VS | | Alluvial |
| | | | SPT 0 N*=0 | 6.0 | 4.0 | | | | | | × 20 | |
| | | | | 5.5 | 4.5 | | | | | | | |
| | | | | 5.0 | 5.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
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Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 2 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | | | |
|---|---|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | | | **started:** | 15.8.2014 |
| **principal:** | | | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | | | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | | | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | | | **RL surface:** | 9.9 m approx. |
| **diameter:** | 100mm | **inclination:** -90° **bearing:** --- **E:** **N:** | | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | Water Level Observed in Piezometer ▼ | | | | | CL | Sandy Silty CLAY, low plasticity, dark grey, fine grained sand, trace of fine grained gravel *(continued)* | >Wp | VS | 100 200 300 400 | |
| | | | | | 5.3 | | SW | SAND, fine to coarse grained, brown, well graded | M | L | | |
| | | | SPT 3,3,5 N*=8 | 4.5 | 5.5 | | | | | | | |
| | | | | 4.0 | 6.0 | | | | | | | |
| | | | | 3.5 | 6.5 | | | | | MD | | |
| | | | SPT 6,7,8 N*=15 | 3.0 | 7.0 | | | | | | | *Smell of fuel on soils @7m due to possible leak from two underground fuel tanks in the vicinity of BH2 |
| | | | | 2.5 | 7.5 | | | | | | | |
| | | | | 2.0 | 8.0 | | | | | | | |
| | | | | | 8.3 | | CL | Sandy CLAY, low plasticity, mottled dark grey and brown, fine to medium grained sand | >Wp | St | | |
| | | | SPT 4,4,2 N*=6 | 1.5 | 8.5 | | | | | | × 190 | |
| | | | | 1.0 | 9.0 | | | | | | | |
| | | | | 0.5 | 9.5 | | | | | S | | |
| | | | | 0.0 | 10.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
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|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 3 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.9 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | | SPT 3,2,2 N*=4 | -0.5 | 10.5 | | CL | Sandy CLAY, low plasticity, mottled dark grey and brown, fine to medium grained sand *(continued)* | >Wp | S | × 20 | |
| | | | | -1.0 | 11.0 | | | | | | | |
| | | | | -1.5 | 11.5 | | | | | | | |
| | | | | -2.0 | 12.0 | | | | | | | |
| | | | | -2.5 | 12.5 | | | Borehole No: BH2 continued as cored hole from 12m | | | | TC Refusal |
| | | | | -3.0 | 13.0 | | | | | | | |
| | | | | -3.5 | 13.5 | | | | | | | |
| | | | | -4.0 | 14.0 | | | | | | | |
| | | | | -4.5 | 14.5 | | | | | | | |
| | | | | -5.0 | 15.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

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Suite 2.05 / 56 Delhi Road
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Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 4 of 5 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.9 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating (specific / general) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None Observed | -2.0 | 12.0 | | Continued from non-cored borehole from 12m | | | | | | |
| NMLC | | | | 12 | | SHALE, dark grey, well developed bedding, thinly laminated | SW | | | | | |
| | | | -2.5 | 12.5 | | | | | | | | JT 45° pl sm cl |
| | | | | | | | | | | | | JT 45° pl sm cl |
| | | | -3.0 | 13.0 | | | | | D=0.8 A=0.86 | | | JT 25° pl sm cl |
| | | | -3.5 | 13.5 | | | | | | | | |
| | | | -4.0 | 14.0 | | | | | D=0.54 A=0.77 | | | |
| | | | -4.5 | 14.5 | | | | | | | | JT 20° pl sm cl |
| | | | -5.0 | 15.0 | | | | | D=0.81 A=0.84 | | | BP 0-5° pl sm cl |
| | | | -5.5 | 15.5 | | | | | | | | |
| | | | -6.0 | 16.0 | | | | | D=0.53 A=0.79 | | | |
| | | | -6.5 | 16.5 | | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 5 of 5 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.9 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

| drilling information | | | | | material information | | | | | rock mass defects | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa: EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH | $Is_{(50)}$ MPa D=diametral × A=axial | RQD % | defect spacing mm: 20, 60, 200, 600, 2000 | defect description: type, inclination, thickness, shape, roughness, coating — specific / general |
| NMLC | | | | | | SHALE, dark grey, well developed bedding, thinly laminated *(continued)* | SW | | D=1.26 | | | |
| | | | | 16.74 | | BH2 terminated at 16.74m | | | A=1.67 | | | |
| | | | -7.0 | 17.0 | | | | | | | | |
| | | | -7.5 | 17.5 | | | | | | | | |
| | | | -8.0 | 18.0 | | | | | | | | |
| | | | -8.5 | 18.5 | | | | | | | | |
| | | | -9.0 | 19.0 | | | | | | | | |
| | | | -9.5 | 19.5 | | | | | | | | |
| | | | -10.0 | 20.0 | | | | | | | | |
| | | | -10.5 | 20.5 | | | | | | | | |
| | | | -11.0 | 21.0 | | | | | | | | |
| | | | -11.5 | 21.5 | | | | | | | | |


| issue | date | description |
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| | | |
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geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED-USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH2

**drawn:** JZ
**date:** 18.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH3** |
| **sheet:** | 1 of 3 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 19.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | | | 10.0 | | | -- | Asphalt | -- | -- | | Asphalt |
| | | | | | 0.1 | | CL | Sandy Gravelly CLAY, low plasticity, mottled dark grey/red brown/white, fine to coarse grained sand, fine to coaorse grained gravel, with sandstone fragments | ~Wp | S | | Fill |
| | | | | | 0.5 | | | | | | | |
| | | | | 9.5 | 0.5 | | SW | SAND, fine to coarse grained, brown, well graded | M | MD | | |
| | | | | | 1.0 | | | | | | | |
| | | | SPT 1,2,1 N*=3 | 9.0 | 1 | | CL | Sandy CLAY, low to medium plasticity, brown mottled dark grey, with terracotta fragments from 1.5 to 1.7m | >Wp | S | | |
| | | | | | 1.5 | | | | | | | |
| | | | | 8.5 | | | | | | | | |
| | | | | | 2.0 | | | | | | | |
| | | | | 8.0 | | | | | | | | |
| | | | | | 2.5 | | | | | | | |
| WB | M | | | 7.5 | 2.6 | | CH | CLAY, medium to high plasticity, mottled red-brown/grey/brown, with fine to medium grained sand, with ironstaining | | VSt | × 400 | Alluvial |
| | | | SPT 2,6,8 N*=14 | | | | | | | | | |
| | | | | 7.0 | 3.0 | | | | | | | |
| | | | | | 3.5 | | | | | | | |
| | | | | 6.5 | | | | | | | | |
| | | | | | 4.0 | | | | | | | |
| | | | SPT 7,9,10 N*=19 | 6.0 | | | | | | | × 300 | |
| | | | | | 4.5 | | | | | | | |
| | | | | 5.5 | | | | | | | | |
| | | | | | 5.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH3** |
| **sheet:** | 2 of 3 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 19.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | Water Level Observed in Piezometer ▼ | | 5.0 | 5.5 | | CH | CLAY, medium to high plasticity, mottled red-brown/grey/brown, with fine to medium grained sand, with ironstaining *(continued)* | >Wp | St | × 150 | |
| | | | SPT 3,3,8 N*=11 | 4.5 | | | | | | | | |
| | | | | 4.0 | 6.0 | | | | | | | |
| | | | | 3.5 | 6.5 | | | | | | | |
| | | | | | 6.8 | | SP | Clayey SAND, fine to medium grained, brown, poorly graded | M | MD | | |
| | | | SPT 6,6,10 N*=16 | 3.0 | 7.0 | | | | | | | |
| | | | | 2.5 | 7.5 | | | | | | | |
| | | | | 2.0 | 8.0 | | | | | | | |
| | | | | 1.5 | 8.5 | | | | | | | |
| | | | | 1.0 | 9.0 | | | | | | | |
| | | | | 0.5 | 9.5 | | | | | | | |
| | | | | | 10.0 | | | Borehole No: BH3 continued as cored hole from 9.7m | | | | TC Refusal |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH3** |
| **sheet:** | 3 of 3 |
| **job no.:** | 2606 |

# Cored Borehole Log

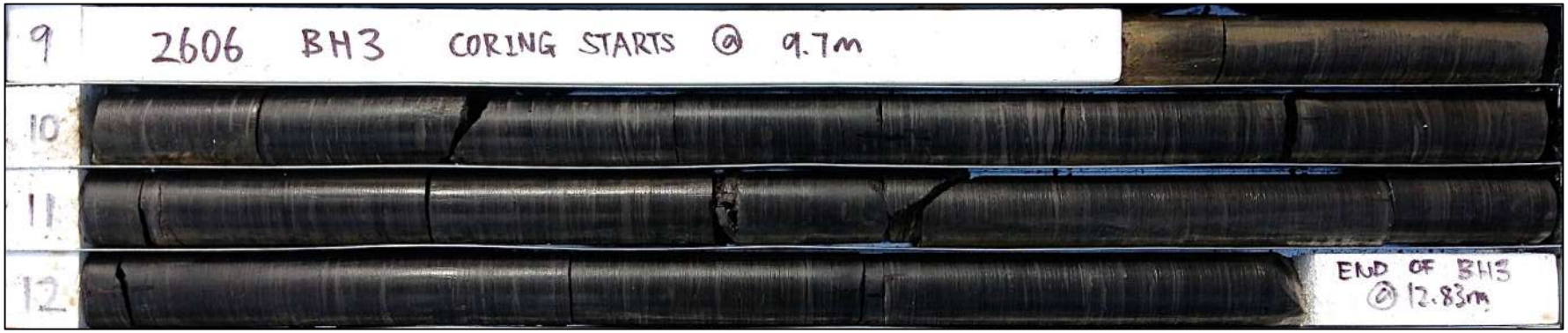
| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 19.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial o | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating — specific / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None Observed | 1.0 | 9.5 | | | | | | | | |
| | | | 0.5 | | | Continued from non-cored borehole from 9.7m | | | | | | |
| NMLC | | | | 9.7 | | SHALE, dark grey, well developed bedding, thinly laminated | SW | | | | | |
| | | | | 10.0 | | | | | D=0.48 | | | |
| | | | 0.0 | | | | | | A=1.2 | | | |
| | | | | 10.5 | | | | | | | | Fractured Zone, sm, cl |
| | | | -0.5 | | | | | | | | | |
| | | | | 11.0 | | | | | D=0.56 | | | |
| | | | -1.0 | | | | | | A=0.8 | | | JT 10° cu sm cl |
| | | | | 11.5 | | | | | | | | Clay SM, sm co |
| | | | -1.5 | | | | | | | | | JT 45° pl sm cl |
| | | | | 12.0 | | | | | D=0.21 | | | |
| | | | -2.0 | | | | | | A=0.83 | | | |
| | | | | 12.5 | | | | | D=0.88 | | | |
| | | | -2.5 | | | | | | A=1.57 | | | |
| | | | | 12.83 | | BH3 terminated at 12.83m | | | | | | |
| | | | | 13.0 | | | | | | | | |
| | | | -3.0 | | | | | | | | | |
| | | | | 13.5 | | | | | | | | |
| | | | -3.5 | | | | | | | | | |
| | | | | 14.0 | | | | | | | | |

BP 0-5° pl sm cl

2606 BOREHOLE LOG.GPJ 5/11/14




| issue | date | description |
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geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH3

**drawn:** JZ
**date:** 21.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH4** |
| **sheet:** | 1 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 19.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.5 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetrometer kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | None Observed | | | | | GW | Clayey Sandy GRAVEL, fine to coarse grained, grey mottled brown, well graded | M | L | | Fill |
| | | | D | 9.0 | 0.5 | | CL | Sandy Gravelly CLAY, low to medium plasticity, mottled grey and brown, fine to coarse grained sand, fine to medium grained gravel | >>Wp | F | × 80 | |
| | | | D | | | | | | | | | |
| | | | | 8.5 | 1.0 | | | | | | | |
| | | | SPT 0 N*=0 | | | | | | | St | | |
| | | | D | 8.0 | 1.5 | | | | | | × 150 | |
| | | | | | 1.7 | | SC | Clayey SAND, fine to coarse grained, dark grey, with fine to medium grained gravel, well graded | M | L | | |
| | | | D | 7.5 | 2.0 | | | | | | | |
| | | | | | 2 | | CH | Sandy CLAY, high plasticity, dark grey mottled brown , fine to medium grained sand, with fine grained gravel *Possible coal tar contamination* | >>Wp | VSt | × 120 | |
| | | | D | | | | | | | | | |
| WB | M | | | 7.0 | 2.5 | | | | | VSt | | |
| | | | SPT 4,5,5 N*=10 | | | | | | | | × 300 | |
| | | | D | 6.5 | 3.0 | | | | | | | |
| | | | | 6.0 | 3.5 | | | | | | | |
| | | | | 5.5 | 4.0 | | | | | | | |
| | | | SPT 1,3,6 N*=9 | | | | | | | | | |
| | | | | 5.0 | 4.5 | | | | | | | |
| | | | | 4.5 | 5.0 | | | | | | | |
| | | | | | 4.2 | | SC | Clayey SAND, fine to coarse grained, brown mottled red-brown, with ironstaining | M | L | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH4** |
| **sheet:** | 2 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 19.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.5 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | None Observed | | | 5.5 | | SC | Clayey SAND, fine to coarse grained, brown mottled red-brown, with ironstaining *(continued)* | M | L | | |
| | | | SPT 8,5,6 N*=11 | 4.0 | | | | | | | | |
| | | | | | 5.7 | | CH | CLAY, high plasticity, dark brown, trace of fine grained sand | >>Wp | VSt | × 290 | |
| | | | | 3.5 | 6.0 | | | | | | | |
| | | | | 3.0 | 6.5 | | | | | | | |
| | | | | | 6.9 | | SW | SAND, fine to coarse grained, pale brown, well graded, with fine grained gravel | M | L | | Alluvial |
| | | | SPT 3,4,4 N*=8 | 2.5 | 7.0 | | | | | | | |
| | | | | 2.0 | 7.5 | | | | | | | |
| | | | | 1.5 | 8.0 | | | | | | | |
| | | | | 1.0 | 8.5 | | | | | | | |
| | | | SPT 2,3,5 N*=8 | | | | | | | | | |
| | | | D | 0.5 | 9.0 | | | | | | | |
| | | | | 0.0 | 9.5 | | | | | | | |
| | | | D | | | | | | | | | |
| | | | | -0.5 | 10.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH4** |
| **sheet:** | 3 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 19.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.5 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | None Observed | SPT 2,3,7 N*=10 | | 10 | | SP | SAND, fine to medium grained, grey, poorly graded | M | L | | |
| | | | | -1.0 | 10.5 | | | | | | | |
| | | | | -1.5 | 11.0 | | | | | | | |
| | | | | | 11 | | CL | Sandy CLAY, low plasticity, dark grey, with wood fragments | >>Wp | -- | | |
| | | | | -2.0 | 11.5 | | | | | | | |
| | | | | -2.5 | 12.0 | | | | | | | |
| | | | | -3.0 | 12.5 | | | | | | | |
| | | | | -3.5 | 13.0 | | | Borehole No: BH4 continued as cored hole from 12.9m | | | | TC Refusal |
| | | | | -4.0 | 13.5 | | | | | | | |
| | | | | -4.5 | 14.0 | | | | | | | |
| | | | | -5.0 | 14.5 | | | | | | | |
| | | | | -5.5 | 15.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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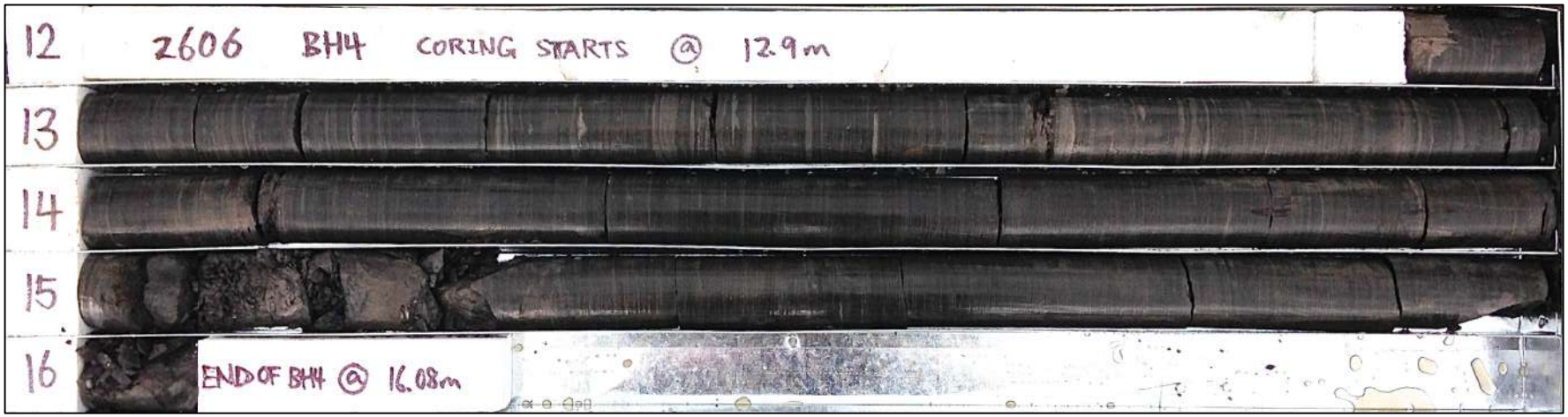
|---|---|
| **BH no:** | **BH4** |
| **sheet:** | 4 of 4 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 19.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.5 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial o | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating — specific / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None Observed | | | | Continued from non-cored borehole from 12.9m | | | D=0.3 | | | |
| NMLC | | | -3.5 | 12.9<br>13.0 | | SHALE, dark grey, well developed bedding, thinly laminated | SW | | A=1.12 | | | |
| | | | -4.0 | 13.5 | | | | | | | | Clay SM, sm cl |
| | | | | | | | | | D=0.16 | | | |
| | | | -4.5 | 14.0 | | | | | A=0.61 | | | |
| | | | | | | | | | | | | Clay SM, sm cl |
| | | | -5.0 | 14.5 | | | | | | | | BP 0-5° pl sm cl |
| | | | | | | | | | D=0.11 | | | |
| | | | -5.5 | 15.0 | | | | | A=1.23 | | | |
| | | | | | | | | | | | | Crushed Zone, sm cl |
| | | | | | | | | | | | | Crushed Zone, sm cl |
| | | | | | | | | | | | | Fractured Zone, sm cl |
| | | | -6.0 | 15.5 | | | | | D=0.75 | | | |
| | | | -6.5 | 16.0 | | | | | A=0.7 | | | JT 15° cu sm cl |
| | | | | 16.08 | | BH4 terminated at 16.08m | | | | | | |
| | | | -7.0 | 16.5 | | | | | | | | |
| | | | -7.5 | 17.0 | | | | | | | | |
| | | | -8.0 | 17.5 | | | | | | | | |




| issue | date | description |
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| A | 21.08.14 | INITIAL ISSUE |

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geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH4

**drawn:** JZ
**date:** 21.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH5** |
| **sheet:** | 1 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 20.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | None Observed | | 10.0 | | | -- | Asphalt | -- | -- | | Asphalt |
| | | | | | 0.1 | | SC | Clayey Gravelly SAND, fine to coarse grained, mottled brown and grey, well graded | M | L | | Fill |
| | | | | | 0.3 | | CL | Gravelly Sandy CLAY, low plasticity, mottled brown/grey/red-brown, fine to coarse grained sand and gravel | ~Wp | F | | |
| | | | | 9.5 | 0.5 | | | | | | | |
| | | | | | 1.0 | | | | | | × 100 | |
| | | | | 9.0 | 1 | | SC | Clayey SAND, fine to coarse grained, dark grey mottled brown, with fine to medium grained gravel, with ash deposits | M | L | | |
| | | | | 8.5 | 1.5 | | | | | | | |
| | | | | | 1.6 | | SP | SAND, fine to medium grained, brown, poorly graded | | | | Alluvial |
| | | | | 8.0 | 2.0 | | | | | | | |
| WB | M | | SPT 2,3,3 N*=6 | 7.5 | 2.5 | | | | | | | |
| | | | | 7.0 | 3.0 | | | | | | | |
| | | | | | 3.3 | | CL | Sandy CLAY, low plasticity, dark grey, with fine grained gravel | >Wp | St | | |
| | | | D | 6.5 | 3.5 | | | | | | | |
| | | | D | 6.0 | 4.0 | | | | | | | |
| | | | D | 5.5 | 4.5 | | | | | | | |
| | | | D | | 5.0 | | | | | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH5** |
| **sheet:** | 2 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | | | |
|---|---|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | | | **started:** | 20.8.2014 |
| **principal:** | | | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | | | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | | | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | | | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm | **inclination:** -90° **bearing:** --- | **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | None Observed | | 5.0 | 5.5 | | CL | Sandy CLAY, low plasticity, dark grey, with fine grained gravel *(continued)* | >Wp | St | | |
| | | | SPT 10,15,15 N*=30 | 4.5 | 5.5 | | SC | Clayey SAND, fine to medium grained, brown | M | D | | |
| | | | D | | 6.0 | | | | | | | |
| | | | | 4.0 | | | | | | | | |
| | | | | | 6.5 | | | | | | | |
| | | | | 3.5 | | | | | | | | |
| | | | D | | 7.0 | | | | | | | |
| | | | | 3.0 | | | | | | | | |
| | | | D | | 7.5 | | | | | MD | | |
| | | | | 2.5 | | | | | | | | |
| | | | | | 8.0 | | | | | | | |
| | | | | 2.0 | | | | | | | | |
| | | | | | 8.5 | | | | | | | |
| | | | SPT 4,6,8 N*=14 | 1.5 | | | | | | | | |
| | | | | | 9.0 | | | | | | | |
| | | | | 1.0 | | | | | | | | |
| | | | | | 9.5 | | | | | | | |
| | | | | 0.5 | 9.5 | | CL | Sandy CLAY, low plasticity, brown, with fine grained sand | >Wp | | | |
| | | | | | 10.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH5** |
| **sheet:** | 3 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 20.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description<br>soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | None Observed | | 0.0<br>-0.5<br>-1.0 | 10.5<br>11.0 | | CL | Sandy CLAY, low plasticity, brown, with fine grained sand *(continued)* | >Wp | MD | | |
| | | | | -1.5<br>-2.0<br>-2.5<br>-3.0<br>-3.5<br>-4.0<br>-4.5 | 11.5<br>12.0<br>12.5<br>13.0<br>13.5<br>14.0<br>14.5<br>15.0 | | | Borehole No: BH5 continued as cored hole from 11.4m | | | | TC Refusal |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH5** |
| **sheet:** | 4 of 4 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 20.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating (specific / general) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None Observed | -1.0 | | | | | | | | | |
| | | | | | | Continued from non-cored borehole from 11.4m | | | | | | |
| NMLC | | | | 11.4 | | SHALE, grey, well developed bedding, thinly laminated | RS / SW | | | | | |
| | | | -1.5 | 11.5 | | | | | | | | Crushed SM, sm cl<br>SM sm cl |
| | | | | | | | | | D=0.16 | | | SM sm cl |
| | | | | 12.0 | | | | | A=0.4 | | | |
| | | | -2.0 | | | | | | | | | Clay SM, sm co<br>JT 45° pl sm cl<br>JT 80° pl sm cl<br>JT 45° pl sm cl<br>JT 45° pl sm cl |
| | | | | 12.5 | | | | | | | | Clay SM, sm co |
| | | | -2.5 | | | | | | | | | Clay SM, sm co |
| | | | | | | | | | D=0.67 | | | JT 25° pl sm cl |
| | | | | | | | | | A=0.82 | | | |
| | | | | 13.0 | | | | | | | | BP 0-5° pl sm cl |
| | | | -3.0 | | | | | | | | | JT 70° pl sm cl |
| | | | | | | | | | | | | JT 60° un sm cl |
| | | | | 13.5 | | | | | D=0.43 | | | |
| | | | -3.5 | | | | | | A=1.02 | | | *Possible drilling induced fractured zone* |
| | | | | 14.0 | | | | | | | | |
| | | | -4.0 | | | | | | | | | |
| | | | | | | | | | D=0.59 | | | |
| | | | | 14.32 | | BH5 terminated at 14.32m | | | A=0.62 | | | |
| | | | | 14.5 | | | | | | | | |
| | | | -4.5 | | | | | | | | | |
| | | | | 15.0 | | | | | | | | |
| | | | -5.0 | | | | | | | | | |
| | | | | 15.5 | | | | | | | | |
| | | | -5.5 | | | | | | | | | |
| | | | | 16.0 | | | | | | | | |


| issue | date | description |
|---|---|---|
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| | | |
| A | 21.08.14 | INITIAL ISSUE |

**ASSET** GEOTECHNICAL
geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH5

**drawn:** JZ
**date:** 21.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 1 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | | | | | | -- | Asphalt | -- | -- | | Asphalt |
| | | | | 10.0 | 0.2 | | GW | Sandy GRAVEL, fine to coarse grained, dark grey, well graded | D | VL | | Fill |
| | | | D | | 0.5 | | | | | | | |
| | | | | 9.5 | 0.6 | | GW | Clayey Sandy GRAVEL, fine to coarse grained, mottled brown and dark grey, trace of sandstone fragments, trace of ballast materials | | L | | |
| | | | D | | 1.0 | | | | | | | |
| | | | SPT 2,2,1 N*=3 | 9.0 | | | | | | | | |
| | | | | | 1.4 | | SW | SAND, fine to coarse grained, brown, well graded | M | | | |
| | | | | 8.5 | 1.5 | | | | | | | |
| | | | D | | 2.0 | | | | | | | |
| | | | | 8.0 | | | | | | | | |
| | | | D | | 2.4 | | CL | Sandy CLAY, low to medium plasticity, brown mottled grey, fine grained sand | >Wp | St | | |
| | M | | | | 2.5 | | | | | | × 200 | |
| | | | SPT 2,3,3 N*=6 | 7.5 | | | | | | | | |
| | | | | | 3.0 | | | | | | | |
| | | | | 7.0 | | | | | | | | |
| | | | D | | 3.5 | | | | | | | |
| | | | | | 3.5 | | SP | SAND, fine to medium grained, brown, poorly graded | M | L | | Alluvial |
| | | | | 6.5 | | | | | | | | |
| | | | D | | 4.0 | | | | | | | |
| | | | SPT 2,3,3 N*=6 | 6.0 | | | | | | | | |
| | | | D | | 4.5 | | | | | | | |
| | | | | 5.5 | | | | | | | | |
| | | | D | | 5.0 | | | | | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 2 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | M | | | | | | SP | SAND, fine to medium grained, brown, poorly graded *(continued)* | M | L | | |
| | | | D | 5.0 | 5.5 | | | | | | | |
| | | | SPT 4,4,6 N*=10 | 4.5 | 6.0 | | | | | | | |
| | | | D | | | | | | | | | |
| | | | | 4.0 | 6.5 | | | | | | | |
| | | | D | | | | | | | | | |
| | | | | 3.5 | | | | | | | | |
| | | | D | | 7.0 | | | | W | | | |
| | | ~ 12.00pm ▼ | SPT 2,2,2 N*=4 | 3.0 | 7.5 | | | | | | | |
| WB | | | | 2.5 | 8.0 | | | | | | | |
| | | | | 2.0 | 8.3 | | CL | Sandy CLAY, low plasticity, grey mottled brown, with iron staining | >Wp | St | × 100 | |
| | | | SPT 3,6,10 N*=16 | 1.5 | 8.5 | | | | | VSt | × 200 | |
| | | | | 1.0 | 9.0 | | | | | | | |
| | | | | 0.5 | 9.5 | | | | | | | |
| | | | | | 10.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 3 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | | | | | | CL | Sandy CLAY, low plasticity, grey mottled brown, with iron staining *(continued)* | >Wp | VSt | | |
| | | | R | 0.0 | 10.5 | | | Borehole No: BH1 continued as cored hole from 10.2m | | | | TC Refusal |
| | | | | -0.5 | 11.0 | | | | | | | |
| | | | | -1.0 | 11.5 | | | | | | | |
| | | | | -1.5 | 12.0 | | | | | | | |
| | | | | -2.0 | 12.5 | | | | | | | |
| | | | | -2.5 | 13.0 | | | | | | | |
| | | | | -3.0 | 13.5 | | | | | | | |
| | | | | -3.5 | 14.0 | | | | | | | |
| | | | | -4.0 | 14.5 | | | | | | | |
| | | | | -4.5 | 15.0 | | | | | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 4 of 5 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial o | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating — specific / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.5 | 10.0 | | Continued from non-cored borehole from 10.2m | | | | | | |
| NMLC | | | 0.0 | 10.2 | | SHALE, grey, well developed bedding, thinly laminated | HW / SW | | D=0.42 A=0.8 | | | JT 10° pl ro cl; JT 45° cu ro cl; Caused by vibration from drilling rig |
| | | | -0.5 | 10.5 | | | | | | | | |
| | | | -1.0 | 11.0 | | | | | | | | |
| | | | -1.5 | 11.5 | | | | | | | | |
| | | | -2.0 | 12.0 | | | | | D=0.06 A=0.63 | | | CZ ro cl |
| | | | -2.5 | 12.5 | | | | | | | | BP 0-5° pl ro co/cl |
| | | | -3.0 | 13.0 | | | | | D=0.44 A=0.62 | | | JT 45° pl ro cl; JT 30° pl ro cl; JT 45° pl ro cl |
| | | | -3.5 | 13.5 | | | | | | | | |
| | | | -4.0 | 14.0 | | | | | D=0.39 A=0.84 | | | |
| | | | | 14.5 | | | | | D=0.83 | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
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|---|---|
| **BH no:** | **BH1** |
| **sheet:** | 5 of 5 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 14.8.2014 |
| **principal:** | | **finished:** | 14.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.3 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

| drilling information | | | | | material information | | | | | rock mass defects | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description<br>rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description<br>type, inclination, thickness, shape, roughness, coating<br>specific / general |
| NMLC | | | | | | SHALE, grey, well developed bedding, thinly laminated *(continued)* | SW | | A=1.24 | | | JT 80° pl ro cl |
| | | | -4.5 | 14.75 | | BH1 terminated at 14.75m | | | | | | |
| | | | | 15.0 | | | | | | | | |
| | | | -5.0 | | | | | | | | | |
| | | | | 15.5 | | | | | | | | |
| | | | -5.5 | | | | | | | | | |
| | | | | 16.0 | | | | | | | | |
| | | | -6.0 | | | | | | | | | |
| | | | | 16.5 | | | | | | | | |
| | | | -6.5 | | | | | | | | | |
| | | | | 17.0 | | | | | | | | |
| | | | -7.0 | | | | | | | | | |
| | | | | 17.5 | | | | | | | | |
| | | | -7.5 | | | | | | | | | |
| | | | | 18.0 | | | | | | | | |
| | | | -8.0 | | | | | | | | | |
| | | | | 18.5 | | | | | | | | |
| | | | -8.5 | | | | | | | | | |
| | | | | 19.0 | | | | | | | | |
| | | | -9.0 | | | | | | | | | |
| | | | | 19.5 | | | | | | | | |


| issue | date | description |
|---|---|---|
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| | | |
| A | 18.08.14 | INITIAL ISSUE |

**ASSET** GEOTECHNICAL
geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH1

**drawn:** JZ
**date:** 18.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 1 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.9 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | | | | | | -- | Asphalt | -- | -- | | Asphalt |
| | | | | | 0.2 | | GW | Sandy GRAVEL, fine to coarse grained, dark grey mottled pale grey, trace of ballast materials | M | L | | Fill |
| | | | | 9.5 | 0.5 | | | | | | | |
| | | | | | 0.6 | | CL | Sandy CLAY, low plasticity, brown mottled grey, with fine to medium grained sand | >Wp | | | |
| | | | | | 0.8 | | CH | CLAY, high plasticity, mottled dark grey and brown, trace of fine to medium grained gravel, trace of fine to medium grained sand | >>Wp | St | | |
| | | | | 9.0 | 1.0 | | | | | | × 210 | |
| | | | SPT 4,6,6 N*=12 | 8.5 | 1.5 | | | | | | | |
| | | | | 8.0 | 2.0 | | | | | | | |
| | | | | 7.5 | 2.5 | | | | | | | |
| WB | M | | SPT 2,3,3 N*=6 | 7.0 | 3.0 | | | | | F | × 100 | |
| | | | | 6.5 | 3.5 | | | | | | | |
| | | | | | 3.8 | | CL | Sandy Silty CLAY, low plasticity, dark grey, fine grained sand, trace of fine grained gravel | >Wp | VS | | Alluvial |
| | | | SPT 0 N*=0 | 6.0 | 4.0 | | | | | | × 20 | |
| | | | | 5.5 | 4.5 | | | | | | | |
| | | | | 5.0 | 5.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
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|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 2 of 5 |
| **job no.:** | 2606 |

# Borehole Log

| | | | | | |
|---|---|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | | | **started:** | 15.8.2014 |
| **principal:** | | | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | | | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | | | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | | | **RL surface:** | 9.9 m approx. |
| **diameter:** | 100mm | **inclination:** -90° **bearing:** --- **E:** **N:** | | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | Water Level Observed in Piezometer ▼ | | | | | CL | Sandy Silty CLAY, low plasticity, dark grey, fine grained sand, trace of fine grained gravel *(continued)* | >Wp | VS | 100 200 300 400 | |
| | | | | | 5.3 | | SW | SAND, fine to coarse grained, brown, well graded | M | L | | |
| | | | SPT 3,3,5 N*=8 | 4.5 | 5.5 | | | | | | | |
| | | | | 4.0 | 6.0 | | | | | | | |
| | | | | 3.5 | 6.5 | | | | | MD | | |
| | | | SPT 6,7,8 N*=15 | 3.0 | 7.0 | | | | | | | *Smell of fuel on soils @7m due to possible leak from two underground fuel tanks in the vicinity of BH2 |
| | | | | 2.5 | 7.5 | | | | | | | |
| | | | | 2.0 | 8.0 | | | | | | | |
| | | | | | 8.3 | | CL | Sandy CLAY, low plasticity, mottled dark grey and brown, fine to medium grained sand | >Wp | St | | |
| | | | SPT 4,4,2 N*=6 | 1.5 | 8.5 | | | | | | × 190 | |
| | | | | 1.0 | 9.0 | | | | | | | |
| | | | | 0.5 | 9.5 | | | | | S | | |
| | | | | 0.0 | 10.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
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|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 3 of 5 |
| **job no.:** | 2606 |

# Borehole Log

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|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.9 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | | SPT 3,2,2 N*=4 | -0.5 | 10.5 | | CL | Sandy CLAY, low plasticity, mottled dark grey and brown, fine to medium grained sand *(continued)* | >Wp | S | × 20 | |
| | | | | -1.0 | 11.0 | | | | | | | |
| | | | | -1.5 | 11.5 | | | | | | | |
| | | | | -2.0 | 12.0 | | | | | | | |
| | | | | -2.5 | 12.5 | | | Borehole No: BH2 continued as cored hole from 12m | | | | TC Refusal |
| | | | | -3.0 | 13.0 | | | | | | | |
| | | | | -3.5 | 13.5 | | | | | | | |
| | | | | -4.0 | 14.0 | | | | | | | |
| | | | | -4.5 | 14.5 | | | | | | | |
| | | | | -5.0 | 15.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 4 of 5 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.9 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating (specific / general) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None Observed | -2.0 | 12.0 | | Continued from non-cored borehole from 12m | | | | | | |
| NMLC | | | | 12 | | SHALE, dark grey, well developed bedding, thinly laminated | SW | | | | | |
| | | | -2.5 | 12.5 | | | | | | | | JT 45° pl sm cl |
| | | | | | | | | | | | | JT 45° pl sm cl |
| | | | -3.0 | 13.0 | | | | | D=0.8 A=0.86 | | | JT 25° pl sm cl |
| | | | -3.5 | 13.5 | | | | | | | | |
| | | | -4.0 | 14.0 | | | | | D=0.54 A=0.77 | | | |
| | | | -4.5 | 14.5 | | | | | | | | JT 20° pl sm cl |
| | | | -5.0 | 15.0 | | | | | D=0.81 A=0.84 | | | BP 0-5° pl sm cl |
| | | | -5.5 | 15.5 | | | | | | | | |
| | | | -6.0 | 16.0 | | | | | D=0.53 A=0.79 | | | |
| | | | -6.5 | 16.5 | | | | | | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH2** |
| **sheet:** | 5 of 5 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 15.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.9 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

| drilling information | | | | | material information | | | | | rock mass defects | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa: EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH | $Is_{(50)}$ MPa D=diametral × A=axial | RQD % | defect spacing mm: 20, 60, 200, 600, 2000 | defect description: type, inclination, thickness, shape, roughness, coating — specific / general |
| NMLC | | | | | | SHALE, dark grey, well developed bedding, thinly laminated *(continued)* | SW | | D=1.26 | | | |
| | | | | 16.74 | | BH2 terminated at 16.74m | | | A=1.67 | | | |
| | | | -7.0 | 17.0 | | | | | | | | |
| | | | -7.5 | 17.5 | | | | | | | | |
| | | | -8.0 | 18.0 | | | | | | | | |
| | | | -8.5 | 18.5 | | | | | | | | |
| | | | -9.0 | 19.0 | | | | | | | | |
| | | | -9.5 | 19.5 | | | | | | | | |
| | | | -10.0 | 20.0 | | | | | | | | |
| | | | -10.5 | 20.5 | | | | | | | | |
| | | | -11.0 | 21.0 | | | | | | | | |
| | | | -11.5 | 21.5 | | | | | | | | |


| issue | date | description |
|---|---|---|
| | | |
| | | |
| A | 18.08.14 | INITIAL ISSUE |

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geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED-USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH2

**drawn:** JZ
**date:** 18.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH3** |
| **sheet:** | 1 of 3 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 19.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | | | 10.0 | | | -- | Asphalt | -- | -- | | Asphalt |
| | | | | | 0.1 | | CL | Sandy Gravelly CLAY, low plasticity, mottled dark grey/red brown/white, fine to coarse grained sand, fine to coaorse grained gravel, with sandstone fragments | ~Wp | S | | Fill |
| | | | | | 0.5 | | | | | | | |
| | | | | 9.5 | 0.5 | | SW | SAND, fine to coarse grained, brown, well graded | M | MD | | |
| | | | | | 1.0 | | | | | | | |
| | | | SPT 1,2,1 N*=3 | 9.0 | 1 | | CL | Sandy CLAY, low to medium plasticity, brown mottled dark grey, with terracotta fragments from 1.5 to 1.7m | >Wp | S | | |
| | | | | | 1.5 | | | | | | | |
| | | | | 8.5 | | | | | | | | |
| | | | | | 2.0 | | | | | | | |
| | | | | 8.0 | | | | | | | | |
| | | | | | 2.5 | | | | | | | |
| WB | M | | | 7.5 | 2.6 | | CH | CLAY, medium to high plasticity, mottled red-brown/grey/brown, with fine to medium grained sand, with ironstaining | | VSt | × 400 | Alluvial |
| | | | SPT 2,6,8 N*=14 | | | | | | | | | |
| | | | | 7.0 | 3.0 | | | | | | | |
| | | | | | 3.5 | | | | | | | |
| | | | | 6.5 | | | | | | | | |
| | | | | | 4.0 | | | | | | | |
| | | | SPT 7,9,10 N*=19 | 6.0 | | | | | | | × 300 | |
| | | | | | 4.5 | | | | | | | |
| | | | | 5.5 | | | | | | | | |
| | | | | | 5.0 | | | | | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
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| | |
|---|---|
| **BH no:** | **BH3** |
| **sheet:** | 2 of 3 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 19.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | Water Level Observed in Piezometer ▼ | | 5.0 | 5.5 | | CH | CLAY, medium to high plasticity, mottled red-brown/grey/brown, with fine to medium grained sand, with ironstaining *(continued)* | >Wp | St | × 150 | |
| | | | SPT 3,3,8 N*=11 | 4.5 | | | | | | | | |
| | | | | 4.0 | 6.0 | | | | | | | |
| | | | | 3.5 | 6.5 | | | | | | | |
| | | | | | 6.8 | | SP | Clayey SAND, fine to medium grained, brown, poorly graded | M | MD | | |
| | | | SPT 6,6,10 N*=16 | 3.0 | 7.0 | | | | | | | |
| | | | | 2.5 | 7.5 | | | | | | | |
| | | | | 2.0 | 8.0 | | | | | | | |
| | | | | 1.5 | 8.5 | | | | | | | |
| | | | | 1.0 | 9.0 | | | | | | | |
| | | | | 0.5 | 9.5 | | | | | | | |
| | | | | | 10.0 | | | Borehole No: BH3 continued as cored hole from 9.7m | | | | TC Refusal |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
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| | |
|---|---|
| **BH no:** | **BH3** |
| **sheet:** | 3 of 3 |
| **job no.:** | 2606 |

# Cored Borehole Log

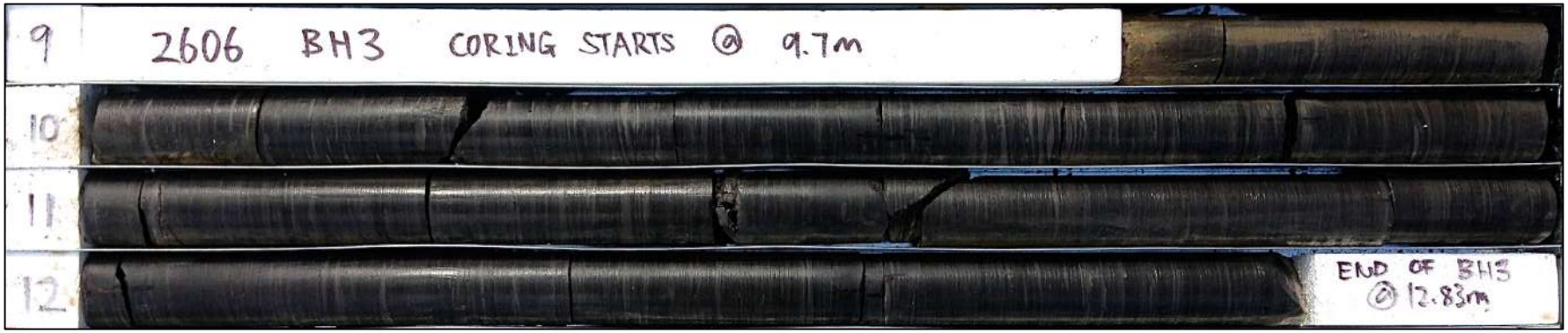
| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 15.8.2014 |
| **principal:** | | **finished:** | 19.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial o | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating — specific / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None Observed | 1.0 | 9.5 | | | | | | | | |
| | | | 0.5 | | | Continued from non-cored borehole from 9.7m | | | | | | |
| NMLC | | | | 9.7 | | SHALE, dark grey, well developed bedding, thinly laminated | SW | | | | | |
| | | | | 10.0 | | | | | D=0.48 | | | |
| | | | 0.0 | | | | | | A=1.2 | | | |
| | | | | 10.5 | | | | | | | | Fractured Zone, sm, cl |
| | | | -0.5 | | | | | | | | | |
| | | | | 11.0 | | | | | D=0.56 | | | |
| | | | -1.0 | | | | | | A=0.8 | | | JT 10° cu sm cl |
| | | | | 11.5 | | | | | | | | Clay SM, sm co |
| | | | -1.5 | | | | | | | | | JT 45° pl sm cl |
| | | | | 12.0 | | | | | D=0.21 | | | |
| | | | -2.0 | | | | | | A=0.83 | | | |
| | | | | 12.5 | | | | | D=0.88 | | | |
| | | | -2.5 | | | | | | A=1.57 | | | |
| | | | | 12.83 | | BH3 terminated at 12.83m | | | | | | |
| | | | | 13.0 | | | | | | | | |
| | | | -3.0 | | | | | | | | | |
| | | | | 13.5 | | | | | | | | |
| | | | -3.5 | | | | | | | | | |
| | | | | 14.0 | | | | | | | | |

BP 0-5° pl sm cl

2606 BOREHOLE LOG.GPJ 5/11/14




| issue | date | description |
|---|---|---|
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| A | 21.08.14 | INITIAL ISSUE |

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geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH3

**drawn:** JZ
**date:** 21.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH4** |
| **sheet:** | 1 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 19.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.5 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetrometer kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | None Observed | | | | | GW | Clayey Sandy GRAVEL, fine to coarse grained, grey mottled brown, well graded | M | L | | Fill |
| | | | D | 9.0 | 0.5 | | CL | Sandy Gravelly CLAY, low to medium plasticity, mottled grey and brown, fine to coarse grained sand, fine to medium grained gravel | >>Wp | F | × 80 | |
| | | | D | | | | | | | | | |
| | | | | 8.5 | 1.0 | | | | | | | |
| | | | SPT 0 N*=0 | | | | | | | St | | |
| | | | D | 8.0 | 1.5 | | | | | | × 150 | |
| | | | | | 1.7 | | SC | Clayey SAND, fine to coarse grained, dark grey, with fine to medium grained gravel, well graded | M | L | | |
| | | | D | 7.5 | 2.0 | | | | | | | |
| | | | | | 2 | | CH | Sandy CLAY, high plasticity, dark grey mottled brown , fine to medium grained sand, with fine grained gravel *Possible coal tar contamination* | >>Wp | VSt | × 120 | |
| | | | D | | | | | | | | | |
| WB | M | | | 7.0 | 2.5 | | | | | VSt | | |
| | | | SPT 4,5,5 N*=10 | | | | | | | | × 300 | |
| | | | D | 6.5 | 3.0 | | | | | | | |
| | | | | 6.0 | 3.5 | | | | | | | |
| | | | | 5.5 | 4.0 | | | | | | | |
| | | | SPT 1,3,6 N*=9 | | | | | | | | | |
| | | | | 5.0 | 4.5 | | | | | | | |
| | | | | 4.5 | 5.0 | | | | | | | |
| | | | | | 4.2 | | SC | Clayey SAND, fine to coarse grained, brown mottled red-brown, with ironstaining | M | L | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

| | |
|---|---|
| **BH no:** | **BH4** |
| **sheet:** | 2 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 19.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.5 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | None Observed | | | 5.5 | | SC | Clayey SAND, fine to coarse grained, brown mottled red-brown, with ironstaining *(continued)* | M | L | | |
| | | | SPT 8,5,6 N*=11 | 4.0 | | | | | | | | |
| | | | | | 5.7 | | CH | CLAY, high plasticity, dark brown, trace of fine grained sand | >>Wp | VSt | × 290 | |
| | | | | 3.5 | 6.0 | | | | | | | |
| | | | | 3.0 | 6.5 | | | | | | | |
| | | | | | 6.9 | | SW | SAND, fine to coarse grained, pale brown, well graded, with fine grained gravel | M | L | | Alluvial |
| | | | SPT 3,4,4 N*=8 | 2.5 | 7.0 | | | | | | | |
| | | | | 2.0 | 7.5 | | | | | | | |
| | | | | 1.5 | 8.0 | | | | | | | |
| | | | | 1.0 | 8.5 | | | | | | | |
| | | | SPT 2,3,5 N*=8 | | | | | | | | | |
| | | | D | 0.5 | 9.0 | | | | | | | |
| | | | | 0.0 | 9.5 | | | | | | | |
| | | | D | | | | | | | | | |
| | | | | -0.5 | 10.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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| **BH no:** | **BH4** |
| **sheet:** | 3 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 19.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.5 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | None Observed | SPT 2,3,7 N*=10 | | 10 | | SP | SAND, fine to medium grained, grey, poorly graded | M | L | | |
| | | | | -1.0 | 10.5 | | | | | | | |
| | | | | -1.5 | 11.0 | | | | | | | |
| | | | | | 11 | | CL | Sandy CLAY, low plasticity, dark grey, with wood fragments | >>Wp | -- | | |
| | | | | -2.0 | 11.5 | | | | | | | |
| | | | | -2.5 | 12.0 | | | | | | | |
| | | | | -3.0 | 12.5 | | | | | | | |
| | | | | -3.5 | 13.0 | | | Borehole No: BH4 continued as cored hole from 12.9m | | | | TC Refusal |
| | | | | -4.0 | 13.5 | | | | | | | |
| | | | | -4.5 | 14.0 | | | | | | | |
| | | | | -5.0 | 14.5 | | | | | | | |
| | | | | -5.5 | 15.0 | | | | | | | |

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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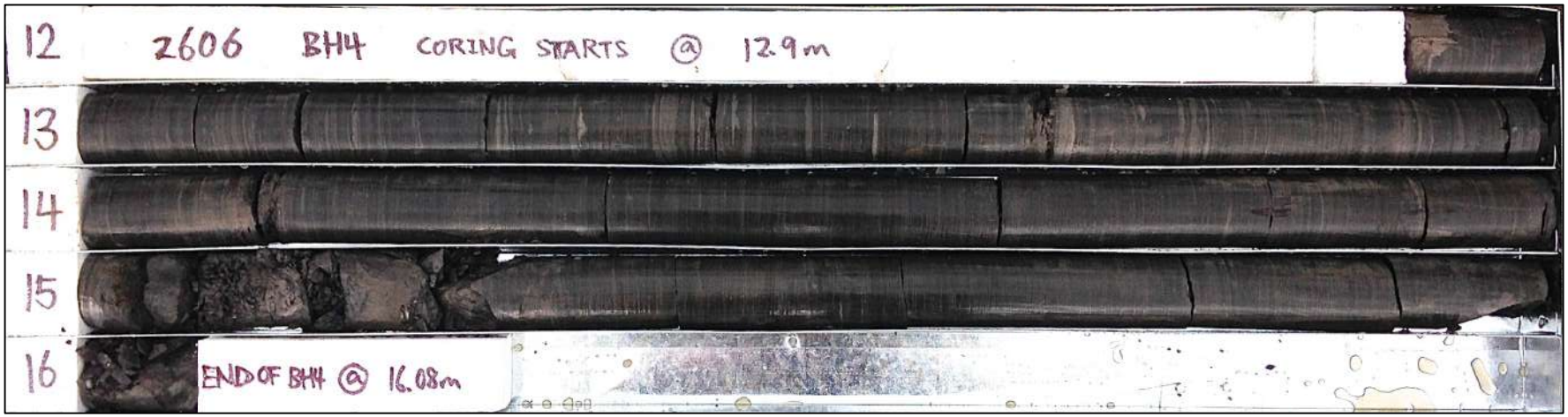
|---|---|
| **BH no:** | **BH4** |
| **sheet:** | 4 of 4 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 19.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 9.5 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial o | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating — specific / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None Observed | | | | Continued from non-cored borehole from 12.9m | | | D=0.3 | | | |
| NMLC | | | -3.5 | 12.9<br>13.0 | | SHALE, dark grey, well developed bedding, thinly laminated | SW | | A=1.12 | | | |
| | | | -4.0 | 13.5 | | | | | | | | Clay SM, sm cl |
| | | | | | | | | | D=0.16 | | | |
| | | | -4.5 | 14.0 | | | | | A=0.61 | | | |
| | | | | | | | | | | | | Clay SM, sm cl |
| | | | -5.0 | 14.5 | | | | | | | | BP 0-5° pl sm cl |
| | | | | | | | | | D=0.11 | | | |
| | | | -5.5 | 15.0 | | | | | A=1.23 | | | |
| | | | | | | | | | | | | Crushed Zone, sm cl |
| | | | | | | | | | | | | Crushed Zone, sm cl |
| | | | | | | | | | | | | Fractured Zone, sm cl |
| | | | -6.0 | 15.5 | | | | | D=0.75 | | | |
| | | | -6.5 | 16.0 | | | | | A=0.7 | | | JT 15° cu sm cl |
| | | | | 16.08 | | BH4 terminated at 16.08m | | | | | | |
| | | | -7.0 | 16.5 | | | | | | | | |
| | | | -7.5 | 17.0 | | | | | | | | |
| | | | -8.0 | 17.5 | | | | | | | | |




| issue | date | description |
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| A | 21.08.14 | INITIAL ISSUE |

**ASSET** GEOTECHNICAL
geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH4

**drawn:** JZ
**date:** 21.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

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geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH5** |
| **sheet:** | 1 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 20.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | C | None Observed | | 10.0 | | | -- | Asphalt | -- | -- | | Asphalt |
| | | | | | 0.1 | | SC | Clayey Gravelly SAND, fine to coarse grained, mottled brown and grey, well graded | M | L | | Fill |
| | | | | | 0.3 | | CL | Gravelly Sandy CLAY, low plasticity, mottled brown/grey/red-brown, fine to coarse grained sand and gravel | ~Wp | F | | |
| | | | | 9.5 | 0.5 | | | | | | | |
| | | | | | 1.0 | | | | | | × 100 | |
| | | | | 9.0 | 1 | | SC | Clayey SAND, fine to coarse grained, dark grey mottled brown, with fine to medium grained gravel, with ash deposits | M | L | | |
| | | | | 8.5 | 1.5 | | | | | | | |
| | | | | | 1.6 | | SP | SAND, fine to medium grained, brown, poorly graded | | | | Alluvial |
| | | | | 8.0 | 2.0 | | | | | | | |
| WB | M | | SPT 2,3,3 N*=6 | 7.5 | 2.5 | | | | | | | |
| | | | | 7.0 | 3.0 | | | | | | | |
| | | | | | 3.3 | | CL | Sandy CLAY, low plasticity, dark grey, with fine grained gravel | >Wp | St | | |
| | | | D | 6.5 | 3.5 | | | | | | | |
| | | | D | 6.0 | 4.0 | | | | | | | |
| | | | D | 5.5 | 4.5 | | | | | | | |
| | | | D | | 5.0 | | | | | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH5** |
| **sheet:** | 2 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | | | |
|---|---|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | | | **started:** | 20.8.2014 |
| **principal:** | | | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | | | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | | | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | | | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm | **inclination:** -90° **bearing:** --- | **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description (soil type: plasticity or particle characteristics, colour, secondary and minor components.) | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | None Observed | | 5.0 | 5.5 | | CL | Sandy CLAY, low plasticity, dark grey, with fine grained gravel *(continued)* | >Wp | St | | |
| | | | SPT 10,15,15 N*=30 | 4.5 | 5.5 | | SC | Clayey SAND, fine to medium grained, brown | M | D | | |
| | | | D | | 6.0 | | | | | | | |
| | | | | 4.0 | | | | | | | | |
| | | | | | 6.5 | | | | | | | |
| | | | | 3.5 | | | | | | | | |
| | | | D | | 7.0 | | | | | | | |
| | | | | 3.0 | | | | | | | | |
| | | | D | | 7.5 | | | | | MD | | |
| | | | | 2.5 | | | | | | | | |
| | | | | | 8.0 | | | | | | | |
| | | | | 2.0 | | | | | | | | |
| | | | | | 8.5 | | | | | | | |
| | | | SPT 4,6,8 N*=14 | 1.5 | | | | | | | | |
| | | | | | 9.0 | | | | | | | |
| | | | | 1.0 | | | | | | | | |
| | | | | | 9.5 | | | | | | | |
| | | | | 0.5 | 9.5 | | CL | Sandy CLAY, low plasticity, brown, with fine grained sand | >Wp | | | |
| | | | | | 10.0 | | | | | | | |

ASSET GEOTECHNICAL
geotechnical engineering consultants

Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
Fax: 02 8282 5011

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|---|---|
| **BH no:** | **BH5** |
| **sheet:** | 3 of 4 |
| **job no.:** | 2606 |

# Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 20.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m approx. |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information**

| method | support | water | notes samples, tests, etc | RL | depth metres | graphic log | USCS symbol | material description<br>soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | hand penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WB | M | None Observed | | 0.0<br>-0.5<br>-1.0 | 10.5<br>11.0 | | CL | Sandy CLAY, low plasticity, brown, with fine grained sand *(continued)* | >Wp | MD | | |
| | | | | -1.5<br>-2.0<br>-2.5<br>-3.0<br>-3.5<br>-4.0<br>-4.5 | 11.5<br>12.0<br>12.5<br>13.0<br>13.5<br>14.0<br>14.5<br>15.0 | | | Borehole No: BH5 continued as cored hole from 11.4m | | | | TC Refusal |

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Asset Geotechnical Engineering Pty Ltd
info@assetgeotechnical.com.au

SYDNEY
Suite 2.05 / 56 Delhi Road
North Ryde NSW 2113
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|---|---|
| **BH no:** | **BH5** |
| **sheet:** | 4 of 4 |
| **job no.:** | 2606 |

# Cored Borehole Log

| | | | |
|---|---|---|---|
| **client:** | Coronation Property Co. Pty Ltd | **started:** | 20.8.2014 |
| **principal:** | | **finished:** | 20.8.2014 |
| **project:** | Proposed Mixed-Use Develpment | **logged:** | JZ |
| **location:** | 20 Shepherd Street, Liverpool | **checked:** | MAB |
| **equipment:** | Track-mounted Drilling Rig | **RL surface:** | 10.1 m |
| **diameter:** | 100mm **inclination:** -90° **bearing:** --- **E:** **N:** | **datum:** | AHD |

**drilling information** | **material information** | **rock mass defects**

| method | support & core-lift | water | RL | depth metres | graphic log core recovery | rock substance description: rock type; grain characteristics, colour, structure, minor components | weathering | estimated strength MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH) | $Is_{(50)}$ MPa D=diametral × A=axial | RQD % | defect spacing mm (20, 60, 200, 600, 2000) | defect description: type, inclination, thickness, shape, roughness, coating (specific / general) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None Observed | -1.0 | | | | | | | | | |
| | | | | | | Continued from non-cored borehole from 11.4m | | | | | | |
| NMLC | | | | 11.4 | | SHALE, grey, well developed bedding, thinly laminated | RS / SW | | | | | |
| | | | -1.5 | 11.5 | | | | | | | | Crushed SM, sm cl<br>SM sm cl |
| | | | | | | | | | D=0.16 | | | SM sm cl |
| | | | | 12.0 | | | | | A=0.4 | | | |
| | | | -2.0 | | | | | | | | | Clay SM, sm co<br>JT 45° pl sm cl<br>JT 80° pl sm cl<br>JT 45° pl sm cl<br>JT 45° pl sm cl |
| | | | | 12.5 | | | | | | | | Clay SM, sm co |
| | | | -2.5 | | | | | | | | | Clay SM, sm co |
| | | | | | | | | | D=0.67 | | | JT 25° pl sm cl |
| | | | | | | | | | A=0.82 | | | |
| | | | | 13.0 | | | | | | | | BP 0-5° pl sm cl |
| | | | -3.0 | | | | | | | | | JT 70° pl sm cl |
| | | | | | | | | | | | | JT 60° un sm cl |
| | | | | 13.5 | | | | | D=0.43 | | | |
| | | | -3.5 | | | | | | A=1.02 | | | *Possible drilling induced fractured zone* |
| | | | | 14.0 | | | | | | | | |
| | | | -4.0 | | | | | | | | | |
| | | | | | | | | | D=0.59 | | | |
| | | | | 14.32 | | BH5 terminated at 14.32m | | | A=0.62 | | | |
| | | | | 14.5 | | | | | | | | |
| | | | -4.5 | | | | | | | | | |
| | | | | 15.0 | | | | | | | | |
| | | | -5.0 | | | | | | | | | |
| | | | | 15.5 | | | | | | | | |
| | | | -5.5 | | | | | | | | | |
| | | | | 16.0 | | | | | | | | |


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| A | 21.08.14 | INITIAL ISSUE |

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geotechnical engineering consultants
info@assetgeotechnical.com.au
SYDNEY
2.05/56 Delhi Rd
North Ryde NSW 2113
Ph: 02 9878 6005
eFax: 02 8282 5011

PROPOSED MIXED–USE DEVELOPMENT
20 SHEPHERD ST, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH5

**drawn:** JZ
**date:** 21.08.14
**checked:** MAB
**scale:** 1:4 A4

**job no.:** 2606
**fig:**
**issue:** A

# APPENDIX C

Laboratory Test Results

# POINT LOAD STRENGTH INDEX REPORT

## AS4133 4.1

| | | | |
|---|---|---|---|
| **Client:** | Asset Geotechnical Pty Ltd | **Moisture Content Condition:** | As Drilled |
| **Address:** | Suite 2.05, 56 Delhi Road, North Ryde | **Storage History:** | Core Box |
| **Project:** | 20 Shepherd St, Liverpool (2606) | **Report No:** | S0879-PLT |
| **Job No:** | 14-573 | **Date Tested:** | 25/08/2014 |

**Test Procedure:** ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

**Sampling:** Sampled by Client **Date Sampled:** 14/8/14-20/8/14

**Preparation:** Prepared in accordance with the test method

| Sample Number | Borehole ID | Depth (m) | Sample Description | Test Type | Average Width (mm) | Platen Seperation (mm) | Failure Load (kN) | Point Load Index Is (MPa) | Point Load Index $Is_{(50)}$ (MPa) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S0879 | BH1 | 10.80-10.94 | Siltstone | Diametral | - | 52.0 | 1.13 | 0.42 | 0.42 | |
| | | | | Axial | 52.0 | 48.0 | 2.40 | 0.75 | 0.80 | |
| S0880 | BH1 | 11.91-12.00 | Siltstone | Diametral | - | 52.0 | 0.17 | 0.06 | 0.06 | |
| | | | | Axial | 52.0 | 50.0 | 1.96 | 0.59 | 0.63 | |
| S0881 | BH1 | 12.84-13.00 | Siltstone | Diametral | - | 52.0 | 1.18 | 0.43 | 0.44 | |
| | | | | Axial | 52.0 | 40.0 | 1.62 | 0.61 | 0.62 | |
| S0882 | BH1 | 13.87-14.00 | Siltstone | Diametral | - | 52.0 | 1.04 | 0.38 | 0.39 | |
| | | | | Axial | 52.0 | 39.0 | 2.15 | 0.83 | 0.84 | |
| S0883 | BH1 | 15.43-15.54 | Siltstone | Diametral | - | 52.0 | 2.21 | 0.82 | 0.83 | |
| | | | | Axial | 52.0 | 42.0 | 3.36 | 1.21 | 1.24 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
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Comments:



Authorised Signatory:

25/08/2014

Date:

**NATA Accredited Laboratory Number: 14874**

Facility Name: Sydney Branch Site
Facility Location: 8/10 Bradford Street, Alexandria NSW 2015
Site No.: 22365

Macquarie Geotechnical
3 Watt Drive
BATHURST NSW 2795

# POINT LOAD STRENGTH INDEX REPORT

## AS4133 4.1

| | | | |
|---|---|---|---|
| **Client:** | Asset Geotechnical Pty Ltd | **Moisture Content Condition:** | As Drilled |
| **Address:** | Suite 2.05, 56 Delhi Road, North Ryde | **Storage History:** | Core Box |
| **Project:** | 20 Shepherd St, Liverpool (2606) | **Report No:** | S0884-PLT |
| **Job No:** | 14-573 | **Date Tested:** | 25/08/2014 |

**Test Procedure:** ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

**Sampling:** Sampled by Client **Date Sampled:** 14/8/14-20/8/14

**Preparation:** Prepared in accordance with the test method

| Sample Number | Borehole ID | Depth (m) | Sample Description | Test Type | Average Width (mm) | Platen Seperation (mm) | Failure Load (kN) | Point Load Index Is (MPa) | Point Load Index $Is_{(50)}$ (MPa) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S0884 | BH2 | 12.92-13.00 | Siltstone | Diametral | - | 52.0 | 2.12 | 0.78 | 0.80 | |
| | | | | Axial | 52.0 | 39.0 | 2.21 | 0.85 | 0.86 | |
| S0885 | BH2 | 13.88-14.00 | Siltstone | Diametral | - | 52.0 | 1.45 | 0.53 | 0.54 | |
| | | | | Axial | 52.0 | 38.0 | 1.95 | 0.77 | 0.77 | |
| S0886 | BH2 | 14.87-14.98 | Siltstone | Diametral | - | 52.0 | 2.17 | 0.80 | 0.81 | |
| | | | | Axial | 52.0 | 43.0 | 2.34 | 0.82 | 0.84 | |
| S0887 | BH2 | 15.86-16.00 | Siltstone | Diametral | - | 52.0 | 1.41 | 0.52 | 0.53 | |
| | | | | Axial | 52.0 | 38.0 | 1.98 | 0.79 | 0.79 | |
| S0888 | BH2 | 16.63-16.74 | Siltstone | Diametral | - | 52.0 | 3.36 | 1.24 | 1.26 | |
| | | | | Axial | 52.0 | 37.0 | 4.11 | 1.68 | 1.67 | |
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Comments:



Authorised Signatory:

25/08/2014

Date:

**NATA Accredited Laboratory Number: 14874**

Facility Name: Sydney Branch Site
Facility Location: 8/10 Bradford Street, Alexandria NSW 2015
Site No.: 22365

Macquarie Geotechnical
3 Watt Drive
BATHURST NSW 2795

# POINT LOAD STRENGTH INDEX REPORT

## AS4133 4.1

| | | | |
|---|---|---|---|
| **Client:** | Asset Geotechnical Pty Ltd | **Moisture Content Condition:** | As Drilled |
| **Address:** | Suite 2.05, 56 Delhi Road, North Ryde | **Storage History:** | Core Box |
| **Project:** | 20 Shepherd St, Liverpool (2606) | **Report No:** | S0889-PLT |
| **Job No:** | 14-573 | **Date Tested:** | 25/08/2014 |

**Test Procedure:** ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

**Sampling:** Sampled by Client **Date Sampled:** 14/8/14-20/8/14

**Preparation:** Prepared in accordance with the test method

| Sample Number | Borehole ID | Depth (m) | Sample Description | Test Type | Average Width (mm) | Platen Seperation (mm) | Failure Load (kN) | Point Load Index Is (MPa) | Point Load Index $Is_{(50)}$ (MPa) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S0889 | BH3 | 9.90-10.00 | Siltstone | Diametral | - | 52.0 | 1.27 | 0.47 | 0.48 | |
| | | | | Axial | 52.0 | 47.0 | 3.54 | 1.14 | 1.20 | |
| S0890 | BH3 | 10.89-11.00 | Siltstone | Diametral | - | 52.0 | 1.50 | 0.55 | 0.56 | |
| | | | | Axial | 52.0 | 38.0 | 2.02 | 0.80 | 0.80 | |
| S0891 | BH3 | 11.89-12.00 | Siltstone | Diametral | - | 52.0 | 0.56 | 0.21 | 0.21 | |
| | | | | Axial | 52.0 | 40.0 | 2.16 | 0.82 | 0.83 | |
| S0892 | BH3 | 12.69-12.80 | Siltstone | Diametral | - | 52.0 | 2.35 | 0.87 | 0.88 | |
| | | | | Axial | 52.0 | 35.0 | 3.71 | 1.60 | 1.57 | |
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Comments:



Authorised Signatory:

25/08/2014

Date:

**NATA Accredited Laboratory Number: 14874**

Facility Name: Sydney Branch Site
Facility Location: 8/10 Bradford Street, Alexandria NSW 2015
Site No.: 22365

Macquarie Geotechnical
3 Watt Drive
BATHURST NSW 2795

# POINT LOAD STRENGTH INDEX REPORT

## AS4133 4.1

| | | | |
|---|---|---|---|
| **Client:** | Asset Geotechnical Pty Ltd | **Moisture Content Condition:** | As Drilled |
| **Address:** | Suite 2.05, 56 Delhi Road, North Ryde | **Storage History:** | Core Box |
| **Project:** | 20 Shepherd St, Liverpool (2606) | **Report No:** | S0893-PLT |
| **Job No:** | 14-573 | **Date Tested:** | 25/08/2014 |

**Test Procedure:** ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

**Sampling:** Sampled by Client **Date Sampled:** 14/8/14-20/8/14

**Preparation:** Prepared in accordance with the test method

| Sample Number | Borehole ID | Depth (m) | Sample Description | Test Type | Average Width (mm) | Platen Seperation (mm) | Failure Load (kN) | Point Load Index Is (MPa) | Point Load Index $Is_{(50)}$ (MPa) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S0893 | BH4 | 12.90-13.00 | Siltstone | Diametral | - | 52.0 | 0.80 | 0.29 | 0.30 | |
| | | | | Axial | 52.0 | 40.0 | 2.94 | 1.11 | 1.12 | |
| S0894 | BH4 | 13.80-13.89 | Siltstone | Diametral | - | 52.0 | 0.42 | 0.16 | 0.16 | |
| | | | | Axial | 52.0 | 43.0 | 1.68 | 0.59 | 0.61 | |
| S0895 | BH4 | 14.80-14.90 | Siltstone | Diametral | - | 52.0 | 0.29 | 0.11 | 0.11 | |
| | | | | Axial | 52.0 | 36.0 | 2.96 | 1.24 | 1.23 | |
| S0896 | BH4 | 15.75-15.88 | Siltstone | Diametral | - | 52.0 | 2.00 | 0.74 | 0.75 | |
| | | | | Axial | 52.0 | 43.0 | 1.93 | 0.68 | 0.70 | |
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Comments:



Authorised Signatory:

25/08/2014

Date:

**NATA Accredited Laboratory Number: 14874**

Facility Name: Sydney Branch Site
Facility Location: 8/10 Bradford Street, Alexandria NSW 2015
Site No.: 22365

Macquarie Geotechnical
3 Watt Drive
BATHURST NSW 2795

# POINT LOAD STRENGTH INDEX REPORT

## AS4133 4.1

| | | | |
|---|---|---|---|
| **Client:** | Asset Geotechnical Pty Ltd | **Moisture Content Condition:** | As Drilled |
| **Address:** | Suite 2.05, 56 Delhi Road, North Ryde | **Storage History:** | Core Box |
| **Project:** | 20 Shepherd St, Liverpool (2606) | **Report No:** | S0897-PLT |
| **Job No:** | 14-573 | **Date Tested:** | 25/08/2014 |

**Test Procedure:** ☑ AS4133 4.1 Rock strength tests - Determination of point load strength index

**Sampling:** Sampled by Client **Date Sampled:** 14/8/14-20/8/14

**Preparation:** Prepared in accordance with the test method

| Sample Number | Borehole ID | Depth (m) | Sample Description | Test Type | Average Width (mm) | Platen Seperation (mm) | Failure Load (kN) | Point Load Index Is (MPa) | Point Load Index $Is_{(50)}$ (MPa) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S0897 | BH5 | 11.81-11.93 | Siltstone | Diametral | - | 52.0 | 0.43 | 0.16 | 0.16 | |
| | | | | Axial | 52.0 | 47.0 | 1.20 | 0.38 | 0.40 | |
| S0898 | BH5 | 12.70-12.79 | Siltstone | Diametral | - | 52.0 | 1.79 | 0.66 | 0.67 | |
| | | | | Axial | 52.0 | 43.0 | 2.26 | 0.79 | 0.82 | |
| S0899 | BH5 | 13.46-13.58 | Siltstone | Diametral | - | 52.0 | 1.15 | 0.43 | 0.43 | |
| | | | | Axial | 52.0 | 41.0 | 2.72 | 1.00 | 1.02 | |
| S0900 | BH5 | 14.24-14.32 | Siltstone | Diametral | - | 52.0 | 1.58 | 0.58 | 0.59 | |
| | | | | Axial | 52.0 | 37.0 | 1.52 | 0.62 | 0.62 | |
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Comments:



Authorised Signatory:

25/08/2014

Date:

**NATA Accredited Laboratory Number: 14874**

Facility Name: Sydney Branch Site
Facility Location: 8/10 Bradford Street, Alexandria NSW 2015
Site No.: 22365

Macquarie Geotechnical
3 Watt Drive
BATHURST NSW 2795

| | | | | | | |
|---|---|---|---|---|---|---|
| **Client Name:** | **Asset Geotechnical** | | **Project Name:** | **2606 - Proposed Mixed Use Development** | | |
| **Client Contact:** | **Joel Huang** | | **Project Location:** | **20 Shepherd St, Liverpool** | | |
| **Batch_ID** | **Sample_ID** | **Data::SampleName** | **Field_pHf** | **Field_pHFOX** | **Soil_Colour** | |
| 31530 | 1 | BH1 0.5m | 8.25 | 8.67 | 10YR 4/1 Dark Grey | |
| 31530 | 2 | BH1 1.0m | 8.22 | 7.7 | 7.5YR 5/2 Brown | |
| 31530 | 3 | BH1 1.5m | 6.56 | 5.37 | 10YR 3/1 Very Dark Grey | |
| 31530 | 4 | BH1 2.0m | 7.94 | 6.61 | 7.5YR 4/2 Brown | |
| 31530 | 5 | BH1 2.5m | 7.53 | 6.8 | 7.5YR 4/2 Brown | |
| 31530 | 7 | BH1 3.5m | 6.66 | 6.22 | 5YR 4/3 Reddish Brown | |
| 31530 | 8 | BH1 4.0m | 6.85 | 5.38 | 7.5YR 4/3 Brown | |
| 31530 | 9 | BH1 4.5m | 7.14 | 6.65 | 7.5YR 4/3 Brown | |
| 31530 | 10 | BH1 5.0m | 6.79 | 5.65 | 7.5YR 4/3 Brown | |
| 31530 | 11 | BH1 5.5m | 6.65 | 5.53 | 7.5YR 5/4 Brown | |
| 31530 | 12 | BH1 6.0m | 6.53 | 4.95 | 7.5YR 5/3 Brown | |
| 31530 | 13 | BH1 6.5m | 6.66 | 6.8 | 7.5YR 4/3 Brown | |
| 31530 | 14 | BH1 7.0m | 6.82 | 5.51 | 7.5YR 4/3 Brown | |
| 31530 | 15 | BH4 0.5m | 8.51 | 8.65 | 10YR 4/1 Dark Grey | |
| 31530 | 16 | BH4 1.0m | 8.1 | 8.06 | 10YR 4/1 Dark Grey | |
| 31530 | 17 | BH4 1.5m | 7.88 | 7.69 | 10YR 4/2 Dark Greyish Brown | |
| 31530 | 18 | BH4 2.0m | 8.06 | 7.08 | 10YR 4/1 Dark Grey | |
| 31530 | 19 | BH4 2.5m | 8.08 | 7.51 | 7.5YR 4/2 Brown | |
| 31530 | 20 | BH4 3.0m | 6.62 | 6.59 | 10YR 4/2 Dark Greyish Brown | |
| 31530 | 21 | BH4 SPT 4-4.45m | 7.24 | 6.56 | Mottled: 7.5YR 4/1 Dark Grey, 7.5YR 4/3 Brown | |
| 31530 | 22 | BH4 8.0m | 6.4 | 4.72 | 10YR 4/2 Dark Greyish Brown | |
| 31530 | 25 | BH5 3.5m | 7.25 | 7.48 | 7.5YR 4/1 Dark Grey | |
| 31530 | 26 | BH5 4.0m | 7.25 | 7.57 | 10YR 4/2 Dark Greyish Brown | |
| 31530 | 27 | BH5 5.0m | 7.03 | 7.05 | 10YR 4/2 Dark Greyish Brown | |
| 31530 | 28 | BH5 5.5m | 7.4 | 4.99 | 10YR 5/2 Greyish Brown | |
| 31530 | 29 | BH5 6.0m | 6.83 | 5.78 | 10YR 5/4 Yellowish Brown | |
| 31530 | 30 | BH5 7.0m | 6.92 | 5.78 | 10YR 5/4 Yellowish Brown | |
| 31530 | 31 | BH5 7.5m | 7.12 | 5.73 | 10YR 5/3 Brown | |

# Corrosion & Scaling Assessment:
## Soil Reporting Profile

**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

**Batch N°: 31531** **Sample N°: 6** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Asset Geotechnical** | Project Name: | **2606 - Proposed Mixed use Development** |
| Client Contact: | **Joel Huang** | Location: | **20 Shepherd St, Liverpool** |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH1 3.5m** |
| Address: | **Suite2.05/56 Delhi Rd North Ryde NSW 2113** | Description: | **Soil** |
| | | Test Type: | **USAWS** |

| TEST | RESULT | COMMENTS |
|---|---|---|
| pH in water (1:5) | 6.7 | |
| EC mS/cm (1:5) | 0.14 | |
| Texture Class | Sandy Clay | |
| Soil Permeability Class | | |
| **SOLUBLE ANION ANALYSIS** | | |
| Sulphate (1:5) mg$SO_4$ / kg | 180 | |
| Chloride (1:5) mgCl / kg | <7.0 | |
| * Resistivity Ω. m | 26.94 | |

* Resistivity tested on a saturated sample/paste

(Note:- 10,000 mg/kg = 1%)

## Recommendations

Analysed by SESL Australia

No commentary requested from SESL.

**pH, EC, Soluble $SO_4$:** Bradley et al., (1983); **Cl,** (4500-Cl- E; APHA, 1998);
**Resistivity,** AS1289.4.4.1:1997, **Texture** - PM0003 (Texture- "Northcote" (1992))

Date Report Generated
3/09/2014

Consultant:
Kelly Lee

Authorised Signatory:
Ryan Jacka

# Corrosion & Scaling Assessment:
## Soil Reporting Profile

**Sample Drop Off:** 16 Chilvers Road Thornleigh NSW 2120
**Mailing Address:** PO Box 357 Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

**Batch N°: 31531** **Sample N°: 12** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Asset Geotechnical** | Project Name: | **2606 - Proposed Mixed use Development** |
| Client Contact: | **Joel Huang** | Location: | **20 Shepherd St, Liverpool** |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH1 6.5m** |
| Address: | **Suite2.05/56 Delhi Rd North Ryde NSW 2113** | Description: | **Soil** |
| | | Test Type: | **USAWS** |

| TEST | RESULT | COMMENTS |
|---|---|---|
| pH in water (1:5) | 7.1 | |
| EC mS/cm (1:5) | 0.04 | |
| Texture Class | Sand | |
| Soil Permeability Class | | |
| **SOLUBLE ANION ANALYSIS** | | |
| Sulphate (1:5) mg$SO_4$ / kg | 20 | |
| Chloride (1:5) mgCl / kg | 30 | |
| * Resistivity Ω. m | 161.24 | |

* Resistivity tested on a saturated sample/paste

(Note:- 10,000 mg/kg = 1%)

## Recommendations

Analysed by SESL Australia

No commentary requested from SESL.

**pH, EC, Soluble $SO_4$:** Bradley et al., (1983); **Cl,** (4500-Cl- E; APHA, 1998);
**Resistivity,** AS1289.4.4.1:1997, **Texture** - PM0003 (Texture- "Northcote" (1992))

Date Report Generated
3/09/2014

Consultant:
Kelly Lee

Authorised Signatory:
Ryan Jacka

# Corrosion & Scaling Assessment:
## Soil Reporting Profile

**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

**Batch N°: 31531** **Sample N°: 20** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Asset Geotechnical** | Project Name: | **2606 - Proposed Mixed use Development** |
| Client Contact: | **Joel Huang** | Location: | **20 Shepherd St, Liverpool** |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH4 4.0m** |
| Address: | **Suite2.05/56 Delhi Rd North Ryde NSW 2113** | Description: | **Soil** |
| | | Test Type: | **USAWS** |

| TEST | RESULT | COMMENTS |
|---|---|---|
| pH in water (1:5) | 5.7 | |
| EC mS/cm (1:5) | 0.45 | |
| Texture Class | Sandy Clay | |
| Soil Permeability Class | | |
| **SOLUBLE ANION ANALYSIS** | | |
| Sulphate (1:5) $mgSO_4$ / kg | 600 | |
| Chloride (1:5) mgCl / kg | 50 | |
| * Resistivity Ω. m | 6.66 | |

* Resistivity tested on a saturated sample/paste

(Note:- 10,000 mg/kg = 1%)

## Recommendations

Analysed by SESL Australia

No commentary requested from SESL.

**pH, EC, Soluble $SO_4$:** Bradley et al., (1983); **Cl,** (4500-Cl- E; APHA, 1998);
**Resistivity,** AS1289.4.4.1:1997, **Texture** - PM0003 (Texture- "Northcote" (1992))

Date Report Generated
3/09/2014

Consultant:
Kelly Lee

Authorised Signatory:
Ryan Jacka

# Corrosion & Scaling Assessment:
## Soil Reporting Profile

**Sample Drop Off:** 16 Chilvers Road Thornleigh NSW 2120
**Mailing Address:** PO Box 357 Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

**Batch N°: 31531** **Sample N°: 21** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Asset Geotechnical** | Project Name: | **2606 - Proposed Mixed use Development** |
| Client Contact: | **Joel Huang** | Location: | **20 Shepherd St, Liverpool** |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH4 SPT 7-7.45m** |
| Address: | **Suite2.05/56 Delhi Rd North Ryde NSW 2113** | Description: | **Soil** |
| | | Test Type: | **USAWS** |

| TEST | RESULT | COMMENTS |
|---|---|---|
| pH in water (1:5) | 7.8 | |
| EC mS/cm (1:5) | 0.03 | |
| Texture Class | Sand | |
| Soil Permeability Class | | |
| **SOLUBLE ANION ANALYSIS** | | |
| Sulphate (1:5) $mgSO_4$ / kg | 20 | |
| Chloride (1:5) mgCl / kg | 10 | |
| * Resistivity Ω. m | 39.3 | |

* Resistivity tested on a saturated sample/paste

(Note:- 10,000 mg/kg = 1%)

## Recommendations

Analysed by SESL Australia

No commentary requested from SESL.

**pH, EC, Soluble $SO_4$:** Bradley et al., (1983); **Cl,** (4500-Cl- E; APHA, 1998);
**Resistivity,** AS1289.4.4.1:1997, **Texture** - PM0003 (Texture- "Northcote" (1992))

Date Report Generated
3/09/2014

Consultant:
Kelly Lee

Authorised Signatory:
Ryan Jacka

# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au


**Batch N°: 31531** **Sample N°: 6** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Asset Geotechnical** | Project Name: | **2606 - Proposed Mixed use Development** |
| Client Contact: | **Joel Huang** | Location: | **20 Shepherd St, Liverpool** |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH1 3.5m** |
| Address: | **Suite2.05/56 Delhi Rd North Ryde NSW 2113** | Description: | **Soil** |
| | | Test Type: | **USAWS** |

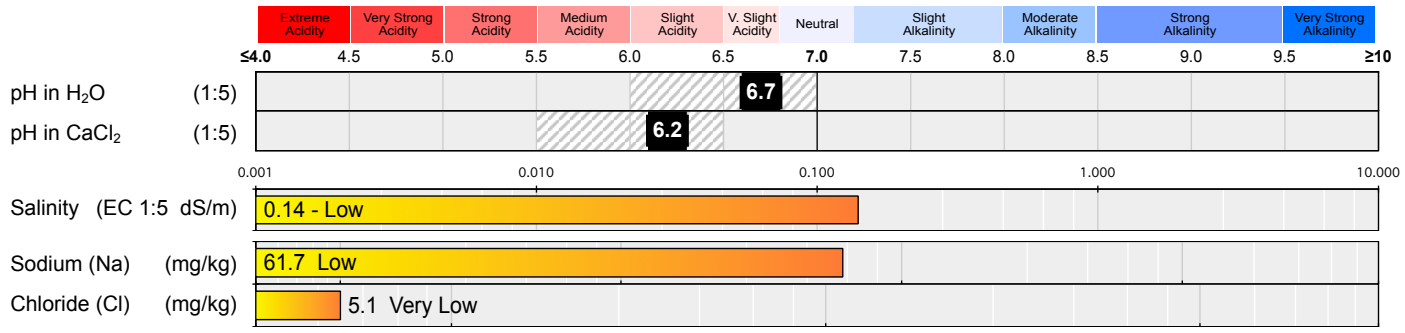
## RECOMMENDATIONS

Analysed by SESL Australia

No commentary requested from SESL.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ○ 150 ◉ 200 **FERTILITY RATING:** ◉ Low ○ Moderate ○ High

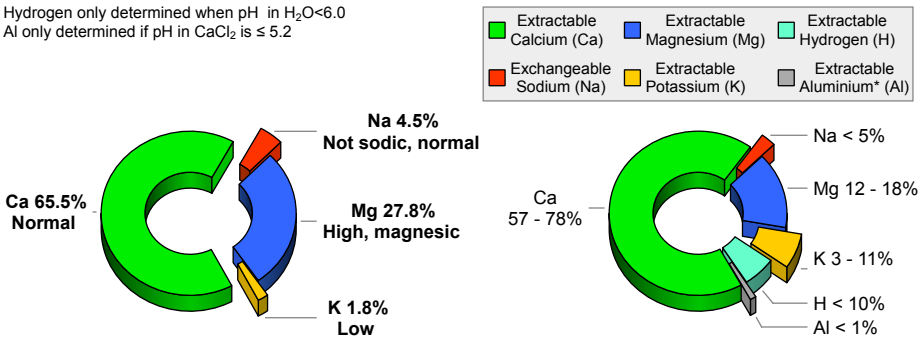
## pH and ELECTRICAL CONDUCTIVITY




## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)


### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 2.4 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | 15.2 | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0.02 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0.4 | N/A |

**Sodium Absorption Ratio:** 0 Low

**Electrochemical Stability Index (ESI):**
0.03 High potential for dispersion and soil structure collapse

### SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

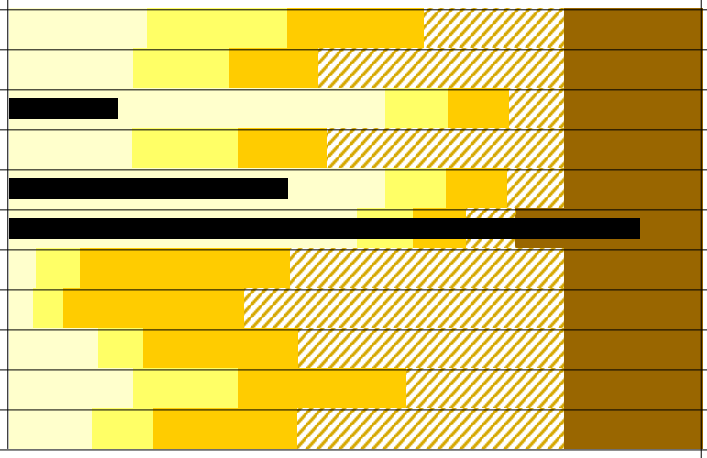
SESL AUSTRALIA
Environment & Soil Sciences

**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

**Batch N°: 31531** **Sample N°: 6** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | - | | - | 8 | Did not test |
| Phosphate-P ($PO_4$) | - | | - | 16.8 | Did not test |
| Potassium (K) † | 42.9 | | 11.4 | 58.5 | 47.1 |
| Sulphate-S ($SO_4$) | - | | - | 18.1 | 18.1 |
| Calcium (Ca) † | 787 | | 209.3 | 416.6 | 207.3 |
| Magnesium (Mg) † | 203 | | 54 | 43.4 | Drawdown |
| Iron (Fe) | - | | - | 146.8 | Did not test |
| Manganese (Mn) † | - | | - | 11.7 | Did not test |
| Zinc (Zn) † | - | | - | 1.3 | Did not test |
| Copper (Cu) | - | | - | 1.7 | Did not test |
| Boron (B) † | - | | - | 0.7 | Did not test |



**Explanation of graph ranges:**

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

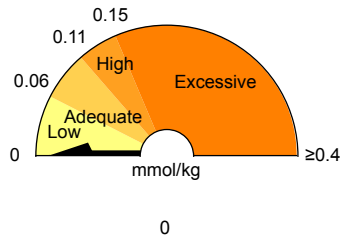
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0

**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | - |
| Sum of Base Cations (meq/100g$^{-1}$): | 6 |
| Eff. Cation Exch. Capacity (eCEC): | 6 |
| Base Saturation (%): | 100 |
| Exchangeable Acidity (meq/100g$^{-1}$): | - |
| Exchangeable Acidity (%): | - |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | 0 |
| – to neutralise Al (g/sqm): | - |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **27**

The CGAR is corrected for a soil depth of 200mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | Sandy Clay |
| Colour: | - |
| Estimated clay content: | 35 - 45% |
| Size: | - |
| Gravel content: | Not gravelly |
| Aggregate strength: | - |
| Structural unit: | Did not test |
| Potential infiltration rate: | Slow |
| Permeability (mm/hr): | Did not test |
| Calculated $EC_{SE}$ (dS/m): | 1.2 |

**– Non-saline. Salinity effects on plants are mostly negligible.**

Organic Carbon (OC%)†: **Did not test**
Organic Matter (OM%): -
Additional comments:

**Consultant: Kelly Lee**

**Authorised Signatory: Ryan Jacka**

Date Report Generated 3/09/2014

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

ASPAC

**A member of the Australasian Soil and Plant Analysis Council**
† This laboratory has been awarded a Certificate of Proficiency for specific soil and plant tissue analyses by the Australasian Soil and Plant Analysis Council (ASPAC). Tests for which proficiency has been demonstrated are highlighted in this report.

# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au


**Batch N°: 31531** **Sample N°: 12** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Asset Geotechnical** | Project Name: | **2606 - Proposed Mixed use Development** |
| Client Contact: | **Joel Huang** | Location: | **20 Shepherd St, Liverpool** |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH1 6.5m** |
| Address: | **Suite2.05/56 Delhi Rd North Ryde NSW 2113** | Description: | **Soil** |
| | | Test Type: | **USAWS** |

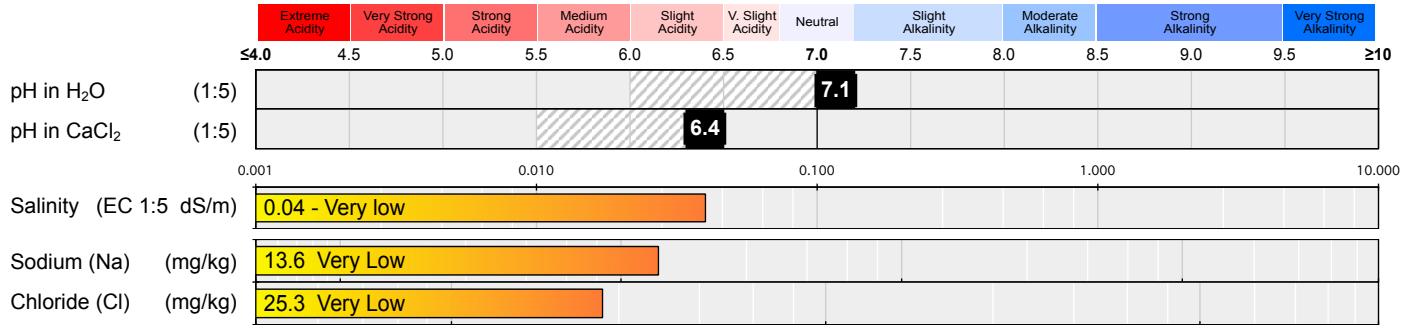
## RECOMMENDATIONS

Analysed by SESL Australia

No commentary requested from SESL.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ○ 150 ◉ 200 **FERTILITY RATING:** ◉ Low ○ Moderate ○ High

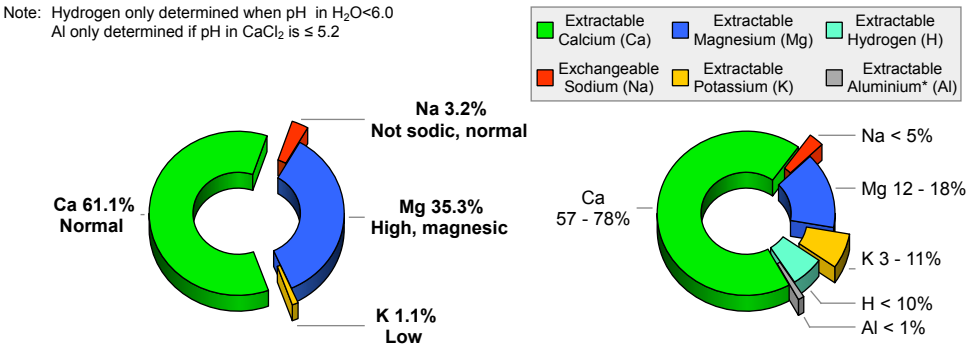
## pH and ELECTRICAL CONDUCTIVITY




## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)


### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1.7 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | 33.5 | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0.01 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0.3 | N/A |

**Sodium Absorption Ratio:** 0 Low

**Electrochemical Stability Index (ESI):**
0.01 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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# Soil Chemistry Profile

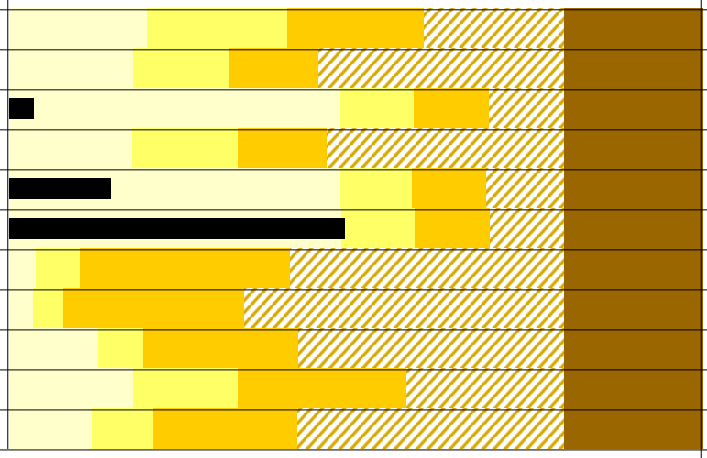
## Mehlich 3 - Multi-nutrient Extractant

**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

**Batch N°: 31531** **Sample N°: 12** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | - | | - | 8 | Did not test |
| Phosphate-P ($PO_4$) | - | | - | 16.8 | Did not test |
| Potassium (K) † | 7.9 | | 2.1 | 47.3 | 45.2 |
| Sulphate-S ($SO_4$) | - | | - | 18.1 | 18.1 |
| Calcium (Ca) † | 232 | | 61.7 | 337 | 275.3 |
| Magnesium (Mg) † | 81 | | 21.5 | 35.6 | 14.1 |
| Iron (Fe) | - | | - | 146.8 | Did not test |
| Manganese (Mn) † | - | | - | 11.7 | Did not test |
| Zinc (Zn) † | - | | - | 1.3 | Did not test |
| Copper (Cu) | - | | - | 1.7 | Did not test |
| Boron (B) † | - | | - | 0.7 | Did not test |



**Explanation of graph ranges:**

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

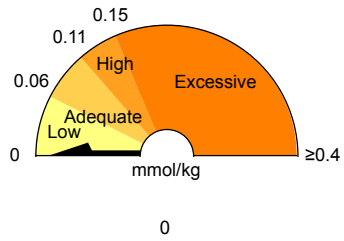
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0

**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | - |
| Sum of Base Cations (meq/100g$^{-1}$): | **1.9** |
| Eff. Cation Exch. Capacity (eCEC): | **1.9** |
| Base Saturation (%): | **100** |
| Exchangeable Acidity (meq/100g$^{-1}$): | - |
| Exchangeable Acidity (%): | - |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **0** |
| – to neutralise Al (g/sqm): | - |

**Gypsum Application Rate**

| | |
|---|---|
| – to achieve 67.5% exch. Ca (g/sqm): | **28** |

The CGAR is corrected for a soil depth of 200mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Sand** |
| Colour: | - |
| Estimated clay content: | **< 5%** |
| Size: | - |
| Gravel content: | **Not gravelly** |
| Aggregate strength: | - |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Very Rapid** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **0.9** |

**– Non-saline. Salinity effects on plants are mostly negligible.**

Organic Carbon (OC%)†: **Did not test**
Organic Matter (OM%): -
Additional comments:

**Consultant: Kelly Lee**

**Authorised Signatory: Ryan Jacka**

Date Report Generated 3/09/2014

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

ASPAC

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au


**Batch N°: 31531** **Sample N°: 20** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Asset Geotechnical** | Project Name: | **2606 - Proposed Mixed use Development** |
| Client Contact: | **Joel Huang** | Location: | **20 Shepherd St, Liverpool** |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH4 4.0m** |
| Address: | **Suite2.05/56 Delhi Rd North Ryde NSW 2113** | Description: | **Soil** |
| | | Test Type: | **USAWS** |

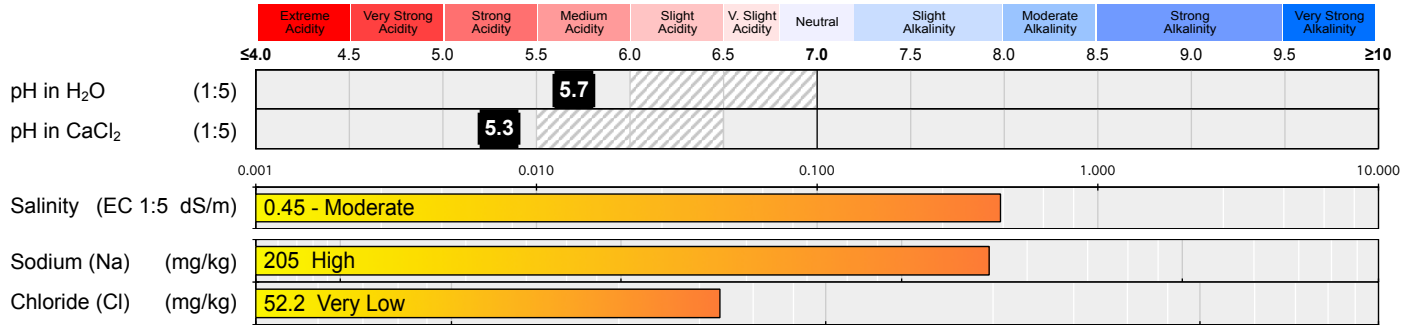
## RECOMMENDATIONS

Analysed by SESL Australia

No commentary requested from SESL.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ○ 150 ◉ 200 **FERTILITY RATING:** ◉ Low ○ Moderate ○ High

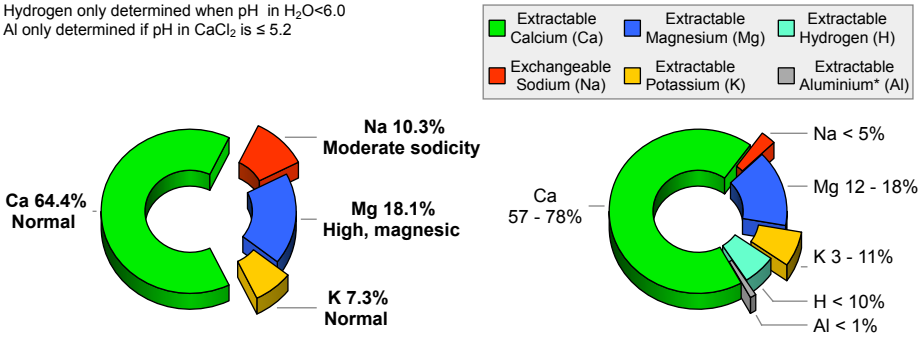
## pH and ELECTRICAL CONDUCTIVITY




## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)


### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| **Ca:Mg** | **3.6** | 4.1 – 6.0 |
| Comment: Calcium low | | |
| **Mg:K** | **2.5** | 2.6 – 5.0 |
| Comment: Magnesium low | | |
| **K/(Ca+Mg)** | **0.09** | < 0.07 |
| Comment: High | | |
| **K:Na** | **0.7** | N/A |

**Sodium Absorption Ratio:** 0 Low

**Electrochemical Stability Index (ESI):**
0.04 High potential for dispersion and soil structure collapse

### SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

SESL AUSTRALIA
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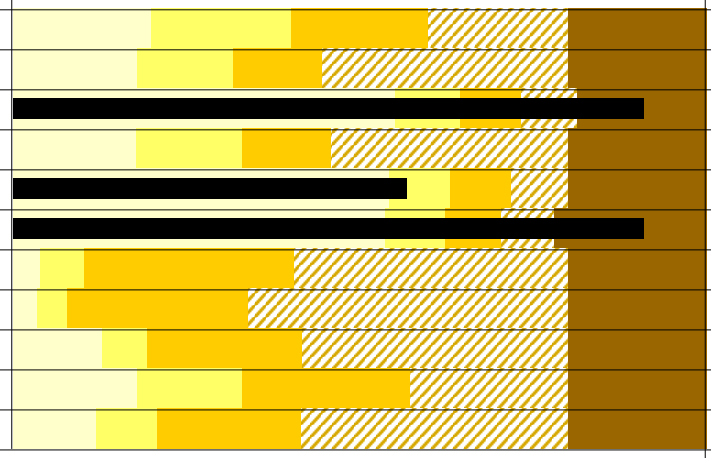
**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

**Batch N°: 31531** **Sample N°: 20** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | - | | - | 8 | Did not test |
| Phosphate-P ($PO_4$) | - | | - | 16.8 | Did not test |
| Potassium (K) † | 246 | | 65.4 | 58.5 | Drawdown |
| Sulphate-S ($SO_4$) | - | | - | 18.1 | 18.1 |
| Calcium (Ca) † | 1110 | | 295.3 | 416.6 | 121.3 |
| Magnesium (Mg) † | 190 | | 50.5 | 43.4 | Drawdown |
| Iron (Fe) | - | | - | 146.8 | Did not test |
| Manganese (Mn) † | - | | - | 11.7 | Did not test |
| Zinc (Zn) † | - | | - | 1.3 | Did not test |
| Copper (Cu) | - | | - | 1.7 | Did not test |
| Boron (B) † | - | | - | 0.7 | Did not test |



**Explanation of graph ranges:**

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

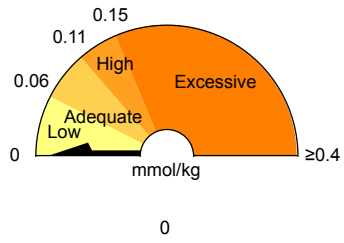
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/$m^3$ and selected soil depth.

### Phosphorus Saturation Index




0

**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | - |
| Sum of Base Cations (meq/$100g^{-1}$): | **8.6** |
| Eff. Cation Exch. Capacity (eCEC): | **8.6** |
| Base Saturation (%): | **100** |
| Exchangeable Acidity (meq/$100g^{-1}$): | - |
| Exchangeable Acidity (%): | - |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | - |
| – to neutralise Al (g/sqm): | - |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **61**

The CGAR is corrected for a soil depth of 200mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Sandy Clay** |
| Colour: | - |
| Estimated clay content: | **35 - 45%** |
| Size: | - |
| Gravel content: | **Not gravelly** |
| Aggregate strength: | - |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Slow** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **3.9** |

**– Slightly saline. Growth on sensitive plant species is effected.**

Organic Carbon (OC%)†: **Did not test**
Organic Matter (OM%): -
Additional comments:

**Consultant: Kelly Lee**

**Authorised Signatory: Ryan Jacka**

Date Report Generated 3/09/2014

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
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**Fax:** 1300 64 46 89
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au


**Batch N°: 31531** **Sample N°: 21** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Asset Geotechnical** | Project Name: | **2606 - Proposed Mixed use Development** |
| Client Contact: | **Joel Huang** | Location: | **20 Shepherd St, Liverpool** |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH4 SPT 7-7.45m** |
| Address: | **Suite2.05/56 Delhi Rd North Ryde NSW 2113** | Description: | **Soil** |
| | | Test Type: | **USAWS** |

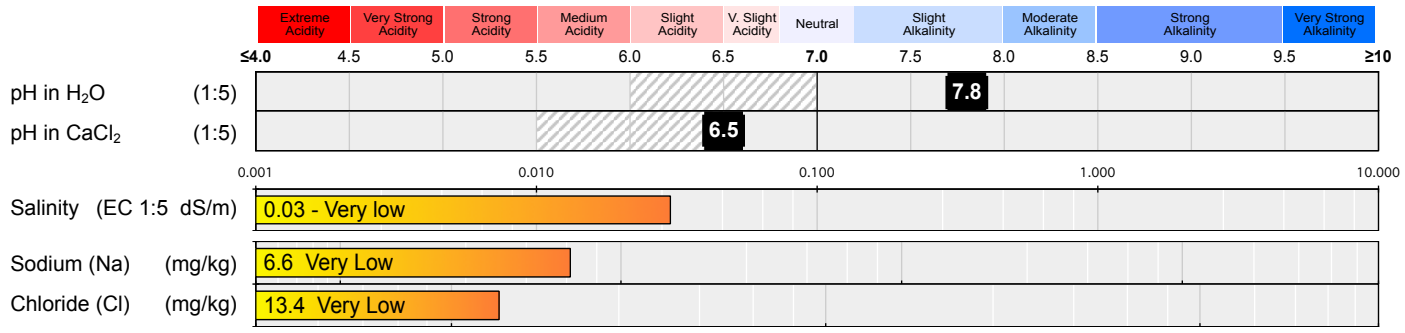
## RECOMMENDATIONS

Analysed by SESL Australia

No commentary requested from SESL.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ○ 150 ◉ 200 **FERTILITY RATING:** ◉ Low ○ Moderate ○ High

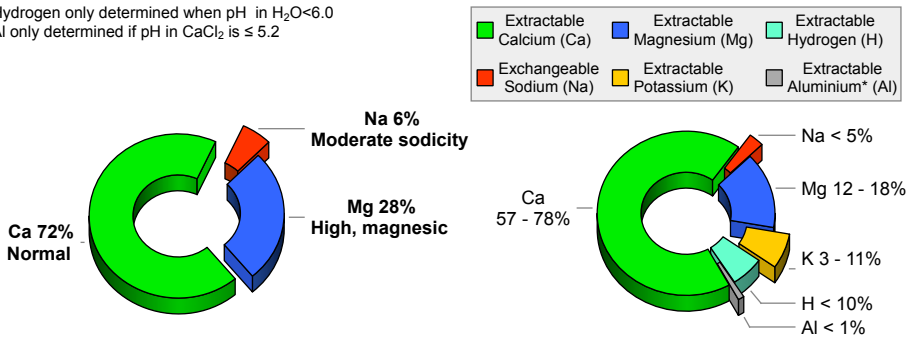
## pH and ELECTRICAL CONDUCTIVITY



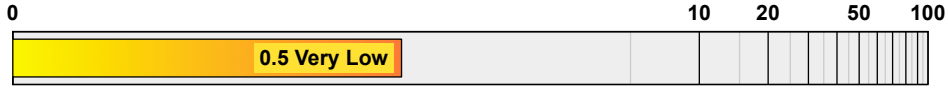

## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 2.6 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** 0 Low

**Electrochemical Stability Index (ESI):**
0.01 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

SESL AUSTRALIA
Environment & Soil Sciences

# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 1300 30 40 80
**Fax:** 1300 64 46 89
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

**Batch N°: 31531** **Sample N°: 21** **Date Received: 22/8/14** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | - | | - | 8 | Did not test |
| Phosphate-P ($PO_4$) | - | | - | 16.8 | Did not test |
| Potassium (K) † | <3.90 | | 1 | 47.3 | 46.3 |
| Sulphate-S ($SO_4$) | - | | - | 18.1 | 18.1 |
| Calcium (Ca) † | 72 | | 19.2 | 337 | 317.8 |
| Magnesium (Mg) † | 17 | | 4.5 | 35.6 | 31.1 |
| Iron (Fe) | - | | - | 146.8 | Did not test |
| Manganese (Mn) † | - | | - | 11.7 | Did not test |
| Zinc (Zn) † | - | | - | 1.3 | Did not test |
| Copper (Cu) | - | | - | 1.7 | Did not test |
| Boron (B) † | - | | - | 0.7 | Did not test |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

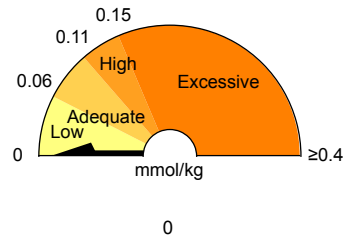
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/$m^3$ and selected soil depth.

### Phosphorus Saturation Index




**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | - |
| Sum of Base Cations (meq/$100g^{-1}$): | **0.5** |
| Eff. Cation Exch. Capacity (eCEC): | **0.5** |
| Base Saturation (%): | **100** |
| Exchangeable Acidity (meq/$100g^{-1}$): | - |
| Exchangeable Acidity (%): | - |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **0** |
| – to neutralise Al (g/sqm): | - |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **0**

The CGAR is corrected for a soil depth of 200mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Sand** |
| Colour: | - |
| Estimated clay content: | **< 5%** |
| Size: | - |
| Gravel content: | **Not gravelly** |
| Aggregate strength: | - |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Very Rapid** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **0.7** |

**– Non-saline. Salinity effects on plants are mostly negligible.**

Organic Carbon (OC%)†: **Did not test**
Organic Matter (OM%): -
Additional comments:

**Consultant: Kelly Lee**

**Authorised Signatory: Ryan Jacka**

Date Report Generated 3/09/2014

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

ASPAC

**A member of the Australasian Soil and Plant Analysis Council**
† This laboratory has been awarded a Certificate of Proficiency for specific soil and plant tissue analyses by the Australasian Soil and Plant Analysis Council (ASPAC). Tests for which proficiency has been demonstrated are highlighted in this report.