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CORONATION (26 SHEPHERD STREET) PTY LTD

GEOTECHNICAL INVESTIGATION REPORT

26-28 Shepherd Street, Liverpool, NSW

Report E23125 GA Rev2
21 December 2016

Report Distribution

Geotechnical Investigation Report

26-28 Shepherd Street, Liverpool, NSW

EI Report No. *E23125 GA Rev2*

Date: *21 December 2016*

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1 INTRODUCTION

1.1 BACKGROUND

At the request of Coronation (26 Shepherd Street) Pty Ltd (the Client), EI Australia (EI) has carried out a Geotechnical Investigation (GI) for the proposed development at 26-28 Shepherd Street, Liverpool, NSW (the Site).

This GI report has been prepared to provide advice and recommendations to assist the designers in the preparation of designs for the proposed development. The investigation has been carried out in accordance with the scope of work outlined in EI's proposal referenced P13774.2, dated 13 April 2016.

A Groundwater Take Assessment (GTA) will be prepared once the final shoring design is provided. The purpose of the GTA, which will be completed using the computer software Seep/W, is to estimate the groundwater infiltration rates and to check if the water entering the basement can be managed with conventional sump and pump methods.

EI has also been commissioned by Coronation (26 Shepherd Street) Pty Ltd to carry out environmental Preliminary Site Investigation Report (PSI) for the site, referenced E23125 AA, Rev 0, and dated 14 October 2016. This report should be read in conjunction with the PSI report.

1.2 PROPOSED DEVELOPMENT

To assist us with the preparation of this GI report, the Client has supplied EI with:

- Architectural drawings of the proposed development prepared by Woods Bagot Pty Ltd, Project No. 120809, Drawing Nos. DA011-DA015 and DA018, Revision P12; DA016 and DA017, Revision P11; DA019, Revision P8; all dated 29 July 2016 and Project No. 120597/120809, Drawing Nos. A022B1 and A022B2, dated 12 December-2016; Drawings Nos. A23202 and A23203, Revision P13, dated 14 December 2016.
- Preliminary basement set out plan prepared by SDG Land Development Solutions, Ref: 6352, DWG: 7054 160916 PREL BASE, dated 16 September 2016;
- Detailed survey plan of the site prepared by SDG Land Development Solutions, Ref. 6683, Issue A, dated 12/02/16, The datum is Australian Height Datum (AHD), all Reduced Levels (RL) mentioned in this report are in AHD; and
- Report prepared by Structural Design Solutions – RE: 28 Shepherd Street, Liverpool – Excavation of Basement, dated 2 December 2016.

A geotechnical report prepared by Asset Geotechnical Engineering Pty Ltd, titled *Preliminary Salinity and Acid Sulphate Soils Assessment,* Report No. 2936-R1, dated 15 April 2015.A geotechnical investigation had been previously carried out by Asset Geotechnical Engineering Pty Ltd (Asset) for 28 Shepherd Street, and the results are presented in their report referenced above. The borehole logs, core photos and laboratory test results completed by Asset have been incorporated into the recommendations made within this report and are presented in Appendix C of this report.

Based on the above documents and discussions with the Client, EI understands that the proposed development will involve the demolition of all existing site structures and the construction of two buildings, 26 Shepherd Street will include fourteen and two storey building and 28 Shepherd Street will include seven and two storey building, both of which will be constructed over a two level common basement carpark. The Finished Floor Level (FFL) of Basement 2 (B2) is proposed to be at Reduced Level (RL) of 4.5m. A Bulk Excavation Level (BEL) of RL4.2m has been assumed to allow for the construction of B2 slab. Based on the latter, maximum bulk excavation to a depth of about 6.5m is expected. Locally deeper excavations for lift overrun pits, footings, crane pads, and service trenches may be required.

1.3 Investigation Objectives

The objective of the GI was to assess site surface and subsurface conditions at four borehole locations, and to provide geotechnical advice and recommendations addressing the following:

- Dilapidation Surveys;
- Excavation methodologies and monitoring requirements;
- Vibration considerations;
- Groundwater considerations;
- Excavation support requirements, including geotechnical design parameters for retaining walls and shoring systems;
- Building foundation options, including;
    - Design parameters.
    - Earthquake loading factor in accordance with AS1170.4:2007.
- Basement floor slab; and
- The requirement for additional geotechnical works.

1.4 Scope of Works

The scope of works for the GI included:

- Preparation of a Work Health and Safety Plan;
- Review of relevant geological maps for the project area;
- Review of a geotechnical report prepared by Asset Geotechnical Engineering Pty Ltd
- Site walkover inspection by a Geotechnical Engineer to assess topographical features and site conditions;
- Electro-magnetic scanning of proposed borehole locations for buried conductive services using a licensed service locator with reference to Dial Before You Dig (DBYD) plans;
- Auger drilling of four boreholes (BH101M, BH102M, BH103 and BH104) by a track-mounted drill rig using solid flight augers equipped with a 'Tungsten-Carbide' (T-C) bit attachment to depths of about 9.1m (or about RL 1.6m AHD), 7.45m (or about RL 3.3m AHD) 8.1m (or about 2.4m AHD) and 9.3m BEGL (or about 1.3m AHD) respectively. Approximate borehole locations are shown on **Figure 2.** The approximate surface levels shown on the borehole logs were interpolated from spot levels shown on the supplied survey plan, which formed the basis of **Figure 2**;
- Standard Penetration Testing (SPT) during auger drilling of the boreholes at regular intervals to assess soil strength/relative densities. These were augmented, where possible, by hand penetrometer readings on cohesive soil samples collected in the SPT split tube sampler. Selected soil samples were sent to Macquarie Geotechnical Pty Ltd (Macquarie) and SGS Australia Pty Ltd (SGS), which are National Australian Testing Authority (NATA) accredited laboratories, for testing and storage, The results of laboratory testing are attached in Appendix B;
- The strength of the bedrock in the augered section of the boreholes was assessed by observation of the auger penetration resistance using a T-C drill bit attached to the augers, examination of the recovered rock cuttings, and rock moisture content test results. It should be noted that rock strengths assessed from augered boreholes are approximate and strength variances can be expected;
- Boreholes BH101M, BH102M and BH103 were extended using NMLC diamond coring techniques, to termination depths of about 16.1m (or about - 5.4m AHD), 13.1m (or about -2.4m AHD) and 16.3m BEGL (or about -5.8m AHD), respectively. Rock core recovered from the boreholes were logged, photographed,

boxed, and sent to Macquarie for point load strength index testing and storage. The rock core photographs and point load strength testing results are attached to this report. The test results are presented in **Appendix B**, and the rock core photographs are presented in **Appendix A**;

- Measurements of groundwater seepage/levels, where possible, in the augered sections of the boreholes during and shortly after completion of auger drilling. The groundwater levels within the installed monitoring wells were measured two days following development , ;
- Installation of three PVC standpipes in BH101M, BH102M and BH104M to allow for long term groundwater monitoring;
- Preparation of this GI report.

EI Geotechnical Engineer was present on site to set out the borehole locations, direct the testing and sampling, log the subsurface conditions and record groundwater levels.

1.5 Investigation Constraints

The GI was limited by the intent of the investigation. The discussions and advice presented in this report are intended to assist the designers in the preparation of designs for the development.

2 SITE DESCRIPTION

2.1 SITE DESCRIPTION AND IDENTIFICATION

The site identification details and associated information are presented in **Table 2-1** below while the site locality is shown on **Figure 1.**

Table 2-1 Summary of Site Information

Information	Detail
Street Address	26-28 Shepherd Street, Liverpool, NSW 2170
Lot and Deposited Plan (DP) Identification	Lots 22 and 23 in DP 859055
Local Government Authority	Liverpool City Council
Parish	St Luke
County	Cumberland
Current Zoning	R4 – High Density Residential (Liverpool Local Environment Plan, 2008)
Site Description	26 Shepherd Street: The site sloped gently from the west down towards the east. The Georges River is located adjacent to the eastern site boundary. At the time of the investigation, the site comprised of a brick and metal clad building with a metal roof in the north-eastern corner of the site. A metal shed was located in the northern corner of the site having Shepherd Street frontage. The remainder of the site is covered in gravelly fill material at surface. Access to the site was from Shepherd Street. 28 Shepherd Street: The site is located on the eastern side of the street. The site sloped gently towards east. The Georges River is located adjacent to the eastern site boundary. At the time of fieldwork, the site comprised a disused steel frame warehouse within the western portion. Some small to medium sized trees were scattered around the site and remainder of the site was covered by grass and shrubs. The ground surface within the eastern portion steeply sloped down towards Georges River and appeared to be a part of an old landslip and subsequent erosion.
Site Area	8,681 m^2 (SDG, Ref. No. 6683, Issue A, dated 12/02/16).

2.2 Local Land Use

The site is situated within an area of mixed residential and commercial use. Current uses on surrounding land are described in **Table 2-2** below.

Table 2-2 Summary of Local Land Use

Direction Relative to Site	Land Use Description
North	An on-going construction site for a multi-level building over a three level basement carpark immediately adjacent to the northern site boundary. The basement is assumed to extend up to the site boundary.
East	Georges River with setback between about 1m and 3m from the eastern site boundary. The southern part of the eastern boundary appeared to be an old landslip and subsequent erosion. At the time of our inspection, the standing water level in Georges River was about 4m lower than the site ground surface level.
South	A vacant site occupied by a brick building with the awnings to the west and east. The eastern and western portion of the site was concrete paved and concrete driveway was located within the road frontage. This site is proposed to be developed into multi-storey building over three level basement.
West	Shepherd Street, a two-lane asphaltic concrete road was locatedadjacent to the western site boundary. Beyond Shepherd Street lie commercial properties.

2.3 Regional Setting

The site topography and geological information for the locality is summarised in **Table 2-3** below**.**

Table 2-3 Topographic, Geological and Hydrogeological Information

Attribute	Description
Topography	The site gently falls down from the south-western corner towards the eastern boundary. The site level ranges from about RL 12.2m AHD from the south-western corner to RL 9.5m AHD along the eastern boundary.
Regional Geology	Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Penrith 1:100,000 Geological Series Sheet 9130 (DMR 1991) indicates the site to be underlain by Quaternary fluvial deposits comprising medium grained sand, clay and silt.

3 INVESTIGATION RESULTS

3.1 STRATIGRAPHY

For the development of a site-specific geotechnical model, the observed stratigraphy during the GI has been grouped into five geotechnical units. A summary of the subsurface conditions across the site, interpreted from the investigations results, is presented in **Table 3-1** below. More detailed descriptions of subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**. The details of the method of soil and rock classification, explanatory notes and abbreviations adopted on the borehole logs are also presented in **Appendix A**.

Table 3-1 Summary of Subsurface Conditions

Unit	Material [1]	Depth to top of Unit (m BEGL) [2]	RL of top of Unit (m AHD) [2]	Observed Thickness (m)	Material Description[1]	Comments
1	**Fill**	0.0 (surface)	10.7 to 10.1	1.5 to 2.8	FILL	Asphaltic-concrete pavement up to 160mm thick was encountered in BH104M overlying gravelly sandy clay fill. Sandy gravels, gravelly clay, sandy clay, clay, clayey sand. Fill appeared to be poorly compacted. Fill was not encountered in BH4.
2	**Alluvium Soil**	1.5 to 2.8	9.2 to 7.7	5.7 to 9.6	SANDY/SILTY CLAYS and SANDS	Silty clay, sandy clay and sandy clay, clayey sand and sand. Clays are of low to high plasticity and of firm to very stiff strength, and Sands are of loose to dense relative density with moist to wet moisture conditions. Unit 2 grades into weathered shale at depth. SPT N values ranged from 2 and 33, and hand penetrometer readings on the SPT sample ranged from 30kPa to 400kPa.
3	**Extremely Low to Very Low Strength Shale**	7.3 to 9.0	3.3 to 1.7	0.0 to 1.5	SHALE	Extremely low or very low strength, extremely to distinctly weathered shale. A band of low strength shale was encountered in BH103. Unit 3 was not encountered in BH101M, BH102M, BH103M, BH1, and BH4. Core loss of 1.3m encountered in BH4 has been inferred as Unit 3 material.
4	**Low to Medium Strength Shale**	7.3 to 9.5	3.4 to 0.6	0.5 to 1.5	SHALE	Generally distinctly to slightly weathered and of low to medium strength shale. Unit 4 was not encountered in BH2 to BH6. Defects in Unit 4 are generally very closely spaced to very widely spaced (20 to >2000mm), including sub-horizontal bedding partings, joints inclined up to 90°, and up to 13.5% decomposed and crushed seams. Core losses have been inferred as decomposed and/ or crushed seams.
5	**Medium Strength Shale[3]**	8.0 to 10.0	2.7 to 0.1	1.4 to 5.1	SHALE	Generally slightly weathered to fresh and at least of medium strength.

Notes:

1 For more detailed descriptions of the subsurface conditions, reference should be made to the borehole logs attached to **Appendix A.**
2 Approximate depth / RL at the time of our investigation. Depths and levels may vary across the site.
3 Unit 5 was observed up to termination depths in all cored boreholes except BH104, BH5, and BH6 as these were augered only.

3.2 GROUNDWATER OBSERVATIONS

Groundwater seepage was observed in BH101M, BH102M and BH104M during auger drilling at depths of about 7m (or about 3.7m AHD), 6m (or about 4.7m AHD) and 7.5m (or about 3.1m AHD) BEGL, respectively. The water induced during the coring process of the boreholes precluded further observations of the groundwater levels in BH101M, BH102M and BH103. However, following the completion of the fieldwork, three monitoring wells were installed in BH101M, BH102M and BH104M for further groundwater monitoring and were developed on the day of installation.

The groundwater levels in BH101M, BH102M and BH104M were recorded during a site visit on 28 September 2016. The groundwater levels in BH102M and BH104M were measured again on 14 October 2016.

Groundwater measurements taken by EI and Asset are presented in **Table 3-2** below.

Table 3-2 Summary of Groundwater Levels

Borehole ID	Date of Observation	Approximate Depth to Groundwater (m BEGL)	Approximate RL of Groundwater (m AHD)	Approximate Bulk Excavation RL at Borehole Location (m AHD)
BH1[1]	28 August 2014	5.3	4.8	1.7
BH3[1]	28 August 2014	7.0	3.6	
BH101M	28 September 2016	6.4	4.3	
BH02M	28 September 2016	6.6	4.1	
	14 October 2016	6.4	4.3	
BH104M	28 September 2016	7.0	3.6	
	14 October 2016	7.0	3.6	

Notes:

1 Groundwater measurements taken from the geotechnical report prepared by Asset Geotechnical Pty Ltd.

3.3 TEST RESULTS

Four soil and one groundwater sample(s) were scheduled for laboratory testing to assess the following:

- Atterberg Limits and Linear Shrinkage;
- Soil and rock Moisture Content;
- Soil and groundwater aggressivity (pH, Chloride and Sulfate content and electrical conductivity).

A summary of these test results is provided in **Table 3-3** below. The laboratory test certificates are presented in **Appendix B.**

Table 3-3 Summary of Laboratory Test Results

Test/ Sample ID		BH102M	BH101M_7.5-7.95	BH101M_1.5-1.95	BH101M_4.5-4.95	BH101_9.0-9.1	BH102_1.5-1.95
Unit		Groundwater	2	1	2	3a	2
Material Description [1]		-	Sandy CLAY	FILL	Sandy CLAY	SHALE	Silty CLAY
Atterberg Limit	Liquid Limit (%)	-	-	-	29	-	61
	Plastic Limit (%)	-	-	-	13	-	18
	Plasticity Index (%)	-	-	-	16	-	43
Linear Shrinkage (%)		-	-	-	7.0	-	14.5
Aggressivity	pH	6.7	7.5	8.3	-	-	-
	Electrical Conductivity (µS/cm)	8900	45	240	-	-	-
	Sulfate SO_4 (mg/kg)	730	36	120	-	-	-
	Chloride Cl (mg/kg)	2500	2.9	7.2	-	-	-
Moisture Content (%)		-	22	16	15.7	11.8	23.3

Notes:
More detailed descriptions of the subsurface conditions at each borehole location are available on the borehole logs presented in **Appendix A**.

42 rock core samples were tested by Macquarie to estimate the Point Load Strength Index (Is_{50}) values to assist with rock strength assessment. The results of the testing are summarised on the attached borehole logs and presented in **Appendix B.**
The point load strength index tests and moisture content results correlated reasonably well with our field assessments of rock strength. The approximate Unconfined Compressive Strength (UCS) of the rock core, estimated from correlations with the point load strength index test results from EI and Asset geotechnical investigations, varied from <1 MPa to 47 MPa.

The Atterberg Limits results on Unit 2 indicated that the sandy clay and silty clay to be of low and high plasticity, respectively, and have a slight to high potential for shrink/swell movements with changes in moisture content.

The assessment indicated low permeability soils were present. In accordance with Tables 6.4.2(C) and 6.5.2(C) of AS 2159:2009 'Piling – Design and Installation', the results of the pH, chloride and sulphate content and electrical conductivity of the soil, provided the following exposure classifications:

Soil:

- 'Mild to Non-aggressive' for buried concrete structural elements; and
- 'Non-aggressive' for buried steel structural elements.

In accordance with Table 4.8.1 of AS3600-2009 'Concrete Structures' the soil would be classified as exposure classification 'A1' for concrete in sulphate soils.

Groundwater:

- 'Non-aggressive' for buried concrete structural elements; and
- 'Non-aggressive' for buried structural elements.

In accordance with Table 4.8.1 of AS3600-2009 'Concrete Structures' the groundwater would be classified as exposure classification 'A1' for concrete in sulphate soils.

4 RECOMMENDATIONS

4.1 GEOTECHNICAL ISSUES

Based on the results of the investigation, we consider the following to be the main geotechnical issues for the proposed development:

- Given the very soft to firm clays encountered in BH1 (Asset), a working platform may be required to provide a trafficable surface during construction;
- Basement excavation and retention to limit lateral deflections and ground loss as a result of excavations, resulting in damage to nearby structures and stability of the riverbank, particularly to adjacent basement structures;
- Groundwater within the depth of the excavation;
- The proximity of the site to Georges River; and
- Foundation design for building loads.

4.2 DILAPIDATION SURVEYS

Prior to excavation and construction, we recommend that detailed dilapidation surveys be carried out on all structures and infrastructures surrounding the site that falls within the zone of influence of the excavation. The zone of influence of the excavation is defined by a distance back from the excavation perimeter of twice the total depth of the excavation. The reports would provide a record of existing conditions prior to commencement of the work. A copy of each report should be provided to the adjoining property owner who should be asked to confirm that it represents a fair assessment of existing conditions. The reports should be carefully reviewed prior to demolition and construction.

4.3 EXCAVATION METHODOLOGY

4.3.1 Excavation Assessment

Prior to any excavation commencing, we recommend that reference be made to the WorkCover Excavation Work Code of Practice – July 2015.

Bulk excavation to a depth of up to 6.5m BEGL is expected to be required to achieve the BEL of RL4.2m. Locally deeper excavations for footings, service trenches, crane pads and lifts overrun pits may be required.

Based on the borehole logs, the proposed basement excavations will therefore extend through Units 1 and 2 outlined in **Table 3-1** above. A retention system must be installed prior to excavation commencing.

Units 1 and 2 may be excavated using buckets of medium to large earthmoving Hydraulic Excavators.

4.3.2 Excavation Monitoring

Consideration should be made to the impact of the proposed development upon neighbouring structures and basements, roadways, Georges River embankment and services. Basement excavation retention systems should be designed so as to limit lateral deflections.

Contractors should also consider the following limits associated with carrying out excavation and construction activities:

- Limit lateral deflection of temporary or permanent retaining structures;
- Limit vertical settlements of ground surface at common property boundaries and services easement.; and
- Limit peak particle velocities (PPV) from vibrations, caused by construction equipment or excavation, experienced by any structure within bounding properties and the services easement.

Monitoring of deflections of retaining structures and surface settlements should be carried out by a registered surveyor at agreed points along the excavation boundaries and along existing building foundations/ services/ pavements and other structures located within or near the zone of influence of the excavation. Geotechnical engineer should review the survey monitoring results carried out by a registered surveyor. In addition, a geotechnical engineer should be present full time on site during drilling, excavation and construction of retaining structure to monitor and/or identify instability of excavated faces, tension cracks and/or any visible sign of ground settlement behind the retaining structure. Owners of existing services adjacent to the site should be consulted to assess appropriate deflection limits for their infrastructure. Measurements should be taken:

- Before commencement of retaining structures where appropriate to determine baseline readings. Two independent sets of measurements must be taken confirming measurement consistency;
- After construction of the retaining structures, but before commencement of excavation;
- After excavation to the first row of supports or anchors, but prior to installation of these supports or anchors;
- After excavation to any subsequent rows of supports or anchors, but prior to installation of these supports or anchors;
- After excavation to the base of the excavation;
- After de-stressing and removal of any rows of supports or anchors;
- One month after completion of the permanent retaining structure or after three consecutive measurements not less than a week apart showing no further movements, whichever is the latter.

4.4 Groundwater Considerations

Groundwater was observed within the monitoring wells installed by both EI and Asset. The latest groundwater measurements in BH101M, BH102M and BH104M were recorded at depths of about 6.4m (RL 4.3m AHD), 6.4m (RL 4.3m AHD) and 7.0m BEGL (RL 3.6m AHD), respectively. Groundwater levels measured in monitoring wells BH1 and BH3 indicated groundwater depths of 5.3m (RL 4.8m AHD) and 7.0m BEGL (RL 3.6m AHD), respectively. These results show groundwater across the site to be at or just above the proposed BEL of RL 4.2m AHD. Depending on groundwater levels at the time of construction, dewatering could be required in some areas of the site, so that the basement can be constructed in 'dry' conditions. Based on current groundwater condition, we expect that the seepage into the excavation would be low and be satisfactorily controlled by conventional sump and pumping.

. We recommend that prior to bulk excavation commencing, further groundwater monitoring with pump out tests be carried out in the installed wells together with seepage analysis using computer software such as SEEP/W for estimation of seepage volumes into the excavation.

The boreholes encountered a profile of clayey sand or sand below the BEL, which are expected to have high permeability, therefore we recommend the construction of a full tanked basement structure. The basement slab should be designed to resist hydrostatic uplift pressures which may require additional mass or ground anchors. It is also noted that high seepage rates are anticipated due to the presence of Georges River to the south of the site. We also expect that hydrostatic pressures will be governed by flood levels within the Georges River. In this regards, we recommend that relief valves be installed to account for such flooding.

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4.5 Excavation Retention

4.5.1 Support Systems

From a geotechnical perspective, it is critical to maintain the stability of the adjacent structures and infrastructures during demolition, excavation and construction works.

Due to the fact that the proposed basement excavation will extend to all site boundaries, temporary batter slopes of the soil and weathered rock profile are not recommended for this site. Unsupported vertical cuts of the soil and

weathered rock profile are not recommended for this site as these carry the risk of potential collapse/slump failure especially after a period of wet weather. Collapse/failure of the material may result in injury to personnel and/or damage to nearby structures/infrastructures and equipment.

We understand that it is proposed to support the excavation by an anchored soldier pile wall. We stress that the gaps between the piles must be sealed by shotcrete or mass concrete, immediately and without delay at maximum excavation depth intervals of 1m to avoid collapse/slumping of the material between the piles, particularly below groundwater and/or during and following wet weather. Slumping/collapse of the material may regress backwards and may result in damage to nearby structures/infrastructures. Over excavation (i.e. deeper than 1m) must not be attempted for this site. During the selection of the shoring system, the risk associated with each type of shoring wall must be assessed by the client.

Alternatively, an anchored and/or propped contiguous or secant pile walls should be used to support the excavation. Alternate piles are first drilled and concreted at close spacing. The intermediate piles are then installed by drilling out the soil between each pair and part of the already installed piles. Cased secant methods provide a high degree of security when in granular soils adjacent to heavily loaded foundations or adjacent to structures. Use of specialist high capacity, cased continuous flight auger rigs is likely to result in little disengagement of the secant piles. Should the second 'hard' piles disengage from the first 'soft' piles, then remedial works would be required to rectify any seepage inflows. Any gaps between the piles may result in loss of material and water inflow from behind the wall which may lead to settlements adjacent to the wall and may result in damage to neighbouring structures and services. The resulting out of position piles may also affect internal layout/clearances.

Anchors and/or props must be installed progressively as excavation proceeds. The piles must be installed to below BEL and socketed into Unit 5 or better.

Due to the presence of the embankment, deep fluvial soil profile and proximity of Georges River to the east, anchors may not be possible and hence, internal props or bracing may be required. In addition, Details of adjoining proposed basements, shoring pile walls and anchors must be obtained prior to final design.

Grout injected CFA piles will be required for this site. However, relatively large capacity piling rigs (e.g. Soilmec SR-40 or larger) will be required for drilling through the shale bedrock. The proposed pile locations should take into account the presence of the neighbouring anchors and/or the presence of buried services. Further advice should be sought from prospective piling contractors who should be provided with a copy of this report. Working platforms may also be required. Bored piers could be attempted for the shoring wall, but significant difficulties with collapse of the poorly compacted fill and alluvial soils due to groundwater inflow will probably be experience. The use of liners, pumps, and tremie concreting techniques may overcome some of these difficulties, but bored pier are still likely to be impractical. If bored piers are to be used, we recommend that trial piers be drilled to assess potential construction difficulties at start of the work.

Given the very soft to firm clays encountered in BH1 (Asset), at some point during excavation works, a working platform of good quality granular material, possibly with geogrid reinforcement, may be required to provide a trafficable surface during construction. The details of the working platform should be determined following inspection of the subgrade as the final thickness will depend on the quality of the subgrade and the equipment that will need to traffic the base.

In addition, we recommend that assessment of the potential impact of the excavation on the embankment to the east be carried out using a computer software such as Slope/W.

4.5.2 Retaining Walls Design Parameters

The following parameters may be used for static design of temporary and permanent retaining walls at the subject site:

- For progressively anchored or propped walls where minor movements can be tolerated (provided there are no buried movement sensitive services), we recommend the use of a trapezoidal earth pressure distribution of 5H kPa for soil and shale bedrock, where H is the retained height in meters. These pressures should be assumed to be uniform over the central 50% of the support system;

- For progressively anchored or propped walls which support areas which are highly sensitive to movement (such as areas where movement sensitive structures or infrastructures or buried services are located in close proximity), we recommend the use of a trapezoidal earth pressure distribution of 8H kPa for soil and shale bedrock, where 'H' is the retained height in meters. These pressures should be assumed to be uniform over the central 50% of the support system;
- The walls must be designed for full hydrostatic pressures, which may occur as a result of flooding of the adjacent Georges River. The shoring design will need to take into account differential pressures inside and outside the excavation due to flooding, etc. The hydrostatic pressure should extend to the base of the perimeter cut-off.
- Appropriate surcharge loading affecting the walls (including from construction equipment, construction loads, adjacent high level footings, shoring walls, etc.) should be adopted in the retaining wall design as an additional surcharge using an 'at rest' earth pressure coefficient, k_o, of 0.58;
- For piles embedded into Unit 4 or better, the allowable lateral toe resistance value outlined in **Table 4-1** below may be adopted. These values assume excavation is not carried out within the zone of influence of the wall toe and the rock does not contain adverse defects etc. The upper 0.3m depth of the socket should not be taken into account to allow for tolerance and disturbance effects during excavation
- If temporary anchors extend beyond the site boundaries, then permission from the neighbouring developments would need to be obtained prior to installation. Also, the presence of neighbouring basements or services and their levels must be confirmed prior to finalising anchor design.
- Soil anchors should be bonded into medium or denser sands and/or very stiff clays and may be designed for a drained angle if internal friction Φ', as shown in Table 4-1 below may be used, subject to the following conditions:
    - Anchors are to be installed with casing within the soil profile to prevent soil collapse and settlement during installation.
    - Anchor should have their free length equal to their height above the base of the excavation and have bond lengths of at least 3m behind the 'active' zone of the excavation (taken as a 45 degree zone above the base of the excavation) is provided;
    - Overall stability, including anchor group interaction, is satisfied;
    - All anchors should be proof loaded to at least 1.33 times the design working load before locked off at working load. Such proof loading is to be witnessed by and engineer independent of the anchoring contractor. We recommend that only experienced contractors be considered for anchor installation with appropriate insurances;
    - If permanent anchors are to be used, these must have appropriate corrosion provisions for longevity.
    - If anchor installation is not feasible due to presence of alluvial soil then provision of internal propping or struts will be required.

Table 4-1 Geotechnical Design Parameters

Material [1]		Unit 1 Fill	Unit 2 Alluvial Soil	Unit 3 Extremely Low to Very Low Strength Shale	Unit 4 Low to Medium Strength Shale	Unit 5 Medium Strength Shale
RL of Top of Unit (m AHD) [2]		10.7 to 10.1(Surface)	9.2 to 7.7	3.3 to 1.7	3.4 to 0.6	2.7 to 0.1
Bulk Unit Weight (kN/m³)		18	19	20	23	24
Drained Angle of Internal Friction, Φ' (°)		25	27	30	40	40
Earth Pressure Coefficients	At rest, K_o [3]	0.58	0.55	0.50		
	Active, K_a [3]	0.41	0.33	0.33		
	Passive, K_p [3]	-	-	-		
Preliminary Allowable Bearing Pressure (kPa) [5]		-	100 (Shallow footing only)	-	1500	3500
Allowable Shaft Adhesion (kPa) [4, 5]	in Compression	-	-	-	150	300
	in Uplift	-	-	-	75	150
Ultimate Bearing Pressure (kPa) [6, 7]		-	300 (Shallow footing only)	-	3000	30,000
Ultimate Shaft Adhesion (kPa) [6, 7]		-	-	-	1500	600
Toe Resistance (kPa)		-	-	-	100	350
Bond Stress (kPa)		-	-	-	75-	300
Earthquake Site Risk Classification		• AS 1170.4:2007 indicates an earthquake subsoil class of Class B_e.(Rock) • AS 1170.4:2007 indicates that the hazard factor (z) for Sydney is 0.08.				

Notes:

1 More detailed descriptions of subsurface conditions are available on the borehole logs presented in **Appendix A.**
2 Approximate levels to top of unit at the time of our investigation. Levels may vary across the site.
3 Earth pressures are provided on the assumption that the ground behind the retaining walls is horizontal.
4 Allowable Shaft Adhesion values given assume there is intimate contact between the pile and foundation material and should achieve a clean socket roughness category R2 or better. Design engineer to check both 'piston pull-out' and 'cone lift out' mechanics in accordance with AS4678-2002 Earth Retaining Structures.
5 To adopt these parameters we have assumed that:
- Piles have a nominal socket of at least two pile diameters or 1 m, whichever is greater, into the relevant founding material;
- There is intimate contact between the pile and foundation material (a clean socket roughness category of R2 or better);
- Potential soil and groundwater aggressivity will be considered in the design of piles;
- The pile should be drilled in the presence of a suitably qualified Geotechnical Engineer prior to pile construction to verify that ground conditions meet design assumptions. Pile excavations should be pumped dry of water prior to pouring concrete, or alternatively a tremie methods should be used;
- The base of all footing excavations are cleaned of loose and softened material and water is pumped out prior to placement of concrete;
- The concrete is poured on the same day as drilling, inspection and cleaning.
- The allowable bearing pressures given above are based on serviceability criteria of settlements at the footing base/pile toe of less than or equal to 1% of the minimum footing dimension (or pile diameter).

6 For side shear only sockets (in tension), we recommend a geotechnical reduction factor, Φ_g, of 0.5 to be used.
7 We recommend a basic geotechnical strength reduction factor, Φ_{gb}, of 0.56 calculated from Table 4.3.2 (A, B, and C) of AS2159-2009: Piling Design and Installation, be adopted.

Furthermore, any existing buried services which run below the site will require diversion prior to the commencement of excavation or alternatively be temporarily supported during excavation, subject to permission or other instructions from the relevant service authorities. Enquiries should also be made for further information and details, such as invert levels, on the buried services.

4.6 FOUNDATIONS

Following bulk excavations, we expect Unit 2b sandy clay or clayey sand to be exposed over the B2 BEL of RL -4.2m.

Shallow footings may be considered using the bearing pressure values outlined in **Table 4-1** above. It is recommended that all footings be founded within material of similar strength to provide uniform support and reduce the potential for differential settlements.

The following support systems may be considered for support of the proposed development:

- Shallow pad and/or strip footings, stiffened raft slab, piled stiffened raft slab on Unit 2b. However, shallow pad and/or strip footings may be susceptible to differential settlements and our preference is the use of the stiffened raft slab/piled stiffened raft slab;
- Piled footing socketed in Unit 4 and 5 shale.

In the case of a pile stiffened raft slab, the piles are designed to their ultimate capacity and act as settlement reducers to the stiffened raft slab.

The subgrade preparation below any raft slabs will be important in the final performance of the raft. Detailed analysis of a piled raft would be required to estimate the settlements, particularly of the clay layers below, and the contact pressures below the raft. Further discussion regarding sub-grade preparation is provided in Section 4.7 below.

Alternatively, the building may be designed as fully suspended (which is our preferred option) with deep piles founded into Unit 4 shale or better. Piles founded in Unit 4 or Unit 5 shale may be designed with an allowable bearing pressure of 1500kPa or 3500kPa, respectively.

Grout Injected CFA piles are recommended for this site. Due to the collapsible nature of the sands and the presence of groundwater, bored piers are not recommended for this site. For piles founded into shale bedrock, relatively large capacity piling rigs with rock augers and coring buckets will be required if drilling through the shale bedrock. Further advice should be sought from prospective piling contractors who should be provided with a copy of this report.

All piles must be designed in accordance with the Australian Standard AS2159-2009 Piling – Design and installation.

At least the initial stages of footing excavation should be inspected by a geotechnical engineer to ascertain that the recommended foundation material and depth has been reached and to check initial assumptions about foundation conditions and possible variations that may occur between test locations. The need for further inspections can be assessed following the initial visit.

4.7 SUBGRADE PREPARATION

The subgrade preparation below any slab is very important in the final performance of the slab. Following bulk excavations for the proposed basement, Unit 2b sandy clay and/or clayey sand are expected to be exposed at BEL. We therefore recommend that the lower basement floor slab should be designed fully tanked and the design is likely to be controlled by the hydrostatic uplift pressures. However, for construction purposes, the slab will overlie stiff sandy clay, but if a pile rig working platform is proposed, we recommend it be placed as early as possible to reduce disturbance.

Earthworks recommendations provided in this report should be complemented by reference to AS3798.

Our recommendations regarding subgrade perpetration are as follows:

- The subgrade below the basement slab or footing will need to be prepared prior to construction of the slab or footing, but the extent of the preparation, inspection and testing will depend on the footing systems adopted. A more rigorous control will be required where a raft slab is adopted.
- No matter what footing system is adopted, the exposed subgrade will need to be rolled to re-compact the surface sands that will have been loosened by the excavations. The base would also need to be inspected by a geotechnical engineer during the final stages of rolling to assess if any weak areas are present that require additional treatment.
- Where a raft slab is adopted, the geotechnical engineer would also need to carry out a series of Dynamic Cone Penetrometer (DCP) tests to assess the density of the sands. We expect that a capping layer of well graded crushed rock or recycled concrete (maximum particle size limited to 40mm) will be required to achieve adequate compaction of the upper sands. This granular layer will be required below the entire raft slab and would be of about 150mm thick.
- The performance of raft (including piled raft) slabs are also dependent on the whole of the design and construction team being familiar with the sensitivity of the situation. It is essential that any services which have to be placed in the subgrade are carefully positioned and an appropriate construction schedule/sequence is provided to the geotechnical engineer for approval at the planning stage.
- Disturbance of the subgrade must be minimised and kept outside the zone of influence of column or wall loads. A documented Inspection and Test Plan (ITP) should be prepared prior to construction with appropriate “hold” points in the Quality System.

5 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL SERVICES

Below is a summary of the previously recommended additional work that needs to be carried out:

- Groundwater monitoring and pump out test within the installed wells;
- Seepage analysis using computer software such as SEEP/W for estimation of seepage volumes into the excavation;
- Impact assessment of the proposed excavation on the riverbank to the east using SLOPE/W;
- Dilapidation surveys;
- Design of working platforms for construction plant by an experienced and qualified geotechnical engineer;
- Classification of all excavated material transported off site;
- Witnessing installation and proof-testing of anchors.
- Geotechnical inspections of foundations; and
- Ongoing monitoring of groundwater inflows into the bulk excavation;

We recommend that a meeting be held after initial structural design has been completed to confirm that our recommendations have been correctly interpreted. We also recommend a meeting at the commencement of construction to discuss the primary geotechnical issues and inspection requirements.

6 STATEMENT OF LIMITATIONS

This report has been prepared for the exclusive use of Coronation (26 Shepherd Street) Pty Ltd who is the only intended beneficiary of EI's work. The scope of the investigation carried out for the purpose of this report is limited to those agreed with Coronation (26 Shepherd Street) Pty Ltd

No other party should rely on the document without the prior written consent of EI, and EI undertakes no duty, or accepts any responsibility or liability, to any third party who purports to rely upon this document without EI's approval.

EI has used a degree of care and skill ordinarily exercised in similar investigations by reputable members of the geotechnical industry in Australia as at the date of this document. No other warranty, expressed or implied, is made or intended. Each section of this report must be read in conjunction with the whole of this report, including its appendices and attachments.

The conclusions presented in this report are based on a limited investigation of conditions, with specific sampling and test locations chosen to be as representative as possible under the given circumstances.

EI's professional opinions are reasonable and based on its professional judgment, experience, training and results from analytical data. EI may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified by EI.

EI's professional opinions contained in this document are subject to modification if additional information is obtained through further investigation, observations, or validation testing and analysis during construction. In some cases, further testing and analysis may be required, which may result in a further report with different conclusions.

We draw your attention to the document "Important Information", which is included in **Appendix E** of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by EI, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Should you have any queries regarding this report, please do not hesitate to contact EI.

7 REFERENCES

AS1170.4:2007, *Structural Design Actions, Part 4: Earthquake Actions in Australia*, Standards Australia.

AS1726:1993, *Geotechnical Site Investigations*, Standards Australia.

AS2159:2009, *Piling – Design and Installation*, Standards Australia.

AS2870:2011, *Residential Slabs and Footings*, Standards Australia.

AS3600:2009, *Concrete Structures,* Standards Australia

Excavation Work Code of Practice – July 2015 – WorkCover NSW,

NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

NSW Department of Mineral Resources (1983) Sydney 1:100,000 Geological Series Sheet 9130 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources.

8 ABBREVIATIONS

AHD	Australian Height Datum
AS	Australian Standard
BEL	Bulk Excavation Level
BEGL	Below Existing Ground Level
BH	Borehole
DBYD	Dial Before You Dig
DP	Deposited Plan
EI	EI Australia
GI	Geotechnical Investigation
NATA	National Association of Testing Authorities, Australia
PPV	Peak Particle Velocities
PVC	Polyvinyl Chloride
RL	Reduced Level
RMS	Roads and Maritime Services
SMDD	Standard Maximum Dry Density
SPT	Standard Penetration Testing
T-C	Tungsten-Carbide
UCS	Unconfined Compressive Strength

FIGURES

eiaustralia Contamination | Remediation | Geotechnical Suite 6.01, 55 Miller Street, PYRMONT 2009 Ph (02) 9516 0722 Fax (02) 9518 5088	Drawn:	V.L.	**Coronation (26 Shepherd Street) Pty Ltd** Geotechnical Investigation 26-28 Shepherd Street, Liverpool NSW Site Locality Plan
	Approved:	S.K.	
	Date:	16/11/16	
	Scale:	Not To Scale	

Figure: 1

Project: E23125 GA

Map Source: SDG Land Development Solution, Ref No. 6683, Dated 12/02/2016

LEGEND

- Approximate Site Boundary
- Approximate basement outline
- Approximate borehole location
- Approximate borehole/ monitoring well location
- Approximate previous borehole location (Asset, Ref. 2936-R1, dated 15 April 2015)

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Contamination | Remediation | Geotechnical
Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9518 5088

Drawn:	S.K.
Approved:	J.P.
Date:	16/11/16

Coronation (26 Shepherd Street) Pty Ltd
Geotechnical Investigation
26-28 Shepherd Street, Liverpool NSW

Borehole Location Plan

Figure: 2

Project: E23125 GA

APPENDIX A

BOREHOLE LOGS AND EXPLANATORY NOTES

BOREHOLE: BH101M

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Project	Proposed New Redevelopment	East	308064.1 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243382.2 m MGA94 Zone 56	Sheet	1 OF 3
Position	Refer to Figure 2	Surface RL	10.70 m AHD	Date Started	21/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	21/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 21/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	E	28/09/16	0	10.70	BH101M_0.2-0.3 ES 0.20-0.30 m 0.20 m PID = 4.6 ppm			-	FILL; Sandy CLAY; low plasticity, dark brown-dark grey, sand is fine to coarse grained, with fine to medium grained gravel.			FILL Appears Poorly Compacted
				0.70	SPT 0.50-0.70 m 5,5/50mm HB N=5				From 0.7 m, brick fragments.			
			1	10.00	BH101M_0.5-0.7 BH101M_1.0-1.2 ES 1.00-1.20 m PID = 3.6 ppm					M (<PL)	-	
					SPT 1.50-1.95 m 3,2,2 N=4 BH101M_1.5-1.95							
			2	2.00 8.70	BH101M_2.0-2.2 ES 2.00-2.20 m PID = 4.7 ppm			CL-CI	Sandy CLAY; low to medium plasticity, brown, sand is fine to medium grained.	M=PL		ALLUVIUM
			3		SPT 3.00-3.45 m 3,5,7 N=12 BH101M_3.0-3.45 PP =100-200 kPa						St	
			4									
				4.50 6.20	SPT 4.50-4.95 m 4,5,5 N=10 BH101M_4.5-4.95 ES 4.50-4.95 m BH101M_4.5-4.95 4.50 m PP =150-250 kPa			CL-CI	Sandy CLAY; low to medium plasticity, brown mottled grey, sand is fine to medium grained.	M (>PL)	St - VSt	
			5									
			6	6.00 4.70	SPT 6.00-6.45 m 6,4,5 N=9 BH101M_6.0-6.45			SC	Clayey SAND; fine to medium grained, light grey/ red/ orange-brown.		L	
			7							M		
					SPT 7.50-7.95 m 6,6,12 N=18 BH101M_7.5-7.95						MD	
			8									
			9	9.00	SPT 9.00-9.10 m 25/100mm HB N=SPT BH101M_9.0-9.1			-	SHALE; grey-brown, distinctly weathered, very low strength. Continued as Cored Borehole	-	-	WEATHERED ROCK
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

BOREHOLE: BH101M

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Project	Proposed New Redevelopment	East	308064.1 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243382.2 m MGA94 Zone 56	Sheet	2 OF 3
Position	Refer to Figure 2	Surface RL	10.70 m AHD	Date Started	21/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	21/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 21/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7							
				8							
				9			Continuation from non-cored borehole				
NMLC	90-100% RETURN	100	68 (85)	10	1.60 *9.53* 1.17 *10.00*		SHALE; yellow-brown/ grey, with light grey laminations, very low to low strength. From 9.53 m, dark grey, with light grey laminations, medium to high strength, with occasional low strength.	DW SW		9.13-9.14: DS 10mm Clay. 9.19-9.20: SZ 10 mm 9.33-9.40: JT 70° CU S CN 9.49-9.53: DS 40mm 9.62: JT 5° CU S CN 9.64-9.65: DS 10mm Clay. 9.74: BP 0° PR S Clay VNR	

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

BOREHOLE: BH101M

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Project	Proposed New Redevelopment	East	308064.1 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243382.2 m MGA94 Zone 56	Sheet	3 OF 3
Position	Refer to Figure 2	Surface RL	10.70 m AHD	Date Started	21/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	21/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 21/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH 10)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
NMLC	90-100% RETURN	100	68 (85)	10	0.70		SHALE; dark grey-brown, with light grey laminations, medium to high strength.	SW			
					10.90 -0.20		From 10.9 m, dark grey, with light grey laminations.	FR		10.88-10.89: DS 10mm Clay.	
		100	92 (97)	12							
				13						13.57-13.61: JT 45° CU S CN 13.76-13.80: JT 30° PR S CN 13.85-13.89: JT 30° PR S CN	
				14	*14.60* -3.90		From 14.6 m, low to medium strength.	SW			
		100	100 (100)	15							
				16	*16.05* -5.35		Hole Terminated at 16.05 m Monitoring well installed.				
				17							
				18							
				19							
				20							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH101M

Project:	Proposed Mixed Use Redevelopment	Surface RL:	10.70 m AHD	Depth Range:	9.09 m to 16.05 m
Location:	26-28 Shepherd Street, Liverpool NSW	East:	308064.1 m	Contractor:	Rockwell Drilling Pty Ltd
Position:	Refer to Figure 2	North:	6243382.2 m MGA94 Zone	Drill Rig:	Hanjin DB8
Job No. :	E23125	Inclination:	56 -90°	LOGGED: JZ	DATE: 21/9/16
Client:	Coronation (26 Shepherd St) Pty Ltd	Box:	1-2 of 2	CHECKED: JP	DATE: 10/11/16
		Hole Depth:	16.05 m		

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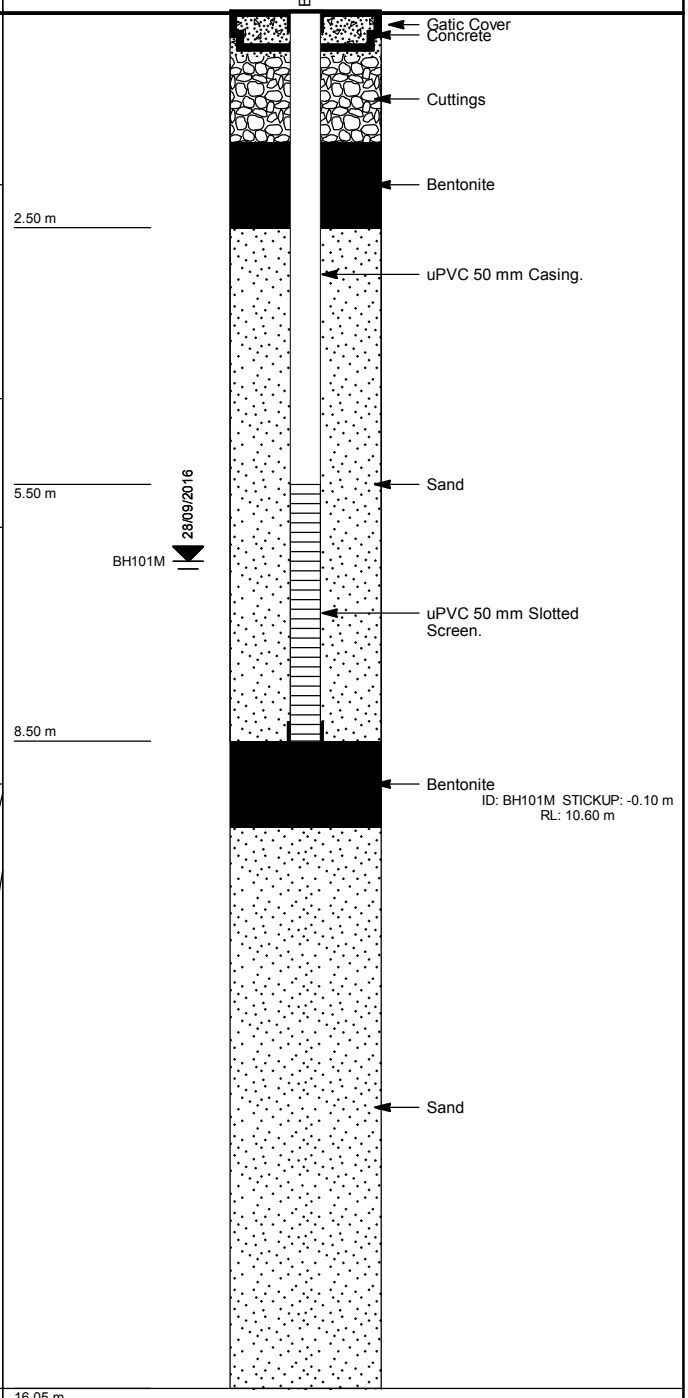
Hole ID
BH101M

CLIENT	: Coronation (26 Shepherd Street) Pty Ltd	POSITION	: Refer to Figure 2	SHEET	: 1 OF 1
CONTRACTOR	: Rockwell Drilling Pty Ltd	EASTING	: 308064.1 m	LOGGED BY	: JZ
PROJECT	: Proposed New Redevelopment	NORTHING	: 6243382.2 m	DRILL DATE	: 21/09/2016
LOCATION	: 26-28 Shepherd Street, Liverpool NSW	COORD. SYS.	: MGA94 Zone 56		
PROJECT No.	: E23125	GROUND RL	: 10.70 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T		0	10		FILL; Sandy CLAY; low plasticity, dark brown-dark grey, sand is fine to coarse grained, with fine to medium grained gravel. From 0.7 m, brick fragments.
		2	8		Sandy CLAY; low to medium plasticity, brown, sand is fine to medium grained.
		4	6		Sandy CLAY; low to medium plasticity, brown mottled grey, sand is fine to medium grained.
		6	4		Clayey SAND; fine to medium grained, light grey/ red/ orange-brown.
		8	2		SHALE; grey-brown, distinctly weathered, very low strength.
NMLC	90-100% RETURN	10	0		SHALE; yellow-brown/ grey, with light grey laminations, very low to low strength. From 9.53 m, dark grey, with light grey laminations, medium to high strength, with occasional low strength.
		12	-2		SHALE; dark grey-brown, with light grey laminations, medium to high strength. From 10.9 m, dark grey, with light grey laminations.
		14	-4		From 14.6 m, low to medium strength.
		16	-6		Hole Terminated at 16.05 m Monitoring well installed.

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH101M	Standpipe	-0.10 m 10.80 m	8.50 m 2.20 m	21/09/2016	6.30m



CHECKED BY	: JP
CHECKED DATE	: 10/11/2016

REMARK
Monitoring well installed.

BOREHOLE: BH102M

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Project	Proposed New Redevelopment	East	308019.6 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243411.2 m MGA94 Zone 56	Sheet	1 OF 3
Position	Refer to Figure 2	Surface RL	10.70 m AHD	Date Started	21/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 22/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	E	23/09/16	0	10.70				-	FILL; Sandy CLAY; low plasticity, brown, sand is fine to coarse grained, with fine to medium grained gravel, with brick fragments and trace of sandstone gravel.			FILL Appears Poorly Compacted
				0.50	BH102M_0.2-0.3 ES 0.20-0.30 m PID = 3.3 ppm							
				10.20	SPT 0.50 m 1/0mm HB BH102M_0.5				From 0.5 m, concrete fragments, hydrocarbon odour.	M (<PL)	-	
			1		BH102M_0.5-0.6 ES 0.50-0.60 m PID = 7.7 ppm BH102M_0.8-1.0 ES 0.80-1.00 m							
				1.50								
				9.20	BH102M_1.2-1.3 ES 1.20-1.30 m PID = 15.8 ppm SPT 1.50-1.95 m 3,7,8 N=15 BH102M_1.5-1.95 1.50 m PP =250-300 kPa BH102M_2.0-2.2 ES 2.00-2.20 m BH102M_2.5-2.6 ES 2.50-2.60 m PID = 5.9 ppm BH102M_2.9-3.0 ES 2.90-3.00 m SPT 3.00-3.45 m 3,5,6 N=11 BH102M_3.0-3.45 3.00 m PP =300-350 kPa			CI-CH	Silty CLAY; medium to high plasticity, red-dark grey, trace of fine to medium grained sand.	M (>PL)	VSt	ALLUVIUM
			4	4.00	BH102M_3.3-3.4 ES							
				6.70	3.30-3.40 m BH102M_3.9-4.0 ES 3.90-4.00 m			SC	Clayey SAND; fine to medium grained, brown/ grey/ red-brown.	M	MD	
			5		BH102M_4.4-4.5 ES 4.40-4.50 m PID = 9.6 ppm SPT 4.50-4.95 m 5,10,10 N=20 BH102M_4.5-4.95 BH102M_4.9-5.0 ES 4.90-5.00 m							
WB		28/09/16	6		BH102M_5.8-6.0 ES 5.80-6.00 m SPT 6.00-6.45 m 5,11,22 N=33 BH102M_6.0-6.2 ES 6.00-6.20 m BH102M_6.0-6.45							
				6.20								
				4.50					From 6.2 m, grey and brown.	W	D	
			7	7.30								
				7.45				-	SHALE; grey, distinctly weathered, very low strength.	-	-	WEATHERED ROCK
									Continued as Cored Borehole			
			8									
			9									
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

BOREHOLE: BH102M

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Contamination | Remediation | Geotechnical

Project	Proposed New Redevelopment	East	308019.6 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243411.2 m MGA94 Zone 56	Sheet	2 OF 3
Position	Refer to Figure 2	Surface RL	10.70 m AHD	Date Started	21/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 22/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7							
					7.45		Continuation from non-cored borehole				
NMLC	90-100% RETURN	100	75 (95)	8	3.25		SHALE; dark grey-brown, with light grey laminations, medium strength.	DW		7.51: BP 0° PR S CN	
					8.00					7.78: JT 5° UN S CN	
					2.70		From 8.0 m, dark grey with light grey laminations, medium to high strength.	SW		7.86: BP 0° PR S CN	
				9						9.09: BP 0° PR S CN	
								FR			
				10	*10.00*						

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

BOREHOLE: BH102M

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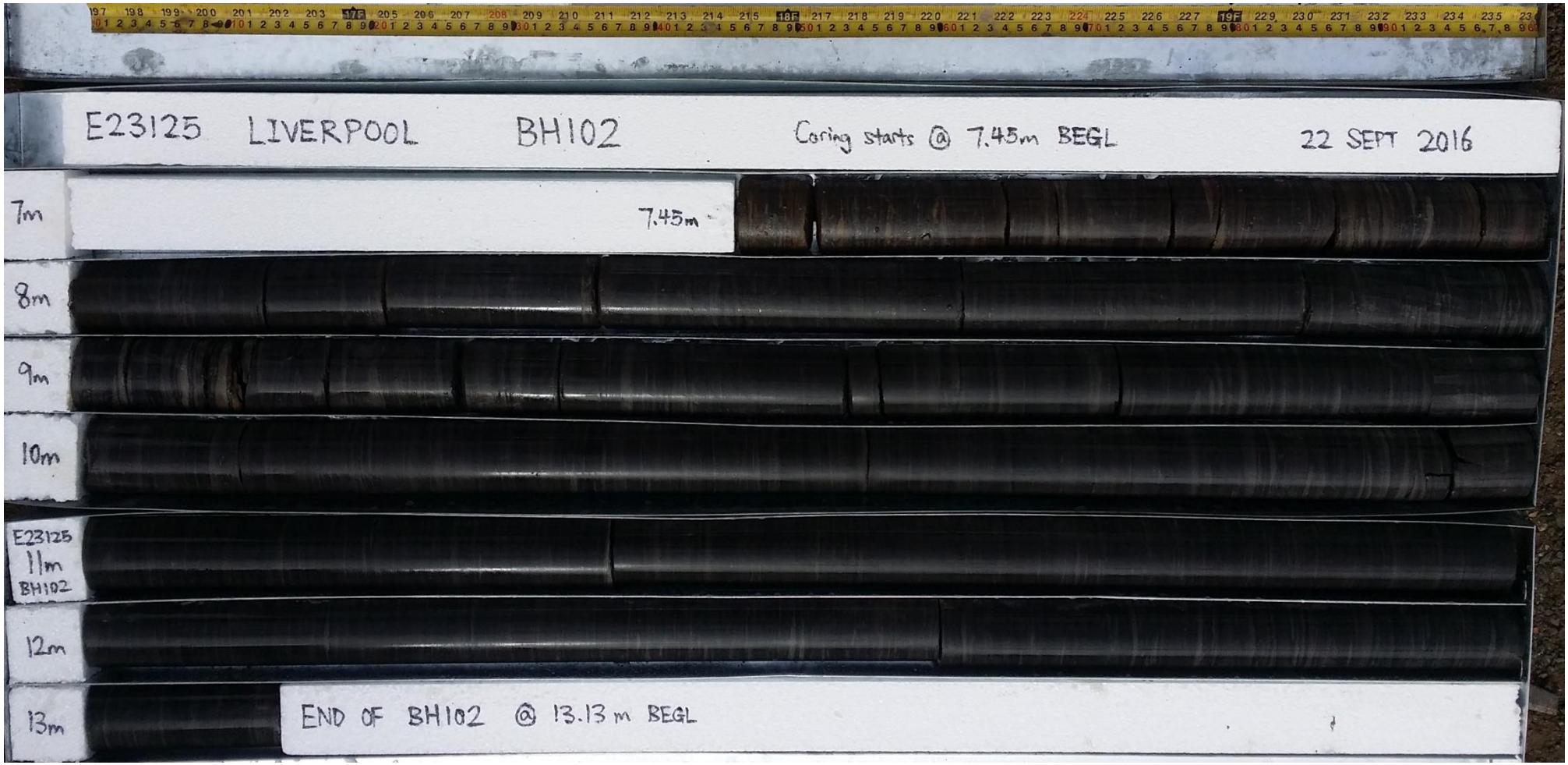
Project	Proposed New Redevelopment	East	308019.6 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243411.2 m MGA94 Zone 56	Sheet	3 OF 3
Position	Refer to Figure 2	Surface RL	10.70 m AHD	Date Started	21/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 22/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH 10)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
NMLC	90-100% RETURN	100	100 (99)	10	0.70		SHALE; dark grey, with light grey laminations, medium to high strength.	FR		10.55: BP 0° PR S CN 10.92-10.94: JT 90° UN S CN	
				13	*13.13* -2.43		Hole Terminated at 13.13 m Monitoring well installed.				

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH102M

Project:	Proposed Mixed Use Redevelopment	Surface RL:	10.70 m AHD	Depth Range:	7.45 m to 13.13 m
Location:	26-28 Shepherd Street, Liverpool NSW	East:	308019.6 m	Contractor:	Rockwell Drilling Pty Ltd
Position:	Refer to Figure 2	North:	6243411.2 m MGA94 Zone 56	Drill Rig:	Hanjin DB8
Job No. :	E23125	Inclination:	-90°	LOGGED: JZ	DATE: 22/9/16
Client:	Coronation (26 Shepherd St) Pty Ltd	Box:	1-2 of 2	CHECKED: JP	DATE: 10/11/16
		Hole Depth:	13.13 m		



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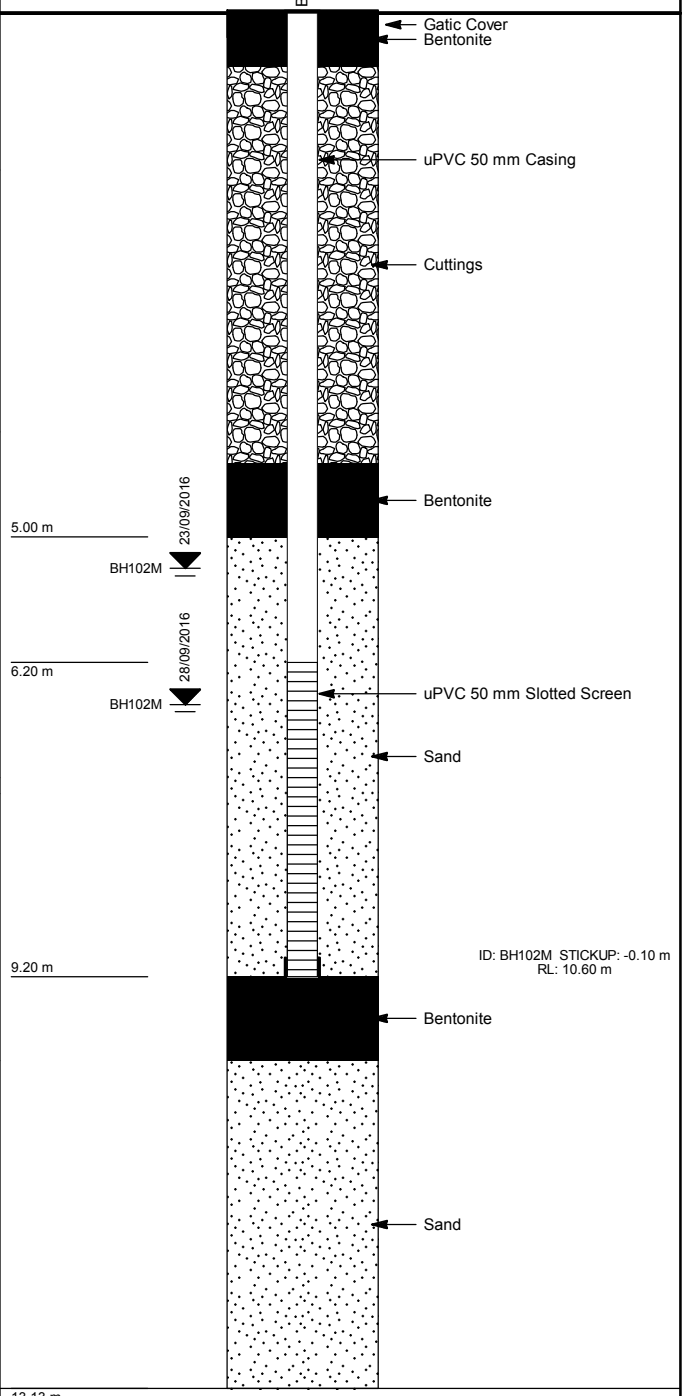
Hole ID
BH102M

CLIENT	: Coronation (26 Shepherd Street) Pty Ltd	POSITION	: Refer to Figure 2	SHEET	: 1 OF 1
CONTRACTOR	: Rockwell Drilling Pty Ltd	EASTING	: 308019.6 m	LOGGED BY	: JZ
PROJECT	: Proposed New Redevelopment	NORTHING	: 6243411.2 m	DRILL DATE	: 21/09/2016 - 22/09/2016
LOCATION	: 26-28 Shepherd Street, Liverpool NSW	COORD. SYS.	: MGA94 Zone 56		
PROJECT No.	: E23125	GROUND RL	: 10.70 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T			10		FILL; Sandy CLAY; low plasticity, brown, sand is fine to coarse grained, with fine to medium grained gravel, with brick fragments and trace of sandstone gravel. From 0.5 m, concrete fragments, hydrocarbon odour.
		2	8		Silty CLAY; medium to high plasticity, red-dark grey, trace of fine to medium grained sand.
		4	6		Clayey SAND; fine to medium grained, brown/ grey/ red-brown.
		6			From 6.2 m, grey and brown.
WB			4		
NMLC	90-100% RETURN	8	2		SHALE; grey, distinctly weathered, very low strength. SHALE; dark grey-brown, with light grey laminations, medium strength. From 8.0 m, dark grey with light grey laminations, medium to high strength.
		10	0		SHALE; dark grey, with light grey laminations, medium to high strength.
		12	-2		
		14			Hole Terminated at 13.13 m Monitoring well installed.

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH102M	Standpipe	-0.10 m 10.80 m	9.20 m 1.50 m	22/09/2016	5.20m



CHECKED BY : JP
CHECKED DATE : 10/11/2016

REMARK
Monitoring well installed.

BOREHOLE: BH103

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Contamination | Remediation | Geotechnical

Project	Proposed New Redevelopment	East	308029.3 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243377.8 m MGA94 Zone 56	Sheet	1 OF 3
Position	Refer to Figure 2	Surface RL	10.50 m AHD	Date Started	22/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 22/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	H	GW not observed due to rotary drilling	0	10.50	BH103_0.2-0.3 ES 0.20-0.30 m PID = 2.9 ppm			-	FILL; Gravelly SAND; fine to medium grained, dark grey/ dark brown/ red, fine to coarse, angular to sub-angular gravel, with clay and brick fragments.	M	-	FILL Appears Poorly Compacted
			1									
			2	*2.30*								
WB	E			8.20	SPT 2.50-2.95 m 4,3,3 N=6 BH103_2.5-2.9 ES 2.50-2.90 m PID = 1.7 ppm BH103_2.5-2.95 PP =50-150 kPa			CL-CI	Sandy CLAY; low to medium plasticity, red-brown/ grey, sand is fine to medium grained.	M (>PL)	F - St	ALLUVIUM
			3									
			4	*4.20*	SPT 4.00-4.45 m 5,8,10 N=18 BH103_4.0-4.45 PP =100-200 kPa							
				6.30					From 4.2 m, grey.			
			5	*5.50*								
				5.00	SPT 5.50-5.95 m 6,8,11 N=19 BH103_5.5-5.95			SC	Clayey SAND; fine to medium grained, brown.	M	MD	
			6									
			7		SPT 7.00-7.45 m 13,15,13 N=28 BH103_7.0-7.45							
			8	*8.00*								
				8.12				-	SHALE; dark grey, distinctly weathered, very low strength.	-	-	WEATHERED ROCK
									Continued as Cored Borehole			
			9									
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

BOREHOLE: BH103

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Contamination | Remediation | Geotechnical

Project	Proposed New Redevelopment	East	308029.3 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243377.8 m MGA94 Zone 56	Sheet	2 OF 3
Position	Refer to Figure 2	Surface RL	10.50 m AHD	Date Started	22/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 22/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7							
				8	*8.12*		Continuation from non-cored borehole				
NMLC		100	71 (88)	9	2.38		SHALE; yellow-brown/ grey, with light grey laminations, very low to low strength.	DW		8.62-8.66: DS 40 mm, CLAY 8.70: JT 5° UN S CN 8.72-8.80: DS 80 mm 8.95: BP 0° PR S CN 9.18: BP 0° PR S CN 9.36: BP 0° PR S CN 9.46: BP 0° PR S CN	
					9.50 1.00		From 9.5 m, medium strength.	SW			
				10	*10.00*						

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

BOREHOLE: BH103

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Contamination | Remediation | Geotechnical

Project	Proposed New Redevelopment	East	308029.3 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243377.8 m MGA94 Zone 56	Sheet	3 OF 3
Position	Refer to Figure 2	Surface RL	10.50 m AHD	Date Started	22/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 22/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (SCR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (El 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH 10)	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)
NMLC		100	71 (88)	10	0.50		SHALE; dark grey, with light grey laminations, medium to high strength.	SW		10.54: BP 0° PR S CN	
		100		11							
				12							
		100	100 (100)	13							
				14							
				15							
				16	16.25 -5.75		Hole Terminated at 16.25 m Backfilled with drilling spoil.				
				17							
				18							
				19							
				20							

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

CORE PHOTOGRAPH OF BOREHOLE: BH103

Project:	Proposed Mixed Use Redevelopment	Surface RL:	10.50 m AHD	Depth Range:	8.12 m to 16.25 m
Location:	26-28 Shepherd Street, Liverpool NSW	East:	308029.3 m	Contractor:	Rockwell Drilling Pty Ltd
Position:	Refer to Figure 2	North:	6243377.8 m MGA94 Zone 56	Drill Rig:	Hanjin DB8
Job No. :	E23125	Inclination:	-90°	LOGGED: JZ	DATE: 22/9/16
Client:	Coronation (26 Shepherd St) Pty Ltd	Box:	1-2 of 2	CHECKED: JP	DATE: 10/11/16
		Hole Depth:	16.25 m		

BOREHOLE: BH104M

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Project	Proposed New Redevelopment	East	308056.6 m		
Location	26-28 Shepherd Street, Liverpool NSW	North	6243361.1 m MGA94 Zone 56	Sheet	1 OF 1
Position	Refer to Figure 2	Surface RL	10.60 m AHD	Date Started	23/9/16
Job No.	E23125	Contractor	Rockwell Drilling Pty Ltd	Date Completed	23/9/16
Client	Coronation (26 Shepherd Street) Pty Ltd	Drill Rig	Hanjin D&B	Logged JZ	Date: 23/9/16
		Inclination	-90°	Checked JP	Date: 10/11/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	E	28/09/16	0	0.16				-	CONCRETE; 160 mm thick.	-	-	CONCRETE HARDSTAND
				10.44	BH104M_0.2-0.3 ES 0.20-0.30 m PID = 2 ppm			-	FILL; Gravelly Sandy CLAY; medium plasticity, sand is fine to coarse grained, gravels are fine to coarse, with brick fragments.			FILL Appears Poorly Compacted
			1		BH104M_0.7-1.0 ES 0.70-1.00 m					M (>PL)	-	
					BH104M_1.2-1.5 ES 1.20-1.50 m							
				1.60								
				9.00	BH104M_1.7-1.8 ES 1.70-1.80 m			CL	Sandy CLAY; low plasticity, sand is fine to medium grained, brown mottled grey.			ALLUVIUM
			2		BH104M_1.8-2.0 ES 1.80-2.00 m					M (>PL)	-	
					BH104M_2.5-2.6 ES 2.50-2.60 m PID = 4.4 ppm							
				3.00	BH104M_2.8-3.0 ES 2.80-3.00 m							
			3	7.60				CL-CI	Silty CLAY; low to medium plasticity, brown/ red-brown, with fine grained sand.			
					BH104M_3.5-3.6 ES 3.50-3.60 m PID = 3.3 ppm							
			4		BH104M_3.8-4.0 ES 3.80-4.00 m					-	-	
					BH104M_4.8-5.0 ES 4.80-5.00 m							
			5	5.50								
				5.10				SC	Clayey SAND; fine to medium grained, brown.			
					BH104M_5.8-6.0 ES 5.80-6.00 m							
			6									
					BH104M_6.8-7.0 ES 6.80-7.00 m					-	-	
			7	7.80								
				2.80	BH104M_7.8-8.0 ES 7.80-8.00 m				From 7.8 m, grey-brown.			
			8	8.50								
	F-H			2.10	BH104M_8.5-9.0 ES 8.50-9.00 m			-	SHALE; dark grey-brown, extremely to distinctly weathered, extremely low to very low strength.	-	-	WEATHERED ROCK
			9		BH104M_9.0-9.3 D 9.00-9.30 m							
				9.30								
									Hole Terminated at 9.30 m Monitoring well installed.			
			10									

This borehole log should be read in conjunction with EI Australia's accompanying standard notes.

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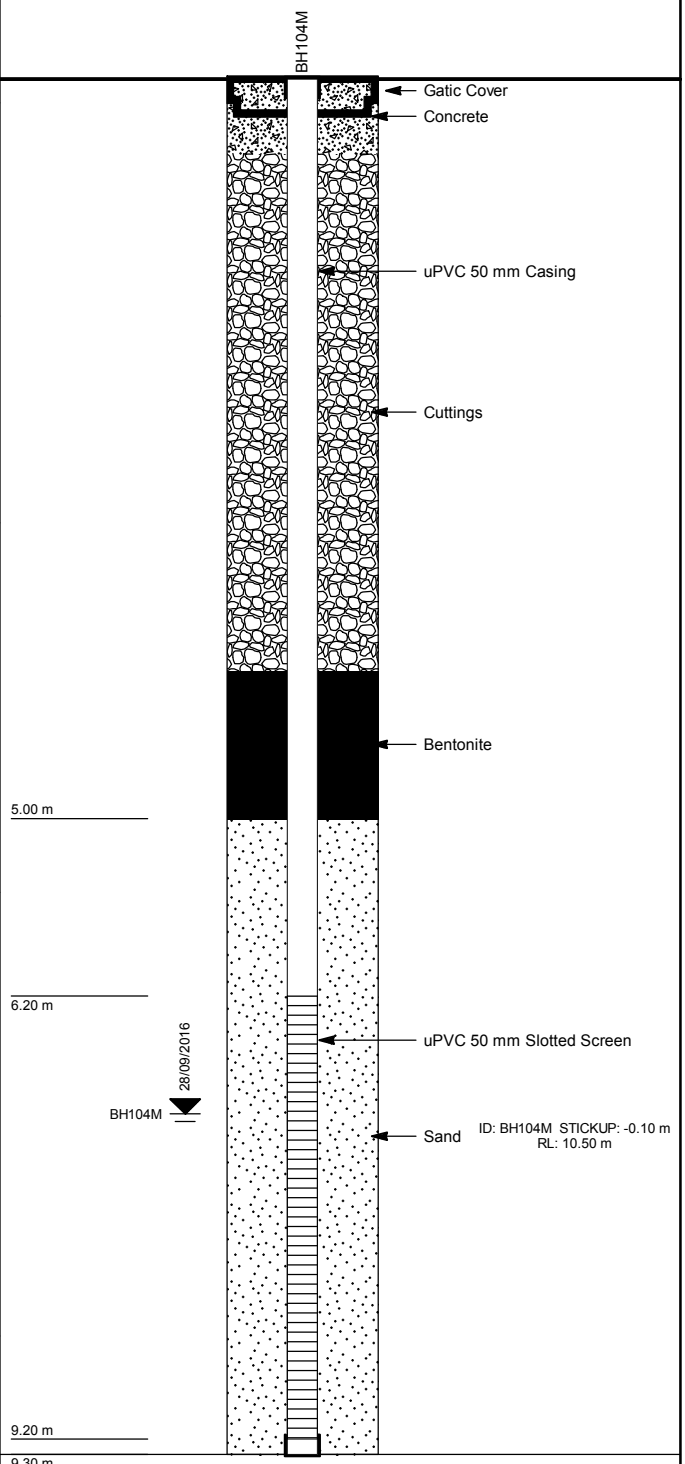
Hole ID
BH104M

CLIENT	: Coronation (26 Shepherd Street) Pty Ltd	POSITION	: Refer to Figure 2	SHEET	: 1 OF 1
CONTRACTOR	: Rockwell Drilling Pty Ltd	EASTING	: 308056.6 m	LOGGED BY	: JZ
PROJECT	: Proposed New Redevelopment	NORTHING	: 6243361.1 m	DRILL DATE	: 23/09/2016
LOCATION	: 26-28 Shepherd Street, Liverpool NSW	COORD. SYS.	: MGA94 Zone 56 GROUND RL AHD	: 10.60 m	
PROJECT No.	: E23125				

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH104M	Standpipe	-0.10 m 10.70 m	9.30 m 1.30 m	23/09/2016	6.90m

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
AD/T	▽	0	10		CONCRETE; 160 mm thick.
		1			FILL; Gravelly Sandy CLAY; medium plasticity, sand is fine to coarse grained, gravels are fine to coarse, with brick fragments.
			9		Sandy CLAY; low plasticity, sand is fine to medium grained, brown mottled grey.
		2			
			8		
		3			Silty CLAY; low to medium plasticity, brown/ red-brown, with fine grained sand.
			7		
		4			
			6		
		5			
			5		Clayey SAND; fine to medium grained, brown.
		6			
			4		
		7			
			3		From 7.8 m, grey-brown.
		8			
			2		SHALE; dark grey-brown, extremely to distinctly weathered, extremely low to very low strength.
		9			
			1		Hole Terminated at 9.30 m Monitoring well installed.
		10			



CHECKED BY : JP
CHECKED DATE : 10/11/2016

REMARK
Monitoring well installed.

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT LOGS

DRILLING/EXCAVATION METHOD

HA	Hand Auger	**RD**	Rotary blade or drag bit	**NQ**	Diamond Core - 47 mm
DTC	Diatube Coring	**RT**	Rotary Tricone bit	**NMLC**	Diamond Core - 52 mm
NDD	Non-destructive digging	**RAB**	Rotary Air Blast	**HQ**	Diamond Core - 63 mm
AS*	Auger Screwing	**RC**	Reverse Circulation	**HMLC**	Diamond Core - 63 mm
AD*	Auger Drilling	**PT**	Push Tube	**BH**	Tractor Mounted Backhoe
***V**	V-Bit	**CT**	Cable Tool Rig	**EX**	Tracked Hydraulic Excavator
***T**	TC-Bit, e.g. AD/T	**JET**	Jetting	**EE**	Existing Excavation
ADH	Hollow Auger	**WB**	Washbore or Bailer	**HAND**	Excavated by Hand Methods

PENETRATION RESISTANCE

L	**Low Resistance**	Rapid penetration/ excavation possible with little effort from equipment used.
M	**Medium Resistance**	Penetration/ excavation possible at an acceptable rate with moderate effort from equipment used.
H	**High Resistance**	Penetration/ excavation is possible but at a slow rate and requires significant effort from equipment used.
R	**Refusal/Practical Refusal**	No further progress possible without risk of damage or unacceptable wear to equipment used.

These assessments are subjective and are dependent on many factors, including equipment power and weight, condition of excavation or drilling tools and experience of the operator.

WATER

Water level at date shown

Partial water loss

Water inflow

Complete Water Loss

GWNE	GROUNDWATER NOT OBSERVED - Observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave-in of the borehole/ test pit.
GWNO	GROUNDWATER NOT ENCOUNTERED - Borehole/ test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/ test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18 seating	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
Sampling	
DS	Disturbed Sample
BDS	Bulk disturbed Sample
GS	Gas Sample
WS	Water Sample
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
Testing	
FP	Field Permeability test over section noted
FVS	Field Vane Shear test expressed as uncorrected shear strength (sv= peak value, sr= residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket Penetrometer test expressed as instrument reading in kPa
WPT	Water Pressure tests
DCP	Dynamic Cone Penetrometer test
CPT	Static Cone Penetration test
CPTu	Static Cone Penetration test with pore pressure (u) measurement

ROCK CORE RECOVERY

TCR=Total Core Recovery

$$= \frac{Length\ of\ core\ recovered}{Length\ of\ core\ run} \times 100$$

SCR=Solid Core Recovery (%)

$$= \frac{\sum Length\ of\ cylindrical\ core\ recovered}{Length\ of\ core\ run} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum Axial\ lengths\ of\ core > 100mm}{Length\ of\ core\ run} \times 100$$

MATERIAL BOUNDARIES

———————— = Inferred Boundary

– – – – – – – – – = Probable Boundary

– ? – ? – ? – ? – ? – = Possible Boundary

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT LOGS

	FILL		ORGANIC SOILS (OL, OH or Pt)		CLAY (CL, CI or CH)
	COUBLES or BOULDERS		SILT (ML or MH)		SAND (SP or SW)
	GRAVEL (GP or GW)	Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay			

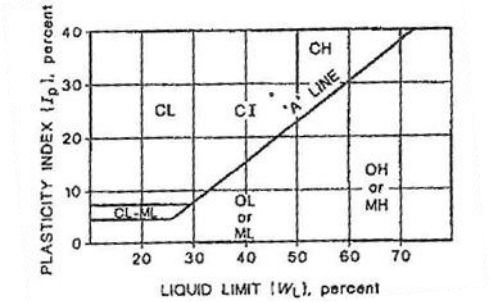
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/tactile methods.

PARTICLE SIZE CHARACTERISTICS

Major Division	Sub Division	Particle Size
BOULDERS		>200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6 to 20 mm
	Fine	2 to 6 mm
SAND	Coarse	0.6 to 2 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2mm
SILT		0.002 to 0.075 mm
CLAY		<0.002 mm

PLASTICITY PROPERTIES



USCS SYMBOLS

Major Divisions		Symbol	Description
COARSE GRAINED SOILS More than 50% by dry mass less than 63mm is greater than 0.075mm	More than 50% of coarse grains are >2.mm	GW	Well graded gravel and gravel-sand mixtures, little or no fines.
		GP	Poorly graded gravel and gravel-sand mixtures, little or no fines.
		GM	Silty gravel, gravel-sand-silt mixtures.
		GC	Clayey gravel, gravel-sand-clay mixtures.
	More than 50% of coarse grains are <2 mm	SW	Well graded sand and gravelly sand, little or no fines.
		SP	Poorly graded sand and gravelly sand, little or no fines.
		SM	Silty sand, sand-silt mixtures.
		SC	Clayey sand, sandy-clay mixtures.
FINE GRAINED SOILS More than 50% by dry mass less than 63mm is less than 0.075mm	Liquid Limit less < 50%	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.
	Liquid Limit > than 50%	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

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

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

CONSISTENCY

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0. to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

DENSITY

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	< 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Density	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.
SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

MINOR COMPONENTS

Term	Assessment Guide	Proportion by Mass
Trace	Presence just detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: ≤ 5% Fine grained soil: ≤15%
Some	Presence easily detectable by feel or eye but soil properties little or no different to general properties of primary component	Coarse grained soils: 5 - 12% Fine grained soil: 15 - 30%

TERMS FOR ROCK MATERIAL STRENGTH AND WEATHERING

CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/ tactile methods.

STRENGTH

Symbol	Term	Point Load Index, $Is_{(50)}$ (MPa) #	Field Guide
EL	Extremely Low	< 0.03	Easily remoulded by hand to a material with soil properties.
VL	Very Low	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure.
L	Low	0.1 to 0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	0.3 to 1	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
H	High	1 to 3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer.
VH	Very High	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

 # Rock Strength Test Results

▼ Point Load Strength Index, $Is_{(50)}$, Axial test (MPa)

● Point Load Strength Index, $Is_{(50)}$, Diametral test (MPa)

Relationship between rock strength test result ($Is_{(50)}$) and unconfined compressive strength (UCS) will vary with rock type and strength, and should be determined on a site-specific basis. UCS is typically 10 to 30 x $Is_{(50)}$, but can be as low as 5 MPa.

ROCK MATERIAL WEATHERING

Symbol		Term	Field Guide
RS		Residual Soil	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
EW		Extremely Weathered	Rock is weathered to such an extent that it has soil properties - i.e. it either disintegrates or can be remoulded, in water.
DW	HW	Distinctly Weathered	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores. In some environments it is convenient to subdivide into Highly Weathered and Moderately Weathered, with the degree of alteration typically less for MW.
	MW		
SW		Slightly Weathered	Rock slightly discoloured but shows little or no change of strength relative to fresh rock.
FR		Fresh	Rock shows no sign of decomposition or staining.

ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in Borehole Logs using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. Material properties are assessed in the field by visual/ tactile methods.

ROCK MATERIAL DESCRIPTION

Layering

Term	Description
Massive	No layering apparent
Poorly Developed	Layering just visible; little effect on properties
Well Developed	Layering (bedding, foliation, cleavage) distinct; rock breaks more easily parallel to layering

Structure

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

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES

Defect Type	Abbr.	Description
Joint	JT	Surface of a fracture or parting, formed without displacement, across which the rock has little or no tensile strength. May be closed or filled by air, water or soil or rock substance, which acts as cement.
Bedding Parting	BP	Surface of fracture or parting, across which the rock has little or no tensile strength, parallel or sub-parallel to layering/ bedding. Bedding refers to the layering or stratification of a rock, indicating orientation during deposition, resulting in planar anisotropy in the rock material.
Foliation	FL	Repetitive planar structure parallel to the shear direction or perpendicular to the direction of higher pressure, especially in metamorphic rock, e.g. Schistosity (SH) and Gneissosity.
Contact	CO	The surface between two types or ages of rock.
Cleavage	CL	Cleavage planes appear as parallel, closely spaced and planar surfaces resulting from mechanical fracturing of rock through deformation or metamorphism, independent of bedding.
Sheared Seam/ Zone (Fault)	SS/SZ	Seam or zone with roughly parallel almost planar boundaries of rock substance cut by closely spaced (often <50 mm) parallel and usually smooth or slickensided joints or cleavage planes.
Crushed Seam/ Zone (Fault)	CS/CZ	Seam or zone composed of disoriented usually angular fragments of the host rock substance, with roughly parallel near-planar boundaries. The brecciated fragments may be of clay, silt, sand or gravel sizes or mixtures of these.
Decomposed Seam/ Zone	DS/DZ	Seam of soil substance, often with gradational boundaries, formed by weathering of the rock material in places.
Infilled Seam	IS	Seam of soil substance, usually clay or clayey, with very distinct roughly parallel boundaries, formed by soil migrating into joint or open cavity.
Schistocity	SH	The foliation in schist or other coarse grained crystalline rock due to the parallel arrangement of platy or prismatic mineral grains, such as mica.
Vein	VN	Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

Shape	Abbr.	Description	Roughness	Abbr.	Description
Planar	Pl	Consistent orientation	Polished	Pol	Shiny smooth surface
Curved	Cu	Gradual change in orientation	Slickensided	SL	Grooved or striated surface, usually polished
Undulating	Un	Wavy surface	Smooth	S	Smooth to touch. Few or no surface irregularities
Stepped	St	One or more well defined steps	Rough	RF	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper
Irregular	Ir	Many sharp changes in orientation	Very Rough	VR	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper

Orientation: **Vertical Boreholes –** The dip (inclination from horizontal) of the defect.
Inclined Boreholes – The inclination is measured as the acute angle to the core axis.

ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING

Coating	Abbr.	Description
Clean	CN	No visible coating or infilling
Stain	SN	No visible coating but surfaces are discoloured by staining, often limonite (orange-brown)
Veneer	VNR	A visible coating of soil or mineral substance, usually too thin to measure (< 1 mm); may be patchy

DEFECT APERTURE

Aperture	Abbr.	Description
Closed	CL	Closed.
Open	O	Without any infill material.
Infilled	-	Soil or rock i.e. clay, talc, pyrite, quartz, etc.

APPENDIX B

LABORATORY CERTIFICATES

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia Pty Ltd	**Moisture Content Condition:**	As Received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core Box
Project:	26-28 Shepherd St, Liverpool (E23125)	**Report No:**	S18300-PL
Job No:	S16426	**Date Tested:**	20.10.16

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

Sampling: Sampled by Client **Date Sampled:** 21.09.16

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S18300	BH101 9.60m	Shale	Diametral	-	49.0	0.21	0.09	0.09	
			Axial	52.0	28.0	2.71	1.46	1.37	
S18301	BH101 10.20m	Shale	Diametral	-	50.0	0.53	0.21	0.21	
			Axial	52.0	40.0	1.85	0.70	0.71	
S18302	BH101 10.75m	Shale	Diametral	-	50.0	0.55	0.22	0.22	
			Axial	52.0	34.0	1.98	0.88	0.86	
S18303	BH101 11.15m	Shale	Diametral	-	49.0	0.55	0.23	0.23	
			Axial	52.0	40.0	1.28	0.48	0.49	
S18304	BH101 11.75m	Shale	Diametral	-	50.0	0.76	0.30	0.30	
			Axial	52.0	39.0	0.65	0.25	0.25	
S18305	BH101 12.15m	Shale	Diametral	-	50.0	0.75	0.30	0.30	
			Axial	52.0	42.0	2.88	1.04	1.06	
S18306	BH101 12.75m	Shale	Diametral	-	49.0	0.66	0.27	0.27	
			Axial	52.0	38.0	3.00	1.19	1.19	
S18307	BH101 9.30m	Shale	Diametral	-	49.0	0.01	0.00	0.00	
			Axial	52.0	26.0	0.13	0.08	0.07	
S18308	BH101 13.30m	Shale	Diametral	-	49.0	0.59	0.25	0.24	
			Axial	52.0	44.0	1.87	0.64	0.66	
S18309	BH101 13.80m	Shale	Diametral	-	50.0	0.37	0.15	0.15	
			Axial	52.0	37.0	0.66	0.27	0.27	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

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Date:

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Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia Pty Ltd	**Moisture Content Condition:**	As Received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core Box
Project:	26-28 Shepherd St, Liverpool (E23125)	**Report No:**	S18310-PL
Job No:	S16426	**Date Tested:**	20.10.16

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

Sampling: Sampled by Client **Date Sampled:** 21.09.16

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S18310	BH101 14.25m	Shale	Diametral	-	50.0	0.41	0.16	0.16	
			Axial	52.0	30.0	1.31	0.66	0.63	
S18311	BH101 14.80m	Shale	Diametral	-	49.0	0.58	0.24	0.24	
			Axial	52.0	46.0	0.76	0.25	0.26	
S18312	BH101 15.25m	Shale	Diametral	-	50.0	0.57	0.23	0.23	
			Axial	52.0	38.0	0.80	0.32	0.32	
S18313	BH101 15.75m	Shale	Diametral	-	50.0	0.69	0.28	0.28	
			Axial	52.0	35.0	0.59	0.25	0.25	

Comments:

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POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia Pty Ltd	**Moisture Content Condition:**	As Received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core Box
Project:	26-28 Shepherd St, Liverpool (E23125)	**Report No:**	S18314-PL
Job No:	S16426	**Date Tested:**	20.10.16

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

Sampling: Sampled by Client **Date Sampled:** 22.09.16

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S18314	BH102 7.60m	Shale	Diametral	-	50.0	0.67	0.27	0.27	
			Axial	52.0	37.0	2.88	1.18	1.17	
S18315	BH102 8.10m	Shale	Diametral	-	50.0	0.52	0.21	0.21	
			Axial	52.0	34.0	1.48	0.66	0.64	
S18316	BH102 8.80m	Shale	Diametral	-	50.0	0.18	0.07	0.07	
			Axial	52.0	36.0	1.71	0.72	0.71	
S18317	BH102 9.20m	Shale	Diametral	-	50.0	0.16	0.06	0.06	
			Axial	52.0	46.0	3.09	1.01	1.06	
S18318	BH102 9.75m	Shale	Diametral	-	50.0	0.81	0.32	0.32	
			Axial	52.0	39.0	2.72	1.05	1.06	
S18319	BH102 10.20m	Shale	Diametral	-	50.0	1.01	0.40	0.40	
			Axial	52.0	43.0	3.26	1.15	1.18	
S18320	BH102 10.70m	Shale	Diametral	-	50.0	0.47	0.19	0.19	
			Axial	52.0	42.0	2.43	0.87	0.90	
S18321	BH102 11.20m	Shale	Diametral	-	50.0	0.11	0.04	0.04	
			Axial	52.0	45.0	3.61	1.21	1.26	
S18322	BH102 11.75m	Shale	Diametral	-	50.0	0.64	0.26	0.26	
			Axial	52.0	30.0	2.54	1.28	1.21	
S18323	BH102 12.20m	Shale	Diametral	-	50.0	0.26	0.10	0.10	
			Axial	52.0	37.0	4.08	1.67	1.66	

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POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia Pty Ltd	**Moisture Content Condition:**	As Received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core Box
Project:	26-28 Shepherd St, Liverpool (E23125)	**Report No:**	S18324-PL
Job No:	S16426	**Date Tested:**	20.10.16

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

Sampling: Sampled by Client **Date Sampled:** 22.09.16

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S18324	BH102 12.75m	Shale	Diametral	-	50.0	0.33	0.13	0.13	
			Axial	52.0	35.0	5.47	2.36	2.32	
S18325	BH102 13.10m	Shale	Diametral	-	50.0	0.47	0.19	0.19	
			Axial	52.0	34.0	4.71	2.09	2.04	

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POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia Pty Ltd	**Moisture Content Condition:**	As Received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core Box
Project:	26-28 Shepherd St, Liverpool (E23125)	**Report No:**	S18326-PL
Job No:	S16426	**Date Tested:**	20.10.16

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

Sampling: Sampled by Client **Date Sampled:** 22.09.16

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S18326	BH103 8.30m	Shale	Diametral	-	41.0	0.03	0.02	0.02	
			Axial	52.0	36.0	0.07	0.03	0.03	
S18327	BH103 9.30m	Shale	Diametral	-	50.0	0.08	0.03	0.03	
			Axial	52.0	36.0	0.57	0.24	0.24	
S18328	BH103 9.75m	Shale	Diametral	-	49.0	0.44	0.18	0.18	
			Axial	52.0	37.0	2.46	1.00	1.00	
S18329	BH103 10.25m	Shale	Diametral	-	49.0	0.60	0.25	0.25	
			Axial	52.0	34.0	0.89	0.40	0.39	
S18330	BH103 10.80m	Shale	Diametral	-	50.0	0.34	0.14	0.14	
			Axial	52.0	41.0	2.40	0.88	0.90	
S18331	BH103 11.25m	Shale	Diametral	-	49.0	0.56	0.23	0.23	
			Axial	52.0	37.0	2.50	1.02	1.02	
S18332	BH103 11.75m	Shale	Diametral	-	49.0	1.14	0.47	0.47	
			Axial	52.0	40.0	1.55	0.59	0.59	
S18333	BH103 12.25m	Shale	Diametral	-	50.0	0.38	0.15	0.15	
			Axial	52.0	37.0	7.37	3.01	2.99	
S18334	BH103 12.65m	Shale	Diametral	-	50.0	0.28	0.11	0.11	
			Axial	52.0	39.0	3.66	1.42	1.43	
S18335	BH103 13.25m	Shale	Diametral	-	50.0	1.13	0.45	0.45	
			Axial	52.0	35.0	2.91	1.26	1.23	

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Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	EI Australia Pty Ltd	**Moisture Content Condition:**	As Received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core Box
Project:	26-28 Shepherd St, Liverpool (E23125)	**Report No:**	S18336-PL
Job No:	S16426	**Date Tested:**	20.10.16

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

Sampling: Sampled by Client **Date Sampled:** 22.09.16

Preparation: Prepared in accordance with the test method

Sample Number	Sample Source	Sample Description	Test Type	Average Width (mm)	Platen Separation (mm)	Failure Load (kN)	Point Load Index Is (MPa)	Point Load Index $Is_{(50)}$ (MPa)	Notes
S18336	BH103 13.75m	Shale	Diametral	-	50.0	0.88	0.35	0.35	
			Axial	52.0	37.0	4.02	1.64	1.63	
S18337	BH103 14.20m	Shale	Diametral	-	50.0	0.69	0.28	0.28	
			Axial	52.0	32.0	2.53	1.19	1.15	
S18338	BH103 14.75m	Shale	Diametral	-	49.0	0.98	0.41	0.40	
			Axial	52.0	29.0	2.14	1.11	1.05	
S18339	BH103 15.25m	Shale	Diametral	-	50.0	0.49	0.20	0.20	
			Axial	52.0	34.0	1.39	0.62	0.60	
S18340	BH103 15.75m	Shale	Diametral	-	50.0	0.81	0.32	0.32	
			Axial	52.0	33.0	0.94	0.43	0.42	
S18341	BH103 16.10m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	52.0	40.0	5.57	2.10	2.13	

Comments:

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MOISTURE CONTENT TEST REPORT

Client:	EI Australia Pty Ltd	**Job No:**	S16426
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Report No:**	S18342-MC
Project:	26-28 Shepherd St, Liverpool (E23125)		

Test Procedure:

- ☑ AS 1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (Standard method).
- ☐ AS4133 1.1.1 Rock moisture content tests - Determination of the moisture content of rock - Oven drying method (standard method)
- ☐ RMS T120 Moisture content of road construction materials (Standard method)
- ☐ RMS T262 Determination of moisture content of aggregates (Standard method)

Sampling:	Sampled by Client	**Date Sampled:**	21-22.09.16
Preparation:	Prepared in accordance with the test method		

Sample No.	Source	Sample Description	Moisture Content %
S18342	BH101 4.5-4.95m	silty CLAY	**15.7**
S18343	BH101 9.0-9.1m	silty CLAY	**11.8**
S18344	BH102 1.5-1.95m	silty CLAY	**23.3**

Notes:

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Alexandria NSW 2015

SOIL CLASSIFICATION REPORT

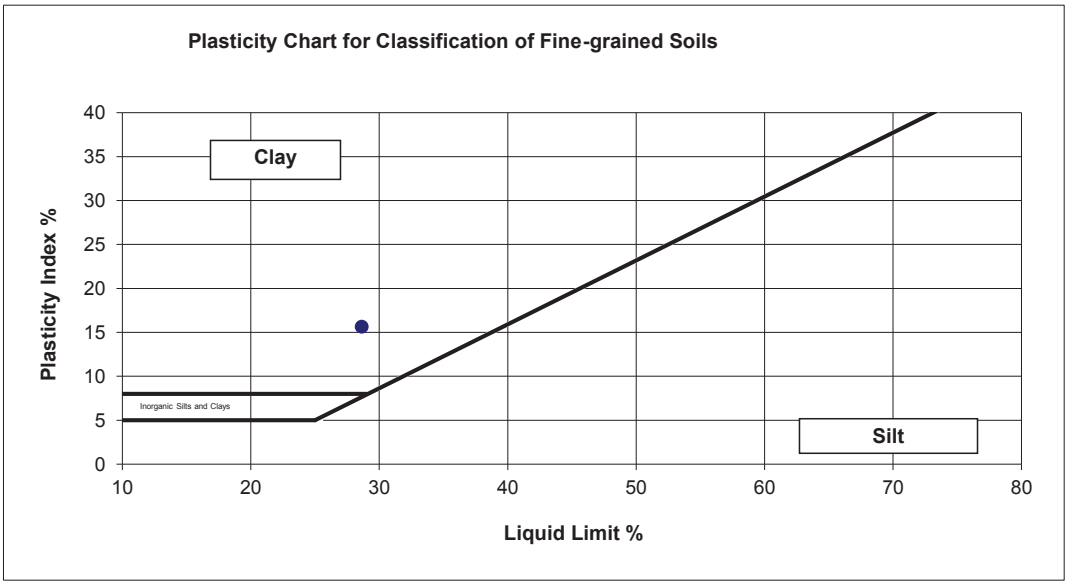
Client:	EI Australia Pty Ltd	**Source:**	BH101 4.5-4.95m
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description:**	silty CLAY
Project:	26-28 Shepherd St, Liverpool (E23125)	**Report No:**	S18342-PI
Job No:	S16426	**Lab No:**	S18342

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	21-22.09.16
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	29	**Linear Shrinkage (%):**	7.0
Plastic Limit (%):	13	**Field Moisture Content (%):**	-
Plastic Index:	16		



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: Linear

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

25/10/2016

Date:

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Bradford Street
Alexandria NSW 2015

SOIL CLASSIFICATION REPORT

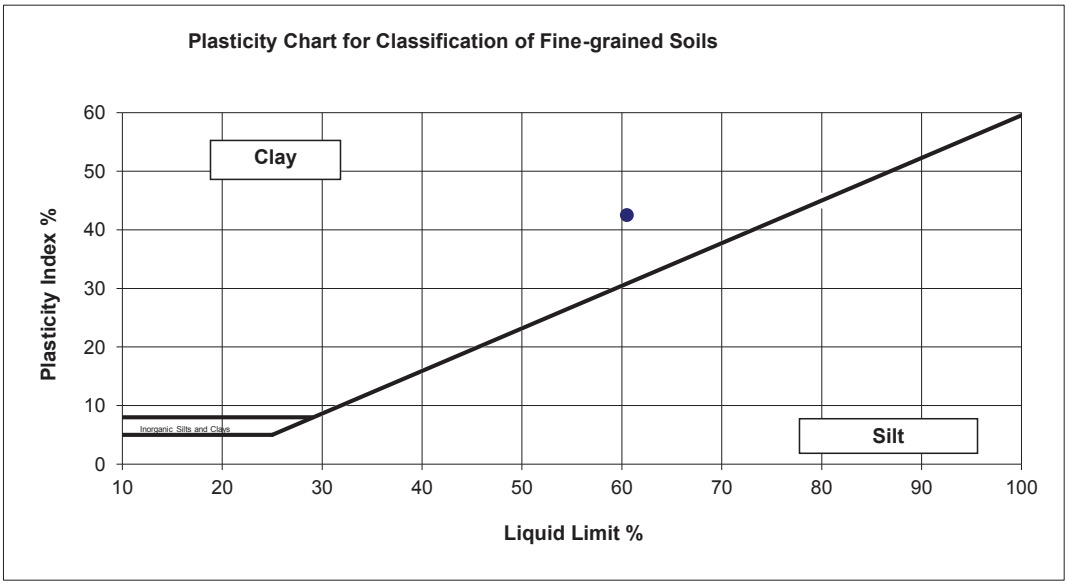
Client:	EI Australia Pty Ltd	**Source:**	BH102 1.5-1.95m
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Sample Description:**	silty CLAY
Project:	26-28 Shepherd St, Liverpool (E23125)	**Report No:**	S18344-PI
Job No:	S16426	**Lab No:**	S18344

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☑ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	21-22.09.16
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	61	**Linear Shrinkage (%):**	14.5
Plastic Limit (%):	18	**Field Moisture Content (%):**	-
Plastic Index:	43		



Soil Preparation Method: Dry Sieved
Soil History: Oven Dried
Soil Condition: Linear

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

25/10/2016

Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
Unit 8/10
Bradford Street
Alexandria NSW 2015

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Benjamin Aggar
Client	EI AUSTRALIA
Address	SUITE 6.01 55 MILLER STREET PYRMONT NSW 2009
Telephone	61 2 95160722
Facsimile	(Not specified)
Email	benjamin.aggar@eiaustralia.com.au
Project	**E23125 - 26-28 Shepherd St, Liverpool NSW**
Order Number	**E23125**
Samples	15

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE157748 R0**
Date Received	4/10/2016
Date Reported	13/10/2016

COMMENTS

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

SPOCAS subcontracted to SGS Cairns, 2/58 Comport St, Portsmith QLD 4870, NATA Accreditation Number: 2562, Site Number: 3146.

SIGNATORIES

Dong Liang
Metals/Inorganics Team Leader

Ly Kim Ha
Organic Section Head

pH in soil (1:5) [AN101] Tested: 5/10/2016

PARAMETER	UOM	LOR	BH102_0.8-1.0 SOIL - 21/9/2016 SE157748.001	BH104_0.7-1.0 SOIL - 23/9/2016 SE157748.007
pH	pH Units	-	**9.5**	**8.3**

Conductivity and TDS by Calculation - Soil [AN106] Tested: 5/10/2016

PARAMETER	UOM	LOR	BH102_0.8-1.0 SOIL - 21/9/2016 SE157748.001	BH104_0.7-1.0 SOIL - 23/9/2016 SE157748.007
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	**260**	**190**

Moisture Content [AN002] Tested: 6/10/2016

PARAMETER	UOM	LOR	BH102_0.8-1.0 SOIL - 21/9/2016 SE157748.001	BH104_0.7-1.0 SOIL - 23/9/2016 SE157748.007
% Moisture	%w/w	0.5	**24**	**20**

Sample Subcontracted [] Tested: 13/10/2016

PARAMETER	UOM	LOR	BH102_2.0-2.2 SOIL - 21/9/2016 SE157748.002	BH102_2.9-3.0 SOIL - 21/9/2016 SE157748.003	BH102_3.9-4.0 SOIL - 21/9/2016 SE157748.004	BH102_4.9-5.0 SOIL - 21/9/2016 SE157748.005	BH102_5.8-6.0 SOIL - 21/9/2016 SE157748.006
Sample Subcontracted*	No unit	-	Subcontracted	Subcontracted	Subcontracted	Subcontracted	Subcontracted

PARAMETER	UOM	LOR	BH104_1.8-2.0 SOIL - 23/9/2016 SE157748.008	BH104_2.8-3.0 SOIL - 23/9/2016 SE157748.009	BH104_3.8-4.0 SOIL - 23/9/2016 SE157748.010	BH104_4.8-5.0 SOIL - 23/9/2016 SE157748.011	BH104_5.8-6.0 SOIL - 23/9/2016 SE157748.012
Sample Subcontracted*	No unit	-	Subcontracted	Subcontracted	Subcontracted	Subcontracted	Subcontracted

PARAMETER	UOM	LOR	BH104_6.8-7.0 SOIL - 23/9/2016 SE157748.013	BH104_7.8-8.0 SOIL - 23/9/2016 SE157748.014	BH104_8.5-9.0 SOIL - 23/9/2016 SE157748.015
Sample Subcontracted*	No unit	-	Subcontracted	Subcontracted	Subcontracted

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.

FOOTNOTES

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

Samples analysed as received.
Solid samples expressed on a dry weight basis.

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

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

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

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

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

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

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	James Zhao
Client	EI AUSTRALIA
Address	SUITE 6.01 55 MILLER STREET PYRMONT NSW 2009
Telephone	61 2 95160722
Facsimile	(Not specified)
Email	james.zhao@eiaustralia.com.au
Project	**E23125 - 26-28 Shepherd St, Liverpool**
Order Number	**E23125**
Samples	3

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
SGS Reference	**SE157855 R0**
Date Received	6/10/2016
Date Reported	12/10/2016

COMMENTS

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

SIGNATORIES

Dong Liang
Metals/Inorganics Team Leader

Ly Kim Ha
Organic Section Head

pH in soil (1:5) [AN101] Tested: 10/10/2016

PARAMETER	UOM	LOR	BH101 7.5-7.95 SOIL - 21/9/2016 SE157855.001	BH101 1.5-1.95 SOIL - 21/9/2016 SE157855.002
pH	pH Units	-	**7.5**	**8.3**

Conductivity and TDS by Calculation - Soil [AN106] Tested: 10/10/2016

PARAMETER	UOM	LOR	BH101 7.5-7.95 SOIL - 21/9/2016 SE157855.001	BH101 1.5-1.95 SOIL - 21/9/2016 SE157855.002
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	**45**	**240**

Soluble Anions (1:5) in Soil by Ion Chromatography [AN245] Tested: 10/10/2016

PARAMETER	UOM	LOR	BH101 7.5-7.95 SOIL - 21/9/2016 SE157855.001	BH101 1.5-1.95 SOIL - 21/9/2016 SE157855.002
Chloride	mg/kg	0.25	**2.9**	**7.2**
Sulphate	mg/kg	5	**36**	**120**

Moisture Content [AN002] Tested: 10/10/2016

PARAMETER	UOM	LOR	BH101 7.5-7.95 SOIL - 21/9/2016 SE157855.001	BH101 1.5-1.95 SOIL - 21/9/2016 SE157855.002
% Moisture	%w/w	0.5	22	16

pH in water [AN101] Tested: 10/10/2016

PARAMETER	UOM	LOR	BH102 WATER - 28/9/2016 SE157855.003
pH**	No unit	-	**6.7**

Conductivity and TDS by Calculation - Water [AN106] Tested: 10/10/2016

PARAMETER	UOM	LOR	BH102 WATER - 28/9/2016 SE157855.003
Conductivity @ 25 C	µS/cm	2	**8900**

Anions by Ion Chromatography in Water [AN245] Tested: 10/10/2016

PARAMETER	UOM	LOR	BH102 WATER - 28/9/2016 SE157855.003
Chloride	mg/L	0.05	**2500**
Sulphate, SO4	mg/L	1	**730**

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode and is calibrated against 3 buffers purchased commercially. For soils, sediments and sludges, an extract with water (or 0.01M CaCl2) is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos /cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Salinity can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. Reference APHA 2510 B.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO2, NO3 and SO4 are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B

FOOTNOTES

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

Samples analysed as received.
Solid samples expressed on a dry weight basis.

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

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

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

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

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

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

APPENDIX C

BOREHOLE LOGS, CORE PHOTOS, AND LABORATORY TEST RESULTS

(ASSET GEOTECHNICAL ENGINEERING PTY LTD)

eiaustralia

ASSET GEOTECHNICAL
geotechnical engineering consultants

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info@assetgeotechnical.com.au

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

Borehole Log

BH no:	**BH1**
sheet:	1 of 2
job no.:	2936

client:	CORONATION PROPERTY CO. PTY LTD	**started:**	19.3.2015
principal:		**finished:**	19.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	**logged:**	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	**checked:**	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	**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 penetrometer kPa (100 200 300 400)	structure and additional observations
ADT	C			10			CL	Gravelly CLAY, low to medium plasticity, dark grey, fine to coarse grained gravel, with rootlets at top 0.05m	¬Wp	--		Fill
					0.4		CL	Sandy CLAY / Brick fragments, low plasticity, mottled dark grey and red				
			SPT 30,8,5 N*=13	9	1							
			D		1.2		CH	Sandy CLAY, medium to high plasticity, brown, fine-grained sand	>Wp	VS-F		
					1.6		CH	CLAY, medium to high plasticity, dark grey				Alluvium or Slope Wash
			D		2							
				8								
			D									
			SPT 0,0,2 N*=2									
			D		2.8		CH	CLAY, medium to high plasticity, red-brown mottled grey, trace of fine grained sand				
				7	3							
			D									
			D									
			D		4					St	× 150	
			SPT 6,5,6 N*=11	6							× 200	
			D									
					4.6		SP-SC	Clayey SAND, fine to medium grained, brown	M	MD		Alluvium
			D		5							
				5								
			D									
			SPT 4,5,6 N*=11		6							
			D	4								
			D									
			D		7							
		▼	SPT 5,7,7 N*=14	3					M-W	D		
		Seepage observed during drilling			8							
				2								
			SPT 4,7,8 N*=15		9							
WB				1								Resistance felt in drilling rig
								Borehole No: BH1 continued as cored hole from 9.5m				
					10							

2936 LOGS.GPJ 27/3/15

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Fax: 02 8282 5011

Cored Borehole Log

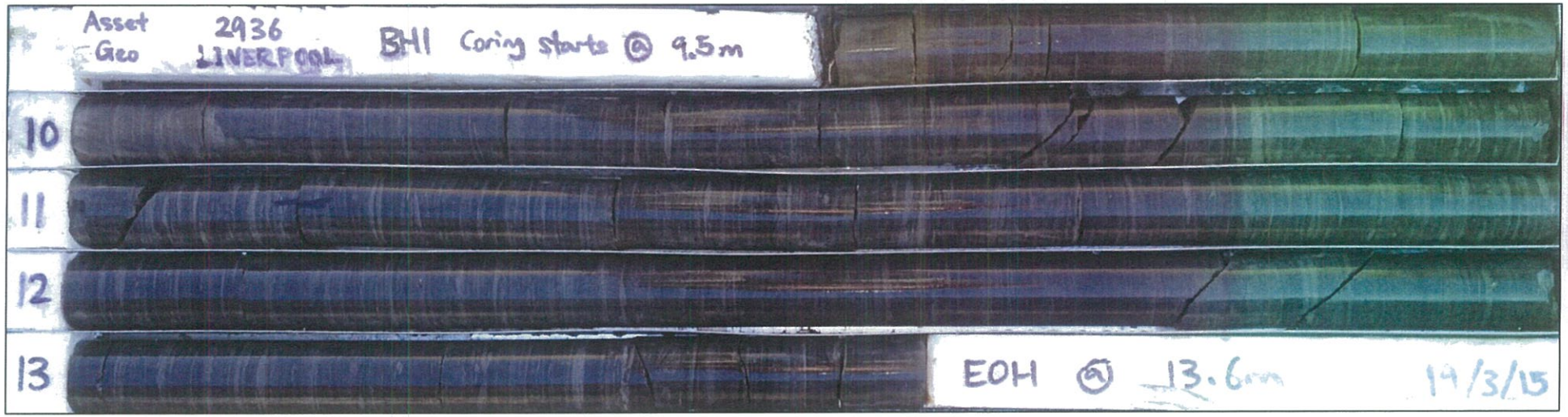
BH no:	**BH1**
sheet:	2 of 2
job no.:	2936

client:	CORONATION PROPERTY CO. PTY LTD	**started:**	19.3.2015
principal:		**finished:**	19.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	**logged:**	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	**checked:**	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	**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
			1			Continued from non-cored borehole from 9.5m						
NMLC			0	9.5 10		SHALE, dark grey, well developed, thinly laminated to medium bedded	SW		D=0.35 A=0.34			JT 20° cu sm cl
			-1	11					D=0.7 A=1.03			JT 45° pl sm cl; JT 45° pl sm cl; JT 45° pl sm cl; JT 45° pl sm cl
			-2	12					D=0.95 A=0.8			BP 0-5° pl sm cl
			-3	13					D=0.61 A=0.83			JT 45° pl sm cl; JT 45° pl sm cl
				13.59		BH1 terminated at 13.59m						JT 30° pl sm cl; JT 20° cu sm cl
			-4	14								
			-5	15								
			-6	16								
			-7	17								
			-8	18								
				19								

2936 LOGS.GPJ 2/4/15



issue	date	description
A	27.03.15	INITIAL ISSUE

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PROPOSED RESIDENTIAL DEVELOPMENT
28 SHEPHERD STREET, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH1

drawn: JZ
date: 27.03.15
checked: MAB
scale: 1:4 A4

job no.: 2936
fig: —
issue: A

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BH no:	**BH2**
sheet:	1 of 2
job no.:	2936

Borehole Log

client:	CORONATION PROPERTY CO. PTY LTD	**started:**	19.3.2015
principal:		**finished:**	20.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	**logged:**	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	**checked:**	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	**RL surface:**	10.4 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			10	0		CL	Gravelly CLAY, low to medium plasticity, dark grey, fine to coarse grained gravel, with rootlets at top 0.05m, with brick fragments	<Wp	--		Fill
			SPT 4,5,11 N*=16	9	1							
			D									
					1.6		CH	CLAY, medium to high plasticity, dark brown, with fine grained sand	>Wp	St-VSt		Alluvium or Slope Wash
			D		2							
				8							× 150	
			D									
			SPT 1,3,6 N*=9								× 100	
			D		3							
					3.1		CH	CLAY, medium to high plasticity, red-brown mottled grey, trace of fine grained sand				
			D	7								
			D		4							
			SPT 5,4,7 N*=11	6								
			D									
					5							
			D	5								
			SPT 3,3,5 N*=8									
			D		5.8		CH	Sandy CLAY, medium to high plasticity, fine to medium, brown				Alluvium
					6							
			D	4								
					7							
			D									
			SPT 2,7,6 N*=13	3							× 100	
		▼ Seepage observed during drilling			8							
				2	8.3		CH	CLAY, medium to high plasticity, mottled brown and grey, trace of shale fragments			× 200	Resistance felt in drilling rig
												Residual
								Borehole No: BH2 continued as cored hole from 8.5m				
					9							
				1								
					10							

2936 LOGS.GPJ 27/3/15

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Fax: 02 8282 5011

BH no:	**BH2**
sheet:	2 of 2
job no.:	2936

Cored Borehole Log

client:	CORONATION PROPERTY CO. PTY LTD	**started:**	19.3.2015
principal:		**finished:**	20.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	**logged:**	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	**checked:**	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	**RL surface:**	10.4 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
			2	8.3		Continued from non-cored borehole from 8.5m						
NMLC				8.5		SHALE, dark grey, well developed, thinly laminated to medium bedded	RS					SM
			1	9			XW - HW		D=0.1 A=0.09			JT 90° pl sm co JT 90° pl sm co JT 30° pl sm cl JT 90° pl sm cl SZ SM with clay infill SZ
			0	10			SW		D=0.81 A=0.72			JT 60° pl sm cl
			-1	11					D=0.53 A=1.6			JT 40° pl sm cl JT 50° pl sm cl JT 30° pl sm cl
				11.4		BH2 terminated at 11.4m						BP 0-5° pl sm cl/co
			-2	12								
			-3	13								
			-4	14								
			-5	15								
			-6	16								
			-7	17								
				18								

issue	date	description
A	27.03.15	INITIAL ISSUE

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PROPOSED RESIDENTIAL DEVELOPMENT
28 SHEPHERD STREET, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH2

drawn: JZ	job no.: 2936
date: 27.03.15	
checked: MAB	fig: —
scale: 1:4 A4	issue: A

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BH no:	BH3
sheet:	1 of 2
job no.:	2936

Borehole Log

client:	CORONATION PROPERTY CO. PTY LTD	started:	20.3.2015
principal:		finished:	20.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	logged:	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	checked:	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	RL surface:	10.6 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			10	0		CL	Gravelly CLAY, medium to high plasticity, mottled dark grey / red / dark brown, fine to coarse grained gravel, with rootlets at top 0.05m, with shale fragments	<Wp	--	× 400	Fill
			SPT 1,7,12 N*=19	9	1						× 400	
					1.6		CH	CLAY, medium to high plasticity, red mottled grey, trace of fine grained sand		H		Alluvium or Slope Wash
			SPT 8,15,18 N*=33	8	2						× 400	
											× 400	
				7	3							
			SPT 5,7,13 N*=20								× 400	
				6	4						× 400	
			SPT 5,8,6 N*=14	5	5							
				4								
					5.6		CH	Clayey SAND, fine to medium grained, brown mottled grey	M	D		Alluvium
					6							
					6.8		CH	Shaley CLAY, medium to high plasticity, mottled grey and orange brown, with shale fragments	<Wp	H		Residual
		▼	SPT 9,11,Rs N*=Rs		7						× 400	
		Seepage observed during drilling		3	8			Borehole No: BH3 continued as cored hole from 7.3m				
				2	9							
				1	10							

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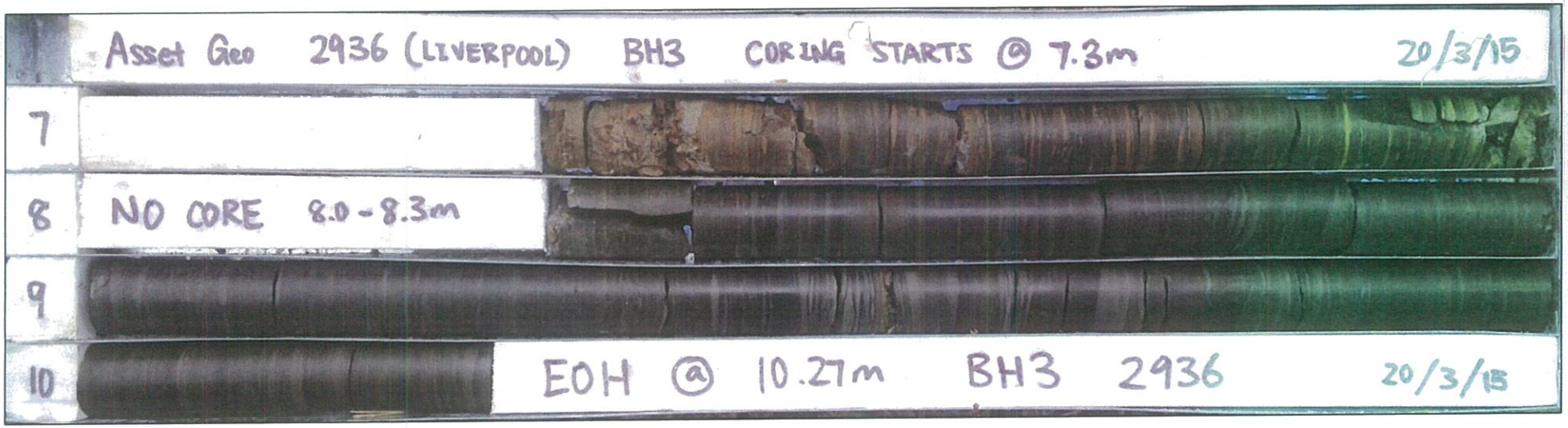
BH no:	BH3
sheet:	2 of 2
job no.:	2936

Cored Borehole Log

client:	CORONATION PROPERTY CO. PTY LTD	started:	20.3.2015
principal:		finished:	20.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	logged:	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	checked:	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	RL surface:	10.6 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 (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH MPa)	$Is_{(50)}$ MPa (D=diametral x, A=axial)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating (specific / general)
						Continued from non-cored borehole from 7.3m						
NMLC		Seepage observed during drilling		7.3		SHALE, dark brown mottled dark grey, well developed, thinly laminated to thinly bedded	XW - HW		D=0.04 A=0.02			SM; JT 30° cu sm cl; JT 15° un sm cl; JT 85° pl sm cl; SZ
				8		No core 0.30m NO CORE						
				8.3		SHALE, dark grey, well developed, thinly laminated to medium bedded	SW		D=0.83 A=1.07			JT 90° cu sm cl; BP 0-5° pl sm cl
									D=0.34 A=0.7			SM with clay infill
				10.27		BH3 terminated at 10.27m						

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED



issue	date	description
A	27.03.15	INITIAL ISSUE

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PROPOSED RESIDENTIAL DEVELOPMENT
28 SHEPHERD STREET, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH3

drawn: JZ	job no.: 2936		
date: 27.03.15			
checked: MAB	fig: —	issue: A	
scale: 1:4 A4			

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Borehole Log

BH no:	**BH4**
sheet:	1 of 2
job no.:	2936

client:	CORONATION PROPERTY CO. PTY LTD	**started:**	23.3.2015
principal:		**finished:**	23.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	**logged:**	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	**checked:**	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	**RL surface:**	10.5 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	Seepage observed during drilling	SPT 7,23,22 N*=45	10 / 9	1 / 2		CH	CLAY, medium to high plasticity, mottled dark brown and dark grey, trace of fine grained sand	¬Wp	H	× 400	Fill or Slope Wash
			SPT 9,13,17 N*=30	8 / 7	3						× 400 × 400 × 400	
			SPT 4,6,8 N*=14	6 / 5	4 / 5							
			SPT 3,4,6 N*=10	5 / 4	6							
			SPT 3,5,13 N*=18	3	7 / 8							
								3.5 SAND, fine to medium grained, brown, with clay	M	MD-D		Alluvium
							SP-SC	5.8 Clayey SAND, fine to medium grained, brown	M-W			
				2 / 1	9 / 10			Borehole No: BH4 continued as cored hole from 8.2m				

2936 LOGS.GPJ 27/3/15

REFER TO EXPLANATION SHEETS FOR DESCRIPTION OF TERMS AND SYMBOLS USED

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BH no:	**BH4**
sheet:	2 of 2
job no.:	2936

Cored Borehole Log

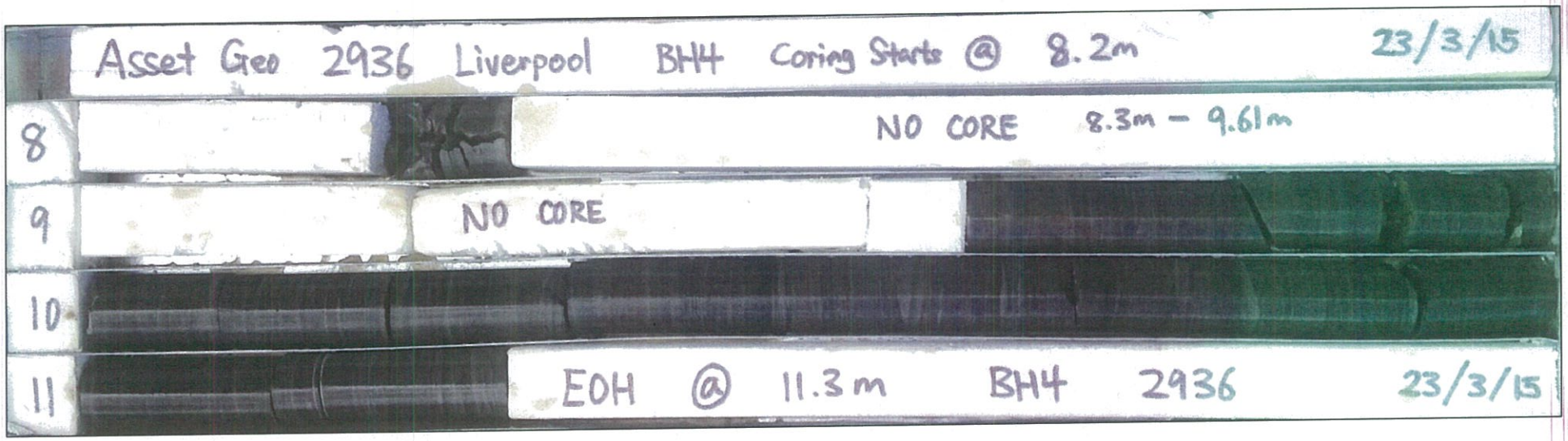
client:	CORONATION PROPERTY CO. PTY LTD	**started:**	23.3.2015
principal:		**finished:**	23.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	**logged:**	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	**checked:**	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	**RL surface:**	10.5 m
diameter:	100mm **inclination:** -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 × o, A=axial)	RQD %	defect spacing mm (20, 60, 200, 600, 2000)	defect description: type, inclination, thickness, shape, roughness, coating — specific / general
						Continued from non-cored borehole from 8.2m						
NMLC			2	8.2		SHALE, dark grey	XW - HW					SZ
				8.3		No core 1.30m NO CORE						
				9								
			1						D=0.83			
				9.6		SHALE, dark grey, well developed, thinly laminated to medium bedded	SW		A=1.71			JT 25° pl sm cl SZ
				10								
			0									
				11					D=0.9 A=1.21			JT 15° cu sm cl
				11.3		BH4 terminated at 11.3m						
			-1	12								
			-2	13								
			-3	14								
			-4	15								
			-5	16								
			-6	17								
			-7	18								

BP 0-5° pl sm cl

2936 LOGS.GPJ 2/4/15



issue	date	description
A	27.03.15	INITIAL ISSUE

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PROPOSED RESIDENTIAL DEVELOPMENT
28 SHEPHERD STREET, LIVERPOOL
for
CORONATION PROPERTY CO. PTY LTD

CORE PHOTOS – BH4

drawn: JZ	job no.: 2936
date: 27.03.15	
checked: MAB	fig: —
scale: 1:4 A4	issue: A

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BH no:	**BH5**
sheet:	1 of 1
job no.:	2936

Borehole Log

client:	CORONATION PROPERTY CO. PTY LTD	**started:**	23.3.2015
principal:		**finished:**	23.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	**logged:**	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	**checked:**	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	**RL surface:**	10.5 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		Seepage observed during drilling		10	1		CH	Gravelly CLAY, medium to high plasticity, mottled dark grey / red / dark brown, fine to coarse grained gravel, with rootlets at top 0.05m	<Wp	--		Fill
			SPT 6,16,14 N*=30	9	2		CL	Sandy CLAY, low to medium plasticity, fine grained sand, mottled dark brown and dark grey	~Wp			
			SPT 4,3,5 N*=8	8	3	2.8	CL	Sandy CLAY, low to medium plasticity, fine grained sand, red-brown	>Wp	St		Alluvium
			SPT 2,2,2 N*=4	7	4						× 100	
				6	5						× 100	
				5		5.5	CL	Sandy CLAY, medium to high plasticity, fine grained sand, grey			× 100	
			SPT 3,2,7 N*=9	4	6	6	SP-SC	Clayey SAND, fine to medium grained, grey	W	D-VD	× 100	
			SPT 12,10,11 N*=21	3	7							
				2	8							
			SPT 19 N*=19		9	8.6	--	SHALE, dark brown mottled dark grey, extremely weathered, extremely low to low strength	--	--		Bedrock
				1	9	9		Borehole No: BH5 terminated at 9m				Near TC-bit refusal
					10							

2936 LOGS.GPJ 27/3/15

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Borehole Log

BH no:	**BH6**
sheet:	1 of 1
job no.:	2936

client:	CORONATION PROPERTY CO. PTY LTD	**started:**	23.3.2015
principal:		**finished:**	23.3.2015
project:	PROPOSED RESIDENTIAL DEVELOPMENT	**logged:**	JZ
location:	28 SHEPHERD STREET, LIVERPOOL	**checked:**	MAB
equipment:	HANJIN D&B TRACK-MOUNTED	**RL surface:**	10.4 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		None observed during drilling		10	1		CH	CLAY, medium to high plasticity, mottled dark grey and dark brown, with rootlets at top 0.05m	¬Wp	--		Fill
				9	2		CL	Clayey SAND / Sandy CLAY, low to medium plasticity, fine to medium grained sand, mottled dark brown and dark grey				
			SPT 6,9,10 N*=19	8	3		SP-SC	Clayey SAND, fine to medium grained, dark brown	M	L-MD		Alluvium
				7	4							
			SPT 5,4,5 N*=9	6	5		SP-SC	Clayey SAND, fine to medium grained, pale brown mottled pale grey				
				5	6							
			SPT 3,4,7 N*=11	4	7							
			SPT 6,10,17 N*=27	3	8		CH	CLAY, medium to high plasticity, grey	¬Wp	H	× 400	Residual
				2	9		--	SHALE, dark brown mottled dark grey, extremely weathered, extremely low to low strength	--	--		Bedrock
				1	10			Borehole No: BH6 terminated at 9m				Near TC-bit refusal

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Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Asset Geotechnical Engineering Pty Ltd
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NSW 2113

Attention: **James Zhao**

Report **451773-S**
Project name 28 SHEPHERD ST LIVERPOOL 2936
Received Date Mar 24, 2015

Client Sample ID			BH1 1.4-1.5M	BH1 1.9-2.0M	BH1 2.4-2.5M	BH1 2.9-3.0M
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins I mgt Sample No.			S15-Ma18835	S15-Ma18836	S15-Ma18837	S15-Ma18838
Date Sampled			Mar 19, 2015	Mar 19, 2015	Mar 19, 2015	Mar 19, 2015
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.5	7.6	7.7	7.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.9	5.4	7.5	6.6
Reaction Ratings*		comment	Slight	Slight	Vigorous	Vigorous

Client Sample ID			BH1 3.4-3.5M	BH1 3.9-4.0M	BH1 4.3-4.4M	BH1 4.9-5.0M
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins I mgt Sample No.			S15-Ma18839	S15-Ma18840	S15-Ma18841	S15-Ma18842
Date Sampled			Mar 19, 2015	Mar 19, 2015	Mar 19, 2015	Mar 19, 2015
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.5	7.7	7.5	8.6
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.4	5.7	5.9	6.1
Reaction Ratings*		comment	High	Slight	High	Slight

Client Sample ID			BH1 5.4-5.5M	BH1 5.8-5.9M	BH1 6.4-6.5M	BH1 6.9-7.0M
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins I mgt Sample No.			S15-Ma18843	S15-Ma18844	S15-Ma18845	S15-Ma18846
Date Sampled			Mar 19, 2015	Mar 19, 2015	Mar 19, 2015	Mar 19, 2015
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.8	7.9	8.0	7.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	6.0	6.2	8.3	7.7
Reaction Ratings*		comment	Slight	Slight	Vigorous	Vigorous

Client Sample ID			BH2 0.9-1.0	BH2 1.4-1.5	BH2 2.0-2.1	BH2 2.4-2.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S15-Ma18847	S15-Ma18848	S15-Ma18849	S15-Ma18850
Date Sampled			Mar 20, 2015	Mar 20, 2015	Mar 20, 2015	Mar 20, 2015
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.8	7.7	7.7	6.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	7.4	6.9	7.6	4.9
Reaction Ratings*		comment	Vigorous	Vigorous	Vigorous	Vigorous

Client Sample ID			BH2 2.8-2.9	BH2 3.4-3.5	BH2 3.9-4.0	BH2 4.3-4.4
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S15-Ma18851	S15-Ma18852	S15-Ma18853	S15-Ma18854
Date Sampled			Mar 20, 2015	Mar 20, 2015	Mar 20, 2015	Mar 20, 2015
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.8	6.6	6.7	7.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.2	5.2	5.0	5.7
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID			BH2 5.4-5.5	BH2 5.8-5.9	BH2 6.4-6.5	BH2 6.9-7.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S15-Ma18855	S15-Ma18856	S15-Ma18857	S15-Ma18858
Date Sampled			Mar 20, 2015	Mar 20, 2015	Mar 20, 2015	Mar 20, 2015
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.1	7.4	7.5	7.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	6.8	7.9	7.5	7.4
Reaction Ratings*		comment	Vigorous	Vigorous	Vigorous	Vigorous

Client Sample ID			BH1 SPT 2.5-2.95	BH1 SPT 5.5-5.95	BH2 SPT 2.5-2.95	BH2 SPT 5.5-5.95
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S15-Ma18859	S15-Ma18860	S15-Ma18861	S15-Ma18862
Date Sampled			Mar 19, 2015	Mar 19, 2015	Mar 20, 2015	Mar 20, 2015
Test/Reference	LOR	Unit				
Salinity (determined from EC)*	20	mg/kg	159	147	141	290

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Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Salinity (determined from EC)*	Brisbane	Mar 27, 2015	0 Day
Acid Sulfate Soils Field pH Test	Brisbane	Mar 27, 2015	7 Day

* Method: LTM-GEN-7060

Company Name:	Asset Geotechnical Engineering Pty Ltd	**Order No.:**	
Address:	Suite 2.05 / 56 Delhi Road North Ryde NSW 2113	**Report #:**	451773
		Phone:	02 9878 6005
		Fax:	
Project Name:	28 SHEPHERD ST LIVERPOOL 2936		

Received:	Mar 24, 2015 3:23 PM
Due:	Mar 31, 2015
Priority:	5 Day
Contact Name:	James Zhao

Eurofins | mgt Client Manager: Charl Du Preez

Sample Detail					Salinity (determined from EC)*	Acid Sulfate Soils Field pH Test
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
BH1 1.4-1.5M	Mar 19, 2015		Soil	S15-Ma18835		X
BH1 1.9-2.0M	Mar 19, 2015		Soil	S15-Ma18836		X
BH1 2.4-2.5M	Mar 19, 2015		Soil	S15-Ma18837		X
BH1 2.9-3.0M	Mar 19, 2015		Soil	S15-Ma18838		X
BH1 3.4-3.5M	Mar 19, 2015		Soil	S15-Ma18839		X
BH1 3.9-4.0M	Mar 19, 2015		Soil	S15-Ma18840		X
BH1 4.3-4.4M	Mar 19, 2015		Soil	S15-Ma18841		X
BH1 4.9-5.0M	Mar 19, 2015		Soil	S15-Ma18842		X
BH1 5.4-5.5M	Mar 19, 2015		Soil	S15-Ma18843		X
BH1 5.8-5.9M	Mar 19, 2015		Soil	S15-Ma18844		X

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Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
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Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	Asset Geotechnical Engineering Pty Ltd	**Order No.:**	
Address:	Suite 2.05 / 56 Delhi Road North Ryde NSW 2113	**Report #:** **Phone:** **Fax:**	451773 02 9878 6005
Project Name:	28 SHEPHERD ST LIVERPOOL 2936		

Received:	Mar 24, 2015 3:23 PM
Due:	Mar 31, 2015
Priority:	5 Day
Contact Name:	James Zhao

Eurofins | mgt Client Manager: Charl Du Preez

Sample Detail					Salinity (determined from EC)*	Acid Sulfate Soils Field pH Test
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
BH1 6.4-6.5M	Mar 19, 2015		Soil	S15-Ma18845		X
BH1 6.9-7.0M	Mar 19, 2015		Soil	S15-Ma18846		X
BH2 0.9-1.0	Mar 20, 2015		Soil	S15-Ma18847		X
BH2 1.4-1.5	Mar 20, 2015		Soil	S15-Ma18848		X
BH2 2.0-2.1	Mar 20, 2015		Soil	S15-Ma18849		X
BH2 2.4-2.5	Mar 20, 2015		Soil	S15-Ma18850		X
BH2 2.8-2.9	Mar 20, 2015		Soil	S15-Ma18851		X
BH2 3.4-3.5	Mar 20, 2015		Soil	S15-Ma18852		X
BH2 3.9-4.0	Mar 20, 2015		Soil	S15-Ma18853		X
BH2 4.3-4.4	Mar 20, 2015		Soil	S15-Ma18854		X
BH2 5.4-5.5	Mar 20, 2015		Soil	S15-Ma18855		X

eurofins | mgt

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Company Name:	Asset Geotechnical Engineering Pty Ltd	**Order No.:**	
Address:	Suite 2.05 / 56 Delhi Road North Ryde NSW 2113	**Report #:**	451773
		Phone:	02 9878 6005
		Fax:	
Project Name:	28 SHEPHERD ST LIVERPOOL 2936		

Received:	Mar 24, 2015 3:23 PM
Due:	Mar 31, 2015
Priority:	5 Day
Contact Name:	James Zhao

Eurofins | mgt Client Manager: Charl Du Preez

Sample Detail					Salinity (determined from EC)*	Acid Sulfate Soils Field pH Test
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
BH2 5.8-5.9	Mar 20, 2015		Soil	S15-Ma18856		X
BH2 6.4-6.5	Mar 20, 2015		Soil	S15-Ma18857		X
BH2 6.9-7.0	Mar 20, 2015		Soil	S15-Ma18858		X
BH1 SPT 2.5-2.95	Mar 19, 2015		Soil	S15-Ma18859	X	
BH1 SPT 5.5-5.95	Mar 19, 2015		Soil	S15-Ma18860	X	
BH2 SPT 2.5-2.95	Mar 20, 2015		Soil	S15-Ma18861	X	
BH2 SPT 5.5-5.95	Mar 20, 2015		Soil	S15-Ma18862	X	

Eurofins | mgt Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

**NOTE: pH duplicates are reported as a range NOT as RPD

UNITS

mg/kg: milligrams per Kilogram

ug/l: micrograms per litre

ppb: Parts per billion

org/100ml: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within
TEQ	Toxic Equivalency Quotient

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S15-Ma18835	CP	pH Units	7.5	7.5	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	S15-Ma18835	CP	pH Units	5.9	5.9	pass	30%	Pass	
Reaction Ratings*	S15-Ma18835	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S15-Ma18845	CP	pH Units	8.0	8.0	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	S15-Ma18845	CP	pH Units	8.3	8.3	pass	30%	Pass	
Reaction Ratings*	S15-Ma18845	CP	comment	Vigorous	Vigorous	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	S15-Ma18855	CP	pH Units	7.1	7.2	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	S15-Ma18855	CP	pH Units	6.8	7.0	pass	30%	Pass	
Reaction Ratings*	S15-Ma18855	CP	comment	Vigorous	Vigorous	pass	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Charl Du Preez	Analytical Services Manager
Richard Comer	Senior Analyst-Inorganic (QLD)

Glenn Jackson
National Laboratory Manager

Final report - this Report replaces any previously Issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

POINT LOAD STRENGTH INDEX REPORT

AS4133 4.1

Client:	Asset Geotechnical	**Moisture Content Condition:**	As received
Address:	Suite 2.05 56 Delhi Road, North Ryde NSW 2113	**Storage History:**	Core Box
Project:	28 Shepherd Street, Liverpool (2936)	**Report No:**	S2752-PLT
Job No:	S15085	**Date Tested:**	2/04/2015

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

Sampling: Sampled by Client **Date Sampled:** 19-23/3/15

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
S2752	BH1	9.75-9.85	Siltstone	Diametral	-	52.0	0.92	0.34	0.35	
				Axial	52.0	50.0	1.07	0.32	0.34	
S2753	BH1	10.80-10.90	Siltstone	Diametral	-	52.0	1.86	0.69	0.70	
				Axial	52.0	46.0	3.00	0.99	1.03	
S2754	BH1	11.80-11.90	Siltstone	Diametral	-	52.0	2.53	0.93	0.95	
				Axial	52.0	43.0	2.20	0.77	0.80	
S2755	BH1	12.90-13.00	Siltstone	Diametral	-	52.0	1.63	0.60	0.61	
				Axial	52.0	42.0	2.26	0.81	0.83	
S2756	BH2	9.38-9.48	Siltstone	Diametral	-	52.0	0.27	0.10	0.10	
				Axial	52.0	40.0	0.25	0.09	0.09	
S2757	BH2	10.40-10.50	Siltstone	Diametral	-	52.0	2.14	0.79	0.81	
				Axial	52.0	40.0	1.89	0.71	0.72	
S2758	BH2	11.32-11.40	Siltstone	Diametral	-	52.0	1.42	0.52	0.53	
				Axial	52.0	39.0	4.10	1.59	1.60	
S2759	BH3	7.60-7.70	Siltstone	Diametral	-	52.0	0.10	0.04	0.04	
				Axial	52.0	47.0	1.83	0.59	0.62	
S2760	BH3	8.60-8.70	Siltstone	Diametral	-	52.0	2.21	0.82	0.83	
				Axial	52.0	45.0	3.06	1.03	1.07	
S2761	BH3	9.54-9.62	Siltstone	Diametral	-	52.0	0.91	0.33	0.34	
				Axial	52.0	40.0	1.84	0.69	0.70	

Comments:

Authorised Signatory:

Chris Lloyd

2/04/2015

Date:

NATA Accredited Laboratory Number: 14874

MACQUARIE GEOTECH

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	**Moisture Content Condition:**	As received
Address:	Suite 2.05 56 Delhi Road, North Ryde NSW 2113	**Storage History:**	Core Box
Project:	28 Shepherd Street, Liverpool (2936)	**Report No:**	S2562-PLT
Job No:	S15085	**Date Tested:**	2/04/2015

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

Sampling: Sampled by Client **Date Sampled:** 19-23/3/15

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
S2562	BH4	9.61-9.71	Siltstone	Diametral	-	52.0	2.22	0.82	0.83	
				Axial	52.0	42.0	4.63	1.67	1.71	
S2563	BH4	10.70-10.80	Siltstone	Diametral	-	52.0	2.38	0.88	0.90	
				Axial	52.0	38.0	3.04	1.21	1.21	

Comments:

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025. This document shall not be reproduced except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

2/04/2015

Date:

MACQUARIE GEOTECH

Facility Name: Sydney Branch Site
Facility Location: 8/10 Bradford Street, Alexandria NSW 2015
Site No.: 22355

Macquarie Geotechnical
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BATHURST NSW 2795

APPENDIX D

Vibration Limits

VIBRATION LIMITS

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally considered to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) directions, in the plane of the uppermost floor), are summarised in **Table A** below.

It should be noted that peak vibration velocities higher than the minimum figures in **Table A** for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual conditions of the structures.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table A DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity (mm/s)			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

Note: For frequencies above 100 Hz, the higher values in the 50 Hz to 100 Hz column should be used.

APPENDIX E

IMPORTANT INFORMATION

Important Information

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 Environmental Investigations Pty Ltd ("EI"). The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

RELIANCE ON DATA

EI 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. EI 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, EI 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 EI.

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.

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. EI 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 EI 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. EI 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 EI 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.

OTHER LIMITATIONS

EI 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.