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COMBINED PROJECTS (WESTMEAD) PTY LTD

GEOTECHNICAL INVESTIGATION REPORT

LOT 4, DARCY ROAD & HAWKESBURY ROAD, UWS WESTMEAD PRECINCT, WESTMEAD, NSW

Report E23033 GA_Rev1

15 December 2016

Report Distribution

Geotechnical Investigation Report

Lot 4, Darcy Road & Hawkesbury Road, UWS Westmead Precinct, Westmead, NSW

EI Report No. *E23033 GA_Rev1*

Date: *15 December 2016 2016*

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	Original	1 July 2016	
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1 INTRODUCTION

1.1 BACKGROUND

At the request of Combined Projects (Westmead) Pty Ltd (the Client), EI Australia (EI) has carried out a Geotechnical Investigation (GI) for the proposed development at Lot 4, Darcy Road & Hawkesbury Road, UWS Westmead Precinct, Westmead, NSW (the Site).

This GI report has been prepared to provide advice and recommendations to assist in the preparation of designs for the proposed development. The investigation has been carried out in accordance with the agreed scope of works outlined in EI's proposal referenced P13871.1, dated 27 May 2016, and the additional works outlined in the email proposal dated 17 June 2016.

A *Geotechnical Investigation UWS Redevelopment, Westmead* was previously prepared by Coffey Geotechnics Pty Ltd (Coffey), referenced GEOTLCOV23424AA – AG, dated 8 February 2007. The investigation included the drilling of 12 boreholes using solid flight augers fitted with a steel 'V' bit. The drilling was continued using a Tungsten-Carbide ('T-C') bit into the weathered rock, followed by NMLC coring to obtain cores of the rock from each of the boreholes. Boreholes were terminated at depths between 6 to 12m. The boreholes encountered fill, residual soil, and Ashfield Shale bedrock ranging from Class V to Class II in quality. These boreholes are short of the proposed basement levels and will not be incorporated within this report.

1.2 PROPOSED DEVELOPMENT

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

- Architectural drawings of Lot 4 prepared by Turner – Project No. 16001, Revision S, dated 16 December 2016;
- Site survey plan prepared by Whelans Insites Pty Ltd – Reference No. D855SC, Sheets 1 to 4 of 4, dated 13 December 2007;
- Draft site survey plan of Subdivision of Lot 4 in DP 1202362 prepared by Peter William Vandergraaf – Ref. PR123658-DP1, dated 22 October 2015;
- Proposed Subdivision Plan prepared by RPS Group – Referenced PR123658-007, Issue B, dated 11 December 2014; and
- Marked structural drawings showing proposed borehole locations prepared by Bonacci Group (NSW) Pty Ltd – Project Ref. 2021746, Drawing No. SK1, Revision P2, dated 16 June 2016.

Based on the above, we understand that the proposed development will involve the construction of a 7 to 21-storey apartment building with a four-level basement. The lowest basement level (B4) is proposed to have a Finish Floor Level (FFL) of Reduced Level (RL) 16.7m Australian Height Datum (AHD). A Bulk Excavation Level (BEL) of RL 16.4m AHD is assumed to allow for the construction of the basement slab. To achieve the latter, excavation depths of up to about 15m to 17m Below Existing Ground Level (BEGL) is expected to be required. Locally deeper excavations may be required for footings, service trenches and lift overrun pits.

1.3 INVESTIGATION OBJECTIVES

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

- Dilapidation Surveys;
- Excavation methodologies and monitoring requirements, including rock excavation;
- Groundwater considerations;
- Excavation support requirements, including geotechnical design parameters;
- Building foundation options, including;

- Design parameters.
- Earthquake loading factor in accordance with AS1170.4:2007.

- 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;
- 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 five boreholes (BH5, BH6, BH7, BH8M, and BH9), by a track-mounted drill rig using solid flight augers equipped with a 'Tungsten-Carbide' (T-C) bit. BH5, BH6, BH7, BH8M, and BH9 were auger drilled to depths of about 5.4m (RL of about 24.9m AHD), 7.0m (RL of about 23.5m AHD), 8.6m (RL of about 22.0m AHD), 7.0m (RL of about 23.0m AHD), and 7.0m BEGL (RL of about 23.3m AHD), respectively. The approximate surface levels shown on the borehole logs were approximated from spot levels shown on the supplied draft survey plan which formed the basis of **Figure 2.** Approximate borehole locations are shown on **Figure 2**;
- Standard Penetration Testing (SPT) was carried out during auger drilling of the boreholes 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. Soil samples were sent to Macquarie Geotechnical Pty Ltd (Macquarie) and SGS Sydney Pty Ltd (SGS), which are National Australian Testing Authority (NATA) accredited laboratories, for testing and storage.
- The strength of the shale bedrock in the augered sections of the boreholes was assessed by observation of the auger penetration resistance using a T-C drill bit, examination of the recovered rock cuttings, and rock moisture content tests. It should be noted that rock strengths assessed from augered boreholes are approximate and strength variances can be expected.
- Continuation of BH5, BH6, BH7, BH8M, and BH9 using NMLC diamond coring techniques to termination depths of about 24.0m (RL of about 6.3m AHD), 21.5m (RL of about 9.0m AHD), 21.5m (RL of about 9.1m AHD), 23.6m (RL of about 6.4m AHD), and 23.7m BEGL (RL of about 6.6m AHD), respectively. Rock cores recovered from the boreholes were boxed, logged, photographed and sent to Macquarie for point load strength index testing and storage. The test results are presented in **Appendix A** and **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.
- Installation of one PVC standpipe in BH8M to allow for long term groundwater monitoring;
- Preparation of this GI report.

An 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 in the preparation of designs for the proposed development. Further geotechnical inspections should be carried out during construction to confirm the geotechnical and groundwater models, and the design parameters provided in this report.

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	158-164 Hawkesbury Road, Westmead, NSW 2145
Lot and Deposited Plan (DP) Identification	Lot 7 in DP 1077852 (proposed subdivision Lot 4)
Local Government Authority	Parramatta City Council
Parish	St John
County	Cumberland
Current Zoning	B4 – Mixed Use (Parramatta Local Environment Plan 2011)
Site Description	At the time of our investigation, all previously site structures were demolished. The site was generally vacant with a few large trees. A few access roads and temporary construction sheds were also present on site.
Site Area	The site area is approximately 6,588m² (based on the proposed subdivision plan).

2.2 LOCAL LAND USE

The site is situated within an area of mixed 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	Towards the northeast – Proposed Lot 3, currently a vacant construction site. Beyond Lot 3 lies Hawkesbury Road, a five to six-lane asphaltic-concrete road. Towards the north and northwest – Parramatta Marist High School, consisting of two to four-storey brick buildings, which appeared to not have any basement levels. No access to the interior was possible. The closest buildings have a setback of about 2m from the Site boundary.
East	A proposed public road currently under construction, followed by the proposed Lot 2, currently a vacant construction site.
South	A proposed public road currently under construction, and a proposed public reserve. Beyond the proposed public reserve and public roads lie the proposed Lot 5, currently a vacant construction site. Lot 5 is proposed to be redeveloped into two apartment buildings of eight and 15 to 22-stories, over a common four-level basement. A BEL of RL 19.4m AHD is assumed for this development. Lot 5 has a setback of about 25 to 50m from the Site Boundary.
West	Parramatta Marist High School, consisting of two to four-storey brick buildings, which appeared to not have any basement levels. No access to the interior was possible. An in-ground swimming pool with a setback of about 8m from the closest site boundary. The closest buildings have a setback of about 2m from the Site boundary.

2.3 REGIONAL SETTING

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

Table 2-3 Topographic and Geological Information

Attribute	Description
Topography	The Site ground topography is generally level across the site, with localised minor slopes falling with angles up to 2°. The site levels vary from RL 30.8m to 29.6m AHD.
Regional Geology	Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Penrith 1:100,000 Geological Series Sheet 9030 (DMR 1991) indicates the site to be underlain by Ashfield Shale. Ashfield Shale typically consists of dark-grey to black claystone-siltstone and fine sandstone-siltstone laminite

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 two geotechnical units, with Unit 2 subdivided into four sub-units. A summary of the subsurface conditions across the site, interpreted from the investigation results, is presented in **Table 3-1** below. A summary of the depths and RL to the top of each unit in each borehole is presented in **Table 3-2**.

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 [2]	Depth to top of Unit (m BEGL) [1]	Approximate RL of Top of Unit (m AHD) [1]	Observed Thickness (m)	Material Description [2]	Comments
1	Fill	Surface	30.6 to 30.0	1.0 to 3.4	FILL	Silty clay, clayey sand, or gravelly sandy fill with various content of gravel, sandstone and brick fragments, and slag. Based on the SPT N values, the fill appeared to be moderately to well compacted. Due to the variable nature and unknown placement and compaction control of the fill, we consider the fill to be 'uncontrolled'.
2a	Extremely Low to Very Low Strength Shale	1.0 to 3.4	29.6 to 26.6	2.0 to 6.5	SHALE	Extremely low to very low strength, extremely to distinctly weathered shale. Defects in Unit 2a are generally very closely spaced (20-60mm), including sub-horizontal bedding partings, joints inclined up to 70°, and up to 35% decomposed and crushed seams. In BH8 and BH9, 210mm and 310mm of core loss zones were observed, respectively. Core loss is inferred to be extremely weathered shale or clay seams.
2b	Low Strength Shale	3.5 to 7.5	26.8 to 23.1	2.5 to 3.3	SHALE	Low strength, distinctly weathered shale. Encountered in BH5, BH6, and BH7 only. Defects in Unit 2b are generally closely spaced (60-200mm), including sub-horizontal bedding partings, joints inclined up to 90°, and up to 6% decomposed and crushed seams. In BH6, 50mm of core loss was observed. Core loss is inferred to be extremely weathered shale or clay seams.
2c	Low to Medium Strength Shale	6.8 to 8.8	23.5 to 21.7	1.3 to 5.0	SHALE	Low to medium strength, distinctly to slighty weathered shale. Encountered in BH5, BH7, and BH8M only. Defects in Unit 2c are generally closely to moderately spaced (60-600mm), including sub-horizontal bedding partings, joints inclined up to 90°, and up to 3% decomposed and crushed seams.
2d	Medium to High Strength Shale	8.0 to 13.8	22.5 to 16.8	7.6 to 14.8 [3]	SHALE	Medium to high strength, fresh shale. Encountered in all boreholes. Defects in Unit 2d are generally moderately to widely spaced (200-2000mm), including sub-horizontal bedding partings, joints inclined up to 70°, and up to 2% decomposed and crushed seams. Bands of low to medium strength shale were observed at the following depths: • BH5: 13.8 to 14.3m, and 22.8 to 23.2m • BH6: 14.2 to 14.8m, • BH7: 22.8 to 23.6m • BH9: 10.7 to 11.2m,

Notes:
1 Approximate depth and level at the time of our investigation. Depths and levels may vary across the site.
2 For more detailed descriptions of the subsurface conditions, reference should be made to the borehole logs attached to **Appendix A**.
3 Observed up to termination depth in BH5, BH6, BH7, BH8M, and BH9.

Table 3-2 Approximate Depth and RL to Top of Unit in Each Borehole

Unit	Material	Approximate Depth to Top of Unit (m BEGL) [Approximate RL to Top of Unit (m AHD)] [1]				
		BH5	BH6	BH7	BH8M	BH9
1	Fill	0 [30.3]	0 [30.5]	0 [30.6]	0 [30.0]	0 [30.3]
2a	Extremely Low to Very Low Strength Shale	1.5 [28.8]	1.5 [29.0]	1.0 [29.6]	3.4 [26.6]	3.0 [27.3]
2b	Low Strength Shale	3.5 [26.8]	5.5 [25.0]	7.5 [23.1]	8.3 [21.7]	8.9 [21.4]
2c	Low to Medium Strength Shale	6.8 [23.5]	8.0 [22.5]	8.8 [21.8]	8.3 [21.7]	8.9 [21.4]
2d	Medium to High Strength Shale[2]	10.75 [19.5]	8.0 [22.5]	13.8 [16.8]	11.8 [18.2]	8.9 [21.4]

Notes:
1 Approximate depth and level at the time of our investigation. Depths and levels may vary across the site.
2 Observed up to borehole termination depth.

3.2 Groundwater Observations

No groundwater seepage was observed in BH5, BH6, BH7, BH8M, and BH9 during auger drilling. The water induced during the coring process of the boreholes precluded further observations of the groundwater levels.

However, following the completion of fieldwork, a groundwater monitoring well was installed in BH8M for further monitoring, and was bailed dry on the day of installation. The groundwater within the well was measured during the duration of the investigation.

The previous investigation by Coffey installed two groundwater monitoring wells, CGBH2 and CGBH3, within the site boundary.

Groundwater levels measured during the groundwater monitoring visit and during the previous Coffey investigation are presented in **Table 3-3** below.

Table 3-3 Summary of Groundwater Levels

Monitoring Well / Borehole ID	Date of Observation	Approximate Depth to Groundwater (m BEGL)	Approximate RL of Groundwater (m AHD)	Assumed Bulk Excavation Level at Borehole Location (m AHD)
BH8M	22/6/16	6.5	23.5	16.4
	23/6/16	5.6	24.4	
CGBH2 (Coffey)	2007	4.5	25.8	
CGBH3 (Coffey)	2007	6.8	23.5	

3.3 Test Results

One soil and nine rock chip samples were selected for laboratory testing to assess the following:

- Rock Moisture Content; and
- Soil aggressivity (pH, Chloride and Sulfate content and electrical conductivity).

A summary of soil test results is provided in **Table 3-4** below.

278 selected rock core samples were tested by Macquarie to estimate the Point Load Strength Index (Is_{50}) values to assist with rock strength investigation. The results of the testing are summarised on the attached borehole logs.

Laboratory test certificates are presented in **Appendix B.**

The point load strength index tests 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, varied from 1 MPa to 66 MPa.

The investigation indicated low permeability soil and bedrock was present above and below the groundwater table. 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 sulfate content and electrical conductivity of the groundwater provided the following exposure classifications:

Weathered Shale

- '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' these soils would be classified as exposure classification 'A2' for concrete in sulfate soils.

Table 3-4 Summary of Laboratory Test Results

Test/ Sample ID		BH5_3.5-4.0	BH6_3.5-4.0	BH6_5.5-6.0	BH7_7.5	BH8M_5.5-6.0
Unit		2b	2a	2b	2b	2a
Material Description [1]		SHALE	SHALE	SHALE	SHALE	SHALE
Moisture Content (%)		4.2	9.3	7.7	4.1	13.3

Table 3-4 Summary of Laboratory Test Results (Continued)

Test/ Sample ID		BH8M_6.5-7.0	BH9_3.5-4.0	BH9_5.5-6.0	BH9_6.5-7.0	BH8M_4.5-4.6
Unit		2a	2a	2a	2a	2a
Material Description [1]		SHALE	SHALE	SHALE	SHALE	SHALE
Aggressivity	pH	-	-	-	-	5.3
	Electrical Conductivity (µS/cm)	-	-	-	-	150
	Sulfate SO_4 (mg/kg)	-	-	-	-	75
	Chloride Cl (mg/kg)	-	-	-	-	68
Moisture Content (%)		7.9	12.7	9.1	5.9	10

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:

- Basement excavation and retention to limit lateral deflections and ground loss as a result of excavations, resulting in damage to nearby structures;
- Rock excavation;
- Groundwater within the depth of the basement excavation; 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.

EI assumes that the proposed development will require a BEL of RL 16.4m AHD, which will require excavation depths ranging from about 15m to 17m BEGL. Locally deeper excavations for footings, service trenches and lifts overrun pits may be required.

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

Unit 1 and 2a should be excavated using buckets of conventional earthmoving Hydraulic Excavators, particularly if fitted with 'Tiger Teeth', with some moderate ripping.

Ripping of Unit 2b would require a high capacity and heavy bulldozer of at least D9 or similar for effective production, while Unit 2c and 2d would require a bulldozer of at least D10 or similar. The use of a smaller size bulldozer will result in lower productivity, and this should be allowed for.

Alternatively, hydraulic rock breakers, rock saws and/ or rotary grinders could be used, though productivity would be lower and equipment wear increases, and this should be allowed for. Such equipment would also be required for detailed excavation, such as footings or service trenches, and for trimming of faces. Final trimming of faces may also be completed using a grinder attachment rather than a rock breaker in order to assist in limiting vibrations. The use of rotary grinders generally generates dust and this may be supressed by spraying with water.

Excavation using rock hammers should commence away from the adjoining structures and the transmitted vibrations monitored to assess how close the hammer can operate to the adjoining structures while maintaining transmitted vibrations within acceptable limits. Alternatively, vibration monitors may be set up on the adjoining buildings to monitor vibrations at all times during rock excavation. Such monitors should be attached to base of external walls of existing building and/ or infrastructure in closest proximity to the excavation and have flashing lights to warn the operator when acceptable limits have been reached. Reference should be made to **Appendix C** for acceptable limits of transmitted vibrations.

Where the transmitted vibrations are excessive, alternate excavation equipment would need to be used, such as a small rock hammer, ripping hooks, rotary grinders or rock saws. If an alternate rock hammer is to be used, the transmitted vibrations from that hammer should be measured to determine how close each individual hammer can operate to the adjoining buildings. To assist in reducing vibrations and over-break of the sandstone, we recommend that initial saw cuts through the bedrock may be provided using rock saw attachments fitted to the excavator. However, the effectiveness of such approach must be confirmed by the results of vibration monitoring

Groundwater seepage monitoring should be carried out during bulk excavation prior to finalising the design of a pump out facility. Outlets into the stormwater system will require Council approval.

It is the builder's responsibility that the excavation works do not adversely impact on the adjoining structures and infrastructures.

4.3.2 Vibration Considerations

Utmost care must be taken when using excavators with hydraulic impact hammer attachments for any rock excavation, as there will likely be direct transmission of ground vibrations to nearby structures and infrastructures. Guideline levels of vibration velocity for evaluating the effects of vibration in structures are given in the attached Vibration Limits in **Appendix C**. We recommend that the acceptable limit for transmitted vibration be set at quite low peak particle velocities at foundation level. To fall within these limits, we recommend that the size of rock hammers initially used during the trial not exceed medium sized rock hammer, say 900kg. If it is found that transmitted vibrations are unacceptable, then it would be necessary to change to a smaller excavator with a smaller rock hammer, or to a rotary grinder, rock saws, or jackhammers.

If rock hammers are to be used, we recommend that the initial excavation in rock should preferably be commenced away from likely critical areas and vibration monitoring be carried out. The monitoring program should be confirmed when details of the contractor's excavation methods and sequence are known.

Vibrations induced by excavations can be reduced by alternative methods such as the following:

- Commence the rock excavation away from potentially sensitive areas;
- Keep rock hammer orientation towards the face and enlarge excavation by breaking small wedges off faces;
- Operate hammers in short bursts only;
- Use smaller equipment (resulting in low productivity); and
- Use line sawing, especially along boundaries, to assist in breaking and trimming.

Furthermore, we recommend that only excavation contractors with appropriate insurances and experience on similar projects be used. The contractor should also be provided with a copy of this report to make his own judgement on the most appropriate excavation equipment.

4.4 Groundwater Considerations

Groundwater was observed in the monitoring well installed in BH8M and during the previous Coffey investigation at a depth ranging between about 4.5 to 6.8m BEGL, or RLs ranging between about 25.8 to 23.5m AHD, which is well above the assumed BEL of RL 12.2m AHD.

However, experience shows that due to the low permeability of the bedrock profile, groundwater inflows into the excavation should not have an adverse impact on the proposed development or on the neighbouring sites. However, we expect that some groundwater inflows into the excavation along the soil/rock interface and through any defects within the shale bedrock (such as jointing, and bending planes, etc.) particularly following a period of heavy rain. The initial flows into the excavation may be locally high, but would be expected to decrease considerably with time as the bedding seams/joints are drained. We recommend that monitoring of seepage be implemented during the excavation works to confirm the capacity of the drainage system.

We expect that any seepage that does occur will be able to be controlled by a conventional sump and pump system. We recommend that a sump-and-pump system be used both during construction and for permanent groundwater control below the basement floor slab.

In the long term, drainage should be provided behind all basement retaining walls, around the perimeter of the basement and below the basement slab. The completed excavation should be inspected by the hydraulic engineer to confirm that adequate drainage has been allowed for. Drainage should be connected to the sump-and-pump system and discharging into the stormwater system. The permanent groundwater control system should take into account any possible soluble substances in the groundwater which may dictate whether or not groundwater can be pumped into the stormwater system.

The design of drainage and pump systems should take the above issues into account along with careful ongoing inspections and maintenance programs.

EI recommends detailed groundwater monitoring with pump out tests be carried out within the installed monitoring well for monitoring of groundwater levels and estimation of seepage volumes into the site.

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.

Based on the encountered subsurface conditions, proposed basement depth and assuming the proposed basement outline extends close to the site boundaries, temporary batters for the encountered soil and weathered shale profile are considered not feasible and not recommended for this site.

A suitable retention system, such as anchored and/or propped soldier pile walls, with concrete infill panels, installed to below bulk excavation levels is recommended and will be required for the support of the excavation. Anchors/props and shotcrete must be installed progressively as excavation proceeds. The use of a more closely spaced shoring system (such as semi-contiguous or contiguous) is recommended adjacent to neighbouring buildings/infrastructures, so as to reduce the lateral movements and the risk of potential damage.

Even though Unit 2d – Medium to high strength shale was encountered within the depth of the excavation, the shale included inclined joints that may be adversely inclined in at least one of the cut faces. If such adversely inclined joints exist within unsupported cut faces, they could result in a large scale failure. Stabilisation of such wedges during excavation is not practical, as when the bases of such joints are exposed it is often too late to install additional support. Should an unsupported rock face excavation be adopted, the excavation would require to be carefully staged so that only part of the face is exposed at a time, with inspections by a geotechnical engineer at 1.5m intervals. This is often undesirable from a construction time and cost perspective. Therefore, we recommend that the piles must be socketed below the base of the bulk excavation levels, and below local footings, service trenches and lift pit excavations.

Bored piers may be used 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 any 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.

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.

4.5.2 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 of less than low strength, 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 of less than low strength, 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 shale of Unit 2b or better, a nominal uniform pressure of 10kPa should be allowed to support small wedges of rock that may occur;
- The shoring wall design should be either checked and designed to accommodate a wedge formed by a joint inclined at 45 degrees intersecting the excavation face at the base of the excavation or the excavation be carried out with close geotechnical supervision in order that additional anchors could be installed if unfavourable defects are revealed.
- Full hydrostatic pressures must be taken into consideration in the design of retaining walls unless measures are taken to provide complete and permanent drainage behind the walls. Strip drains protected with a non-woven geotextile fabric should be used behind the shotcrete infill panels for soldier pile walls or inserted between gaps in contiguous piles. Alternatively, for the contiguous pile walls, weepholes comprising 20mm diameter PVC pipes grouted into holes or gaps between adjacent piles at 1.2m centres (horizontal and vertical), may be used. The embedded end of the pipes must, however, be wrapped with a non-woven geotextile fabric (such as Bidim A34) to act as a filter against subsoil erosion;
- All surcharge loading affecting the walls (including from construction equipment, construction loads, adjacent high level footings, etc.) should be adopted in the retaining wall design as an additional surcharge using an 'at rest' earth pressure coefficient, k_o, of 0.59;
- For piles embedded into Unit 2d or better, the allowable lateral toe resistance value outlined in **Table 4-1** below may be adopted;
- If temporary anchors extend beyond the site boundaries, then permission from the neighbouring properties would need to be obtained prior to installation. Also, the presence of neighbouring basements (if any) or services and their levels must be confirmed prior to finalising anchor design;
- Anchors should have their bond length within Unit 2b or better. For the design of anchors bonded into Unit 2b or better, the allowable bond stress value outlined in **Table 4-1** below may be used, subject to the following conditions:

    1. Anchor 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;
    2. Overall stability, including anchor group interaction, is satisfied;
    3. All anchors should be proof loaded to at least 1.3 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;
    4. Permanent anchors must have appropriate corrosion provisions for longevity.

Table 4-1 Geotechnical Design Parameters

Material [1]		Unit 1 Fill	Unit 2a Extremely Low to Very Low Strength Shale	Unit 2b Low Strength Shale	Unit 2c Low to Medium Strength Shale	Unit 2d Medium to High Strength Shale
RL of Top of Unit (m AHD) [2]		30.6 to 30.0 (Surface)	29.6 to 26.6	26.8 to 25.0	23.5 to 21.7	22.5 to 16.8
Bulk Unit Weight (kN/m³)		18	22	23	24	24
Earth Pressure Coefficients	At rest, K_o [3]	0.59	0.50	0.43	0.36	0.29
	Active, K_a [3]	0.42	0.33	0.27	0.22	0.17
	Passive, K_p [3]	-	-	-	4.60	5.88
Allowable Bearing Pressure (kPa) [5, 6]		-	-	-	-	3000
Allowable Shaft Adhesion (kPa) [4, 5]	in Compression	-	-	-	-	300
	in Uplift	-	-	-	-	150
Toe Resistance (kPa)		-	-	-	-	300
Bond Stress (kPa)		-	-	150	200	350
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. More detailed descriptions of subsurface conditions are available on the borehole logs in **Appendix A**. Levels may vary across the site.

3 Earth pressures are provided on the assumption that the ground behind the retaining walls is horizontal.

4 Side 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 liftout' 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 0.3m, 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 Geotechnical Engineer prior to pile construction to ascertain that ground conditions meet design assumptions. Where groundwater ingress is encountered during pile excavation, concrete is to be placed as soon as possible upon completion of pile excavation. Pile excavations should be pumped dry of water prior to pouring concrete, or alternatively a tremie method should be used;
- The bases 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.

6 Based on a settlement of 1%.

4.6 FOUNDATIONS

At the assumed BEL of RL 16.4m AHD, we expect Unit 2d material to be exposed.

It is recommended that all footings for the building be founded within shale bedrock of similar strength to provide uniform support and reduce the potential for differential settlements.

Footings founded within Unit 2d may be designed for an allowable bearing capacity of 3000kPa, based on serviceability. Within the basement area, strip/pad footings may be used.

Geotechnical inspections of foundations by a geotechnical engineer to determine that the required socket material has been achieved and founding material has been reached and determine any variations that may occur between the boreholes and inspected locations are recommended.

4.7 LOWEST BASEMENT FLOOR SLAB

Following bulk excavations for the proposed basements, shale bedrock is expected to be exposed at BEL. The lowest basement slab should be provided with a granular sub-base layer to provide a separation between the rock and the floor slab. We recommend that the sub-base layer comprise at least 100mm thickness of crushed rock to RMS QA specification 3051 (2013) unbound base material (or equivalent good quality and durable fine crushed rock) compacted to at least 100% of Standard Maximum Dry Density (SMDD). Concrete pavements should be designed with an effective shear transmission at all joints by way of either dowelled or keyed joints. The completed excavation should be inspected by the hydraulic engineer to confirm the extent of the drainage required

In addition, a system of sub-soil drains comprising a durable single sized aggregate with perforated drains/pipes leading to sumps should be provided. The basement floor slab should be isolated from columns.

Permission may need to be obtained from the NSW Department of Primary Industries (DPI) and possibly Council for any permanent discharge of seepage into the drainage system. Given the subsurface conditions, we expect that seepage volumes would be low and within the DPI limits. However, if permission for discharge is not obtained, the basement may need to be designed as a tanked basement.

5 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL SERVICES

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

- Pump-out tests within the installed well;
- Dilapidation surveys;
- Design of working platforms (if required) for construction plant by an experienced and qualified geotechnical engineer;
- Classification of all excavated material transported off site;
- Rock face inspections, if required;
- Witnessing installation and proof-testing of anchors (if required).
- 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 Combined Projects (Westmead) 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 Combined Projects (Westmead) 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 D** 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.

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

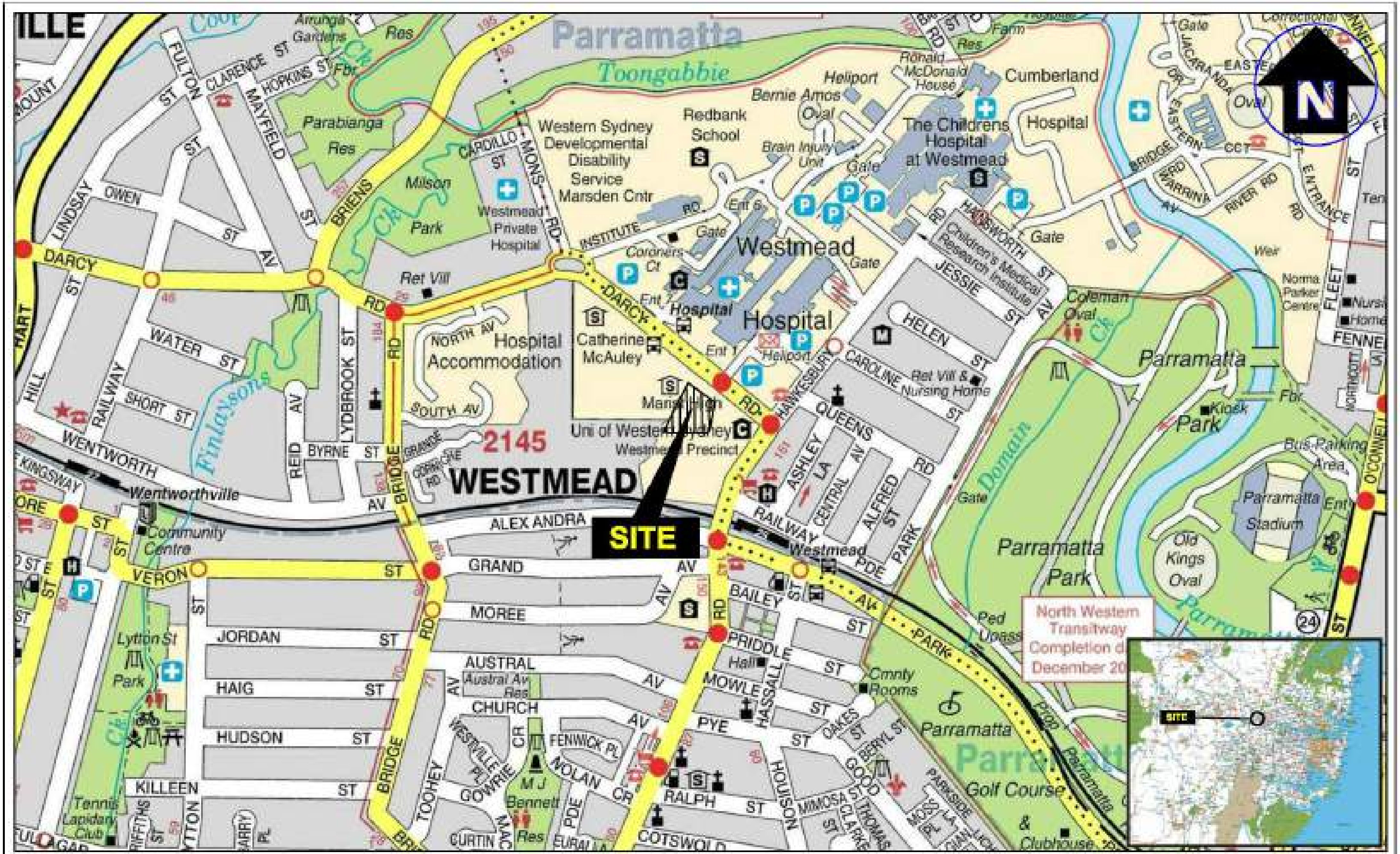
NSW Department of Finance and Service, Spatial Information Viewer, maps.six.nsw.gov.au.

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
RL	Reduced Level
T-C	Tungsten-Carbide
UCS	Unconfined Compressive Strength

FIGURES



Drawn:	M.G.
Approved:	S.K.
Date:	1/7/16
Approx Scale:	N.T.S.

DeiCorp Constructions (NSW) Pty Ltd

Geotechnical Investigation

Lot 4, Darcy Road and Hawkesbury Road, UWS Westmead Precinct, Westmead, NSW

Site Locality Plan

Figure: 1

Project: E23033 GA

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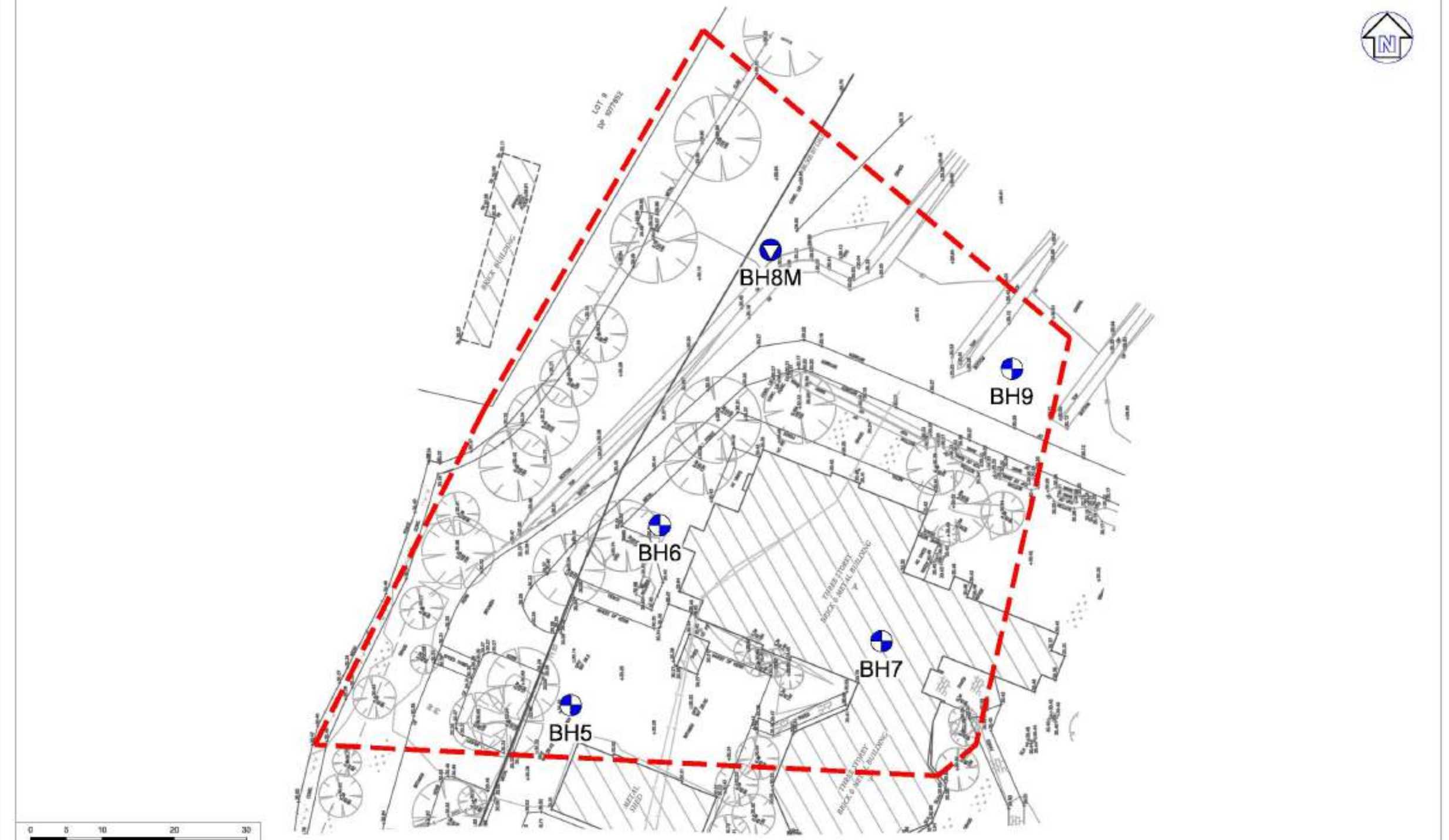
Contamination | Remediation | Geotechnical

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



Map Source: Whelans Insites Pty Ltd, Job Reference: D855SC, Sheets 1 and 2, Dated 13/12/2007

LEGEND

- Approximate borehole/monitoring well location
- Approximate borehole location
- Approximate site boundary

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Contamination | Remediation | Geotechnical
Suite 6.01, 55 Miller Street, PYRMONT 2009
Ph (02) 9516 0722 Fax (02) 9516 5068

Drawn:	M.G.
Approved:	S.K.
Date:	1/7/16
Approx Scale:	1:500 @ A3 or as shown

DeiCorp Constructions (NSW) Pty Ltd
Geotechnical Investigation
Lot 4, Darcy Road and Hawkesbury Road, UWS
Westmead Precinct, Westmead, NSW
Borehole Location Plan

Figure: 2

Project: E23033 GA

APPENDIX A

BOREHOLE LOGS AND EXPLANATORY NOTES

eiaustralia

BOREHOLE: BH5

Project	Proposed Residential Development	East	313562.1 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257477.5 m MGA94 Zone 56	Sheet	1 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	20/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 20/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

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	M	GWNE during and at completion of auger drilling	0	30.30				-	FILL: Clayey SAND; fine to medium grained, dark brown-dark grey, with fine to coarse, sub-angular to sub-rounded gravel.			FILL
				0.50 29.80	SPT 0.50-0.89 m 20/100mm HB N=SPT BH5_0.5-0.6				From 0.5 m, with sandstone gravel.	M	-	
			1	1.50 28.80	SPT 1.50-1.88 m 16,3/10mm HB N>3 BH5_1.5-1.88			-	SHALE: brown-grey, extremely to distinctly weathered, extremely low to very low strength.			WEATHERED ROCK
	W		2									
			3		SPT 3.00-3.23 m 9,16/80mm HB N>16 BH5_3.0-3.23							
				3.50 26.80	BH5_3.5-4.0 D 3.50-4.00 m				From 3.5 m, distinctly weathered, low strength.	-	-	ROCK
	H		4									
			5	5.40								
									Continued as Cored Borehole			
			6									
			7									
			8									
			9									
			10									

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

BOREHOLE: BH5

Project	Proposed Residential Development	East	313562.1 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257477.5 m MGA94 Zone 56	Sheet	2 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	20/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 20/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
				0							
				1							
				2							
				3							
				4							
				5							
					5.40		Continuation from non-cored borehole				
NMLC	90-100% RETURN				24.90		SHALE; bedding dipping 0-5 degrees, dark grey-brown.	DW		5.40-5.55: BPx1.5 0° PR S CN	
				6						5.58-5.62: JT 45° UN S CN 5.66: JT 45° UN S CN 5.73-5.77: DS 40 mm. 5.92-6.05: JT 80 - 90° UN S CN 6.02: JT 15° PR S CN 6.10: JT 45° UN S CN 6.16-6.24: JT 70 - 90° UN S CN	
										6.56-6.59: DS 20 mm.	
		100	42 (40)	7				DW - SW		6.90-6.96: JT 60° CU S CN 6.97-7.03: DS 60 mm.	
										7.26-7.32: JT 60° UN S CN	
										7.61-7.66: JT 45° CU S CN	
					8.00					7.77-7.80: DS 30 mm. 7.85-7.87: JT 90° UN S CN	
				8	22.30		SHALE; bedding dipping 0-5 degrees, dark grey.			7.87: JT 10° CU S CN 7.91-8.01: DS 10 mm. 8.01-8.11: JT 45 - 90° CU S CN	
										8.56-8.66: JT 80 - 90° UN S CN	
										8.89-8.93: JT 70 - 90° UN S CN 8.93-8.97: JT 60 - 70° UN S CN 9.00-9.05: JT 45° UN S CN	
		100	87 (86)	9						9.25: BP 0° PR S CN	
										9.40: BP 0° PR S CN 9.49-9.53: JT 80° UN S CN 9.58: BP 0° PR S CN 9.73: BP 0° PR S CN	
				10							

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

BOREHOLE: BH5

Project	Proposed Residential Development	East	313562.1 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257477.5 m MGA94 Zone 56	Sheet	3 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	20/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 20/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	90-100% RETURN	100	87 (86)	10			SHALE; bedding dipping 0-5 degrees, dark grey.	FR		10.58: BP 0° PR S CN 10.66: JT 5 - 10° CU S CN 10.82: JT 5° CU S CN 10.92: BP 0° PR S CN 11.00-11.06: JT 80° UN S CN 11.03-11.16: DS 100 mm. 11.17: BP 0° PR S CN 11.24: BP 0° PR S CN 11.30: BP 0° PR S CN	
				11							
				12						11.94: BP 0° PR S CN 12.24: BP 0° PR S CN 12.49: BP 0° PR S CN	
		100	89 (88)	13						12.70: JT 10° PR S CN 12.72-12.79: JT 80 - 90° UN S CN 12.79-12.81: DS 20 mm. 12.90: BP 0° PR S CN 12.95: BP 0° PR S CN 13.13: JT 5° PR S CN 13.36: BP 0° PR S CN 13.41-13.42: DS 20 mm. 13.44-13.47: DS 30 mm. 13.59: JT 10° PR S CN 13.77: BP 0° PR S CN	
				14						14.06: BP 0° PR S CN 14.22-14.24: DS 20 mm.	
				15						14.55: BP 0° PR S CN 14.83: BP 0° PR S CN 15.06: BP 0° PR S CN	
		100	92 (93)	16						15.69: BP 0° PR S CN 15.70: BP 0° PR S CN 16.06: JT 0 - 10° CU S CN 16.11-16.17: DS 60 mm. 16.22: BP 0° PR S CN	
				17						16.62: BP 0° PR S CN 16.63: BP 0° PR S CN	
				18						17.21: BP 0° PR S CN 17.33: BP 0° PR S CN 17.66: BP 0° PR S CN 18.12: BP 0° PR S CN	
		100	84 (87)	19						18.72: BP 0° PR S CN	
				20						19.18: JT 45° PR S CN 19.24: JT 5° UN S CN 19.30: BP 0° PR S CN 19.47: JT 30° UN S CN 19.49-19.69: JT 60 - 70° CU S CN 19.53: JT 5 - 10° UN S CN 19.54: JT 5 - 10° UN S CN	

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

BOREHOLE: BH5

Project	Proposed Residential Development	East	313562.1 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257477.5 m MGA94 Zone 56	Sheet	4 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	20/6/16
Client	DeiCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 20/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	90-100% RETURN	100	84 (87)	20			SHALE; bedding dipping 0-5 degrees, dark grey.	FR		19.65: JT 30° CU S CN 19.66-19.90: JT 45° CU S CN 19.90-19.92: JT 30° CU S CN 20.04: JT 40° UN S CN 20.10: JT 5 - 10° CU S CN 20.35: BP 0° PR S CN 20.43: JT 45° PR S CN 20.76-20.78: JT 5 - 30° ST S CN	
		100	100 (98)	21						21.08: BP 0° PR S CN	
				22						22.00: BP 0° PR S CN 22.31: BP 0° PR S CN	
				23						22.73: BP 0° PR S CN 23.13: JT 5° PR S CN 23.27: JT 5° UN S CN	
		100	100 (100)	24	24.00 6.30		Hole Terminated at 24.00 m Backfilled with drilling spoil.				
				25							
				26							
				27							
				28							
				29							
				30							

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

CORE PHOTOGRAPH OF BOREHOLE: BH5

Project:	Proposed Residential Development	East:	313562.1 m	Depth Range:	5.40 m to 14.00 m
Location:	Darcy & Hawkesbury Road, Westmead	North	6257477.5 m MGA94 Zone 56	Contractor:	Rockwell Drilling Pty Ltd
Position:	Lot 4	Surface RL:	30.30 m AHD	Drill Rig:	Hanjin DB8
Job No. :	E23033	Inclination:	-90°	LOGGED: JZ	DATE: 20/6/16
Client:	DeiCorp Constructions (NSW) Pty Ltd	Box:	1-2 of 4	CHECKED: SK	DATE: 1/7/16
		Hole Depth:	24.00 m		

CORE PHOTOGRAPH OF BOREHOLE: BH5

Project:	Proposed Residential Development	East:	313562.1 m	Depth Range:	14.00 m to 24.00 m
Location:	Darcy & Hawkesbury Road, Westmead	North	6257477.5 m MGA94 Zone 56	Contractor:	Rockwell Drilling Pty Ltd
Position:	Lot 4	Surface RL:	30.30 m AHD	Drill Rig:	Hanjin DB8
Job No.:	E23033	Inclination:	-90°	LOGGED: JZ	DATE: 20/6/16
Client:	DeiCorp Constructions (NSW) Pty Ltd	Box:	3-4 of 4	CHECKED: SK	DATE: 1/7/16
		Hole Depth:	24.00 m		

BOREHOLE: BH6

Project	Proposed Residential Development	East	313584.5 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257500.8 m MGA94 Zone 56	Sheet	1 OF 4
Position	Lot 4	Surface RL	30.50 m AHD	Date Started	21/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 22/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

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	GWANE during and at completion of auger drilling	0	30.50				-	FILL: Silty CLAY; medium plasticity, dark brown to dark grey-red, with fine to coarse, sub-angular to angular shale gravel, with trace of fine to medium grained sand.	M (<PL)	-	FILL
					SPT 0.50-0.95 m 7,7,11 N=18 BH6_0.5-0.95							
			1	1.50								
				29.00	SPT 1.50-1.80 m 12/100mm HB N=SPT BH6_1.5-1.8			-	SHALE; pale grey-brown, extremely to distinctly weathered, extremely low to very low strength.			WEATHERED ROCK
			2									
					BH6_2.5-3.0 D 2.50-3.00 m							
			3									
					BH6_3.5-4.0 D 3.50-4.00 m							
			4							-	-	
			5									
				5.50								
				25.00	BH6_5.5-6.0 D 5.50-6.00 m				From 5.5 m, distinctly weathered, low strength.			ROCK
			6									
				7.00								
			7						Continued as Cored Borehole			
			8									
			9									
			10									

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

BOREHOLE: BH6

Project	Proposed Residential Development	East	313584.5 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257500.8 m MGA94 Zone 56	Sheet	2 OF 4
Position	Lot 4	Surface RL	30.50 m AHD	Date Started	21/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 22/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7	7.00		Continuation from non-cored borehole				
NMLC	90-100% RETURN	98	78 (78)	8	23.45		CORE LOSS; 50 mm thick.	DW		7.05-7.07: DS 20 mm.	
							SHALE; bedding dipping 0-5 degrees, dark grey.			7.13: BP 0° PR S CN	
										7.49: BP 0° PR S CN	
										7.60-7.61: DS 10 mm.	
										7.65-7.72: JT 60 - 80° CU S CN	
										7.75-7.91: JT 70 - 90° UN S CN	
										7.92: BP 0° PR S CN	
								FR		8.12: BP 0° PR S CN	
										8.21: BP 0° PR S CN	
										8.36: BP 0° PR S CN	
										8.37: BP 0° PR S CN	
				9						8.76: BP 0° PR S CN	
										9.20: BP 0° PR S CN	
										9.38: JT 5° PR S CN	
										9.52: BP 0° PR S CN	
		100	76 (79)	10						9.75-9.75: DS 30 mm.	
										9.81: BP 0° PR S CN	

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

BOREHOLE: BH6

Project	Proposed Residential Development	East	313584.5 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257500.6 m MGA94 Zone 56	Sheet	3 OF 4
Position	Lot 4	Surface RL	30.50 m AHD	Date Started	21/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/6/16
Client	DeiCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 22/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	90-100% RETURN	100	76 (79)	10			SHALE; bedding dipping 0-5 degrees, dark grey.	FR		9.85: BP 0° PR S CN 9.92: JT 10° PR S CN 9.93: BP 0° PR S CN 9.99-10.06: CS 60 mm. 10.12: BP 0° PR S CN 10.22: BP 0° PR S CN 10.23: BP 0° PR S CN 10.38: BP 0° PR S CN 10.65-11.11: JTx5 45 - 80° UN S CN 11.03: BP 0° PR S CN 11.44: BP 0° PR S CN 12.12: BP 0° PR S CN 12.26: BP 0° PR S CN 12.63: JT 5° CU S CN 12.66: BP 0° PR S CN 13.26: BP 0° PR S CN 14.29: BP 0° PR S CN 14.86: BP 0° PR S CN 15.03: BP 0° PR S CN 15.27: BP 0° PR S CN 15.40: BP 0° PR S CN 15.46: JT 10° CU S CN 15.53-15.58: JT 80° PR S CN 15.66: BP 0° PR S CN 15.66-15.80: JT 70 - 80° UN S CN 15.88-15.93: JT 45° UN S CN 15.97: BP 0° PR S CN 16.11: JT 5° UN S CN 16.14: JT 10° ST S CN 16.18: BP 0° PR S CN 16.39: BP 0° PR S CN 16.76: BP 0° PR S CN 16.83: JT 10° UN S CN 16.90: BP 0° PR S CN 16.99: JT 10° PR S CN 17.07: BP 5° PR S CN 17.17: BP 5° PR S CN 17.57: BP 5° PR S CN 17.76: BP 0° PR S CN 17.86-17.94: JT 70° PR S CN 17.95-18.00: JT 70° PR S CN 18.06-18.08: JT 45° PR S CN 18.15: JT 10° UN S CN 18.18: BP 5° PR S CN 18.30: BP 5° PR S CN 18.38-18.43: JT 60° CU S CN 18.38-18.43: CS 60 mm. 18.40: JT 30° CU S CN 18.40: JT 10 - 30° CU S CN 18.88: BP 0° PR S CN 19.01: BP 0° PR S CN 19.14: BP 0° PR S CN 19.56: BP 0° PR S CN 19.88: BP 0° PR S CN	
		100	82 (97)	14							
		100	71 (84)	16							
		100	100 (98)	18							
				20							

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

BOREHOLE: BH6

Project	Proposed Residential Development	East	313584.5 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257500.8 m MGA94 Zone 56	Sheet	4 OF 4
Position	Lot 4	Surface RL	30.50 m AHD	Date Started	21/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	22/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 22/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	90-100% RETURN	100	100 (96)	20			SHALE; bedding dipping 0-5 degrees, dark grey.	FR		20.39: BP 5° PR S CN 20.89: JT 5° CU S CN 21.20: BP 0° PR S CN	
				21							
					21.53 8.97		Hole Terminated at 21.53 m Backfilled with drilling spoil.				
				22							
				23							
				24							
				25							
				26							
				27							
				28							
				29							
				30							

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

CORE PHOTOGRAPH OF BOREHOLE: BH6

Project:	Proposed Residential Development	East:	313584.5 m	Depth Range:	7.00 m to 21.53 m
Location:	Darcy & Hawkesbury Road, Westmead	North	6257500.8 m MGA94 Zone 56	Contractor:	Rockwell Drilling Pty Ltd
Position:	Lot 4	Surface RL:	30.50 m AHD	Drill Rig:	Hanjin DB8
Job No. :	E23033	Inclination:	-90°	LOGGED: JZ	DATE: 22/6/16
Client:	DeiCorp Constructions (NSW) Pty Ltd	Box:	1-3 of 3	CHECKED: SK	DATE: 1/7/16
		Hole Depth:	21.53 m		

BOREHOLE: BH7

Project	Proposed Residential Development	East	313618.1 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257466.4 m MGA94 Zone 56	Sheet	1 OF 4
Position	Lot 4	Surface RL	30.60 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	BG Drilling Pty Ltd	Date Completed	20/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged VL	Date: 20/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

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
ADT	m	GWNE during and at completion of auger drilling	0	30.60				-	FILL: Gravelly SAND; fine grained, brown, gravel is fine to medium, sub-angular, with trace of slag and brick.	D	-	FILL
				1.00								
			1	29.60	SPT 1.00-1.45 m 5,9,11 N=20 BH7_1.0-1.45			-	SHALE: pale grey to grey, with orange-brown iron staining, extremely weathered, extremely low strength, with iron indurated bands.			WEATHERED ROCK
				2.00								
			2	28.60	SPT 2.00-2.03 m 23/30mm HB N=SPT BH7_2.0-2.03				From 2.0m, dark grey with red iron staining.			
			3									
					SPT 3.50-3.74 m 16,12/90mm HB N>12 BH7_3.5-3.59							
			4									
			5		SPT 5.00-5.01 m 6/10mm HB N=SPT BH7_5.0-5.01					-	-	
			6									
			7									
	F			7.50								
				23.10	BH7_7.5 D 7.50-7.60 m				From 7.5m, distinctly weathered, low strength.			ROCK
	H		8	8.60								
									Continued as Cored Borehole			
			9									
			10									

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

BOREHOLE: BH7

Project	Proposed Residential Development	East	313618.1 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257466.4 m MGA94 Zone 56	Sheet	2 OF 4
Position	Lot 4	Surface RL	30.60 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	BG Drilling Pty Ltd	Date Completed	20/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged VL	Date: 20/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7							
				8							
					8.60		Continuation from non-cored borehole				
NMLC	100% RETURN	100	83 (87)	9	22.00		SHALE; bedding dipping 0-5 degrees, with siltstone laminations, dark grey	DW		8.60-8.66: DS 60 mm. 8.69: JT PR RF Clay VNR 8.72-8.74: DS 20 mm. 8.75-8.78: CS 10 mm. 8.82: BP 0° PR RF CN 9.02: BP 0° PR RF Clay VNR 9.04: BP 0° PR RF Clay VNR 9.81: BP 0° PR RF Clay VNR	
				10							

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

BOREHOLE: BH7

Project	Proposed Residential Development	East	313618.1 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257466.4 m MGA94 Zone 56	Sheet	3 OF 4
Position	Lot 4	Surface RL	30.60 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	BG Drilling Pty Ltd	Date Completed	20/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged VL	Date: 20/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	100% RETURN	100	83 (87)	10			SHALE; bedding dipping 0-5 degrees, with siltstone laminations, dark grey.	DW		10.23: JT 2° PR RF Clay VNR	
										10.41: JT 5° PR RF Clay VNR 10.42: JT 0° PR RF Clay VNR 10.46: JT 0° PR RF Clay VNR 10.47-10.49: DS 20 mm. 10.50: BP 0° PR RF Clay VNR 10.68: JT 0° PR RF CN	
		100	69 (88)	11						11.24: JT 2° PR RF Clay VNR 11.62: BP 2° PR RF Clay VNR 11.72-11.78: JT 90° PR RF CN 11.83-11.85: JT 5 - 60° UN RF CN 11.92: JT 0° PR RF Clay VNR 12.02: JT 2 - 5° PR RF Clay VNR 12.06-12.07: CS 20 mm. 12.16: JT 2 - 5° PR RF Clay VNR 12.25: BP 2° PR RF Clay VNR 12.29: BP 2° PR RF Clay VNR	
				12							
				13						13.00: JT 0° PR RF CN 13.58: JT 0° PR RF CN	
		100	87 (97)	14				FR		13.60-14.40: BPx5 0° PR RF CN average spacing 200 mm. 14.53-14.54: CS 10 mm.	
	80-90% RETURN			15							
				16						15.36: BP 0° PR RF CN 15.53-15.55: JT 30° PR RF Clay VNR 15.84-15.86: BP 30° PR RF CN 16.36: JT 5° PR RF CN 16.58: JT 0° PR RF CN	
		100	90 (91)	17						17.13-17.14: BP 20° PR RF CN 17.15-17.29: JTwl 65° PR RF CN average spacing 20 mm. 17.20-17.22: CS 10 mm. 17.53: JT 2° PR RF CN 17.70: JT 2° PR RF CN 17.71: JT 2° PR RF CN	
				18							
		100	100 (96)	19						18.98-19.02: BP 60° PR RF CN 19.49: JT 0° PR RF CN 19.88: JT 0° PR RF CN	
				20							

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

BOREHOLE: BH7

Project	Proposed Residential Development	East	313618.1 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257466.4 m MGA94 Zone 56	Sheet	4 OF 4
Position	Lot 4	Surface RL	30.60 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	BG Drilling Pty Ltd	Date Completed	20/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged VL	Date: 20/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	80-90% RETURN	100	100 (95)	20			SHALE; bedding dipping 0-5 degrees, with siltstone laminations, dark grey.	FR		20.34-20.65: JT 0 - 10° PR RF CN average spacing 50 mm. 20.88-20.93: JT 80° PR RF CN 21.19: JT 5° PR RF CN	
				21							
					21.48 9.12		Hole Terminated at 21.48 m Backfilled with drilling spoil.				
				22							
				23							
				24							
				25							
				26							
				27							
				28							
				29							
				30							

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

CORE PHOTOGRAPH OF BOREHOLE: BH7

Project:	Proposed Residential Development	East:	313618.1 m	Depth Range:	8.60 m to 21.48 m
Location:	Darcy & Hawkesbury Road, Westmead	North	6257466.4 m MGA94 Zone 56	Contractor:	BG Drilling Pty Ltd
Position:	Lot 4	Surface RL:		Drill Rig:	Hanjin DB8
Job No.:	E23033	Inclination:	-90°	LOGGED: VL	DATE: 20/6/16
Client:	DeiCorp Constructions (NSW) Pty Ltd	Box:	1-3 of 3	CHECKED: SK	DATE: 1/7/16
		Hole Depth:	21.48 m		

BOREHOLE: BH8M

Project	Proposed Residential Development	East	313606.6 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257536.4 m MGA94 Zone 56	Sheet	1 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	21/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 21/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

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
ADT	M	GWNE during and at completion of auger drilling	0	30.30				-	FILL; Silty CLAY; brown-grey-red, with fine to coarse, sub-angular to sub-rounded shale and ironstone gravel, with trace of brick fragments.			FILL
					SPT 0.50-0.95 m 3,6,8 N=14 BH8M_0.5-0.95							
			1		SPT 1.50-1.95 m 1,4,4 N=8 BH8M_1.5-1.95					D	-	
			2									
			3		SPT 3.00-3.45 m 1,1,3 N=4 BH8M_3.0-3.4 BH8M_3.4-3.45							
				3.40 26.90				-	SHALE; grey-orange-brown, extremely to distinctly weathered, extremely low to very low strength.			WEATHERED ROCK
			4									
		25/06/16		4.50 25.80	SPT 4.50-4.68 m 10/100mm HB N=SPT BH8M_4.5-4.8				From 4.5 m, grey-red.			
	F		5							-	-	
		22/06/16			BH8M_5.5-6.0 D 5.50-6.00 m							
			6									
				6.50 23.80	BH8M_6.5-7.0 D 6.50-7.00 m				From 6.5 m, distinctly weathered, very low to low strength.			ROCK
	H			7.00								
			7						Continued as Cored Borehole			
			8									
			9									
			10									

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

BOREHOLE: BH8M

Project	Proposed Residential Development	East	313606.6 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257536.4 m MGA94 Zone 56	Sheet	2 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	21/6/16
Client	DeiCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 21/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
				0							
				1							
				2							
				3							
				4							
				5							
				6							
				7	7.00		Continuation from non-cored borehole				
NMLC	90-100% RETURN	87	38 (46)	8	23.30 7.55 22.75 7.76 22.54		SHALE; bedding dipping 0-5 degrees, dark grey-brown. CORE LOSS; 210 mm thick. SHALE; bedding dipping 0-5 degrees, dark grey-brown.	DW DW		7.02: JT 5° UN S CN 7.06: JT 5° UN S CN 7.29-7.33: JT 70° PR S CN 7.44: BP 5° PR S CN 7.46-7.55: CS 70 mm. 7.79: BP 0° PR S CN 7.81: JT 0 - 30° CU S CN 7.91-7.93: DS 20 mm. 8.01: BP 0° PR S CN	
		100	99 (97)	9	8.27 22.03		SHALE; bedding dipping 0-10 degrees, dark grey.			8.07-8.09: DS 10 mm. 8.15-8.18: JT 90° PR S CN 8.21: JT 5° CU S CN 8.24-8.29: DS 20 mm. 8.53: BP 5° PR S CN 8.43: BP 5° PR S CN 8.86: BP 0° PR S CN 8.88: BP 0° PR S CN 9.25: JT 40° PR S CN 9.58: BP 0° PR S CN 9.80: BP 0° PR S CN	
				10							

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

BOREHOLE: BH8M

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Project	Proposed Residential Development	East	313606.6 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257536.4 m MGA94 Zone 56	Sheet	3 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	21/6/16
Client	DeiCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 21/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	90-100% RETURN	100	99 (97)	10			SHALE; bedding dipping 0-10 degrees, dark grey.			10.28: BP 0° PR S CN 10.54: BP 0° PR S CN 10.84: BP 0° PR S CN 11.16: BP 0° PR S CN 11.27: JT 5° CU S CN 11.66: BP 0° PR S CN	
		100	95 (95)	12				FR		11.98: BP 0° PR S CN 12.55-12.58: DS 30 mm. 12.61: JT 5° UN S CN 12.83: BP 0° PR S CN 13.19: BP 0° PR S CN 13.45: BP 0° PR S CN 13.98: JT 5° UN S CN 13.99: BP 0° PR S CN 14.32: BP 0° PR S CN 14.74: BP 0° PR S CN	
		100	83 (84)	16						15.02: JT 10° UN S CN 16.49: JT 10° PR S CN 16.60-16.65: JT 60 - 70° CU S CN 16.63: JT 30° CU S CN 16.76: BP 10° PR S CN 16.84: BP 10° PR S CN 16.92: BP 10° PR S CN 16.93-16.98: JTx2 85° UN S CN 17.06: JT 5° PR S CN 17.07: BP 10° PR S CN 17.12-17.15: CS 30 mm. 17.19: JT 5° CU S CN 17.26: JT 30° PR S CN 17.46: BP 0° PR S CN 17.99: BP 0° PR S CN 18.13: BP 0° PR S CN 18.46: BP 0° PR S CN 18.78: BP 0° PR S CN	
		100	99 (99)	19						19.43: BP 0° PR S CN 19.86: BP 0° PR S CN	
				20							

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

BOREHOLE: BH8M

Project	Proposed Residential Development	East	313606.6 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257536.4 m MGA94 Zone 56	Sheet	4 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	20/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	21/6/16
Client	DeiCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 21/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	80-100% RETURN	100	99 (99)	20			SHALE; bedding dipping 0-10 degrees, dark grey.	FR		20.17: BP 0° PR S CN 20.44: JT 5° UN S CN 20.48: JT 5° UN S CN 20.90: BP 0° PR S CN 21.09: BP 5° PR S CN 21.26: BP 0° PR S CN 21.34: JT 5° UN S CN 21.46: BP 5° PR S CN 21.71: BP 0° PR S CN 21.77: BP 0° PR S CN 21.95: JT 10° CU S CN 22.03: BP 5° PR S CN 22.06: JT 5° UN S CN 22.18: BP 0° PR S CN 22.22: BP 0° PR S CN 22.29: BP 0° PR S CN 22.32: JT 5° CU S CN 22.51: JT 5° UN S CN 22.54: JT 5° UN S CN 22.62: BP 0° PR S CN 22.68: BP 0° PR S CN 22.77: BP 0° PR S CN 22.98: BP 0° PR S CN 23.09-23.10: DS 10 mm. 23.28: JT 15° PR S CN	
		100	76 (92)	21 22 23				DW			
					23.63 6.67		Hole Terminated at 23.63 m Converted to monitoring well.				
				24 25 26 27 28 29 30							

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

CORE PHOTOGRAPH OF BOREHOLE: BH8M

Project:	Proposed Residential Development	East:	313606.6 m	Depth Range:	7.00 m to 16.00 m
Location:	Darcy & Hawkesbury Road, Westmead	North	6257536.4 m MGA94 Zone 56	Contractor:	Rockwell Drilling Pty Ltd
Position:	Lot 4	Surface RL:	30.30 m AHD	Drill Rig:	Hanjin DB8
Job No.:	E23033	Inclination:	-90°	LOGGED: JZ	DATE: 21/6/16
Client:	DeiCorp Constructions (NSW) Pty Ltd	Box:	1-2 of 4	CHECKED: SK	DATE: 1/7/16
		Hole Depth:	23.83 m		

CORE PHOTOGRAPH OF BOREHOLE: BH8M

Project:	Proposed Residential Development	East:	313606.6 m	Depth Range:	16.00 m to 23.63 m
Location:	Darcy & Hawkesbury Road, Westmead	North	6257536.4 m MGA94 Zone 56	Contractor:	Rockwell Drilling Pty Ltd
Position:	Lot 4	Surface RL:	30.30 m AHD	Drill Rig:	Hanjin DB8
Job No.:	E23033	Inclination:	-90°	LOGGED: JZ	DATE: 21/6/16
Client:	DeiCorp Constructions (NSW) Pty Ltd	Box:	3-4 of 4	CHECKED: SK	DATE: 1/7/16
		Hole Depth:	23.63 m		

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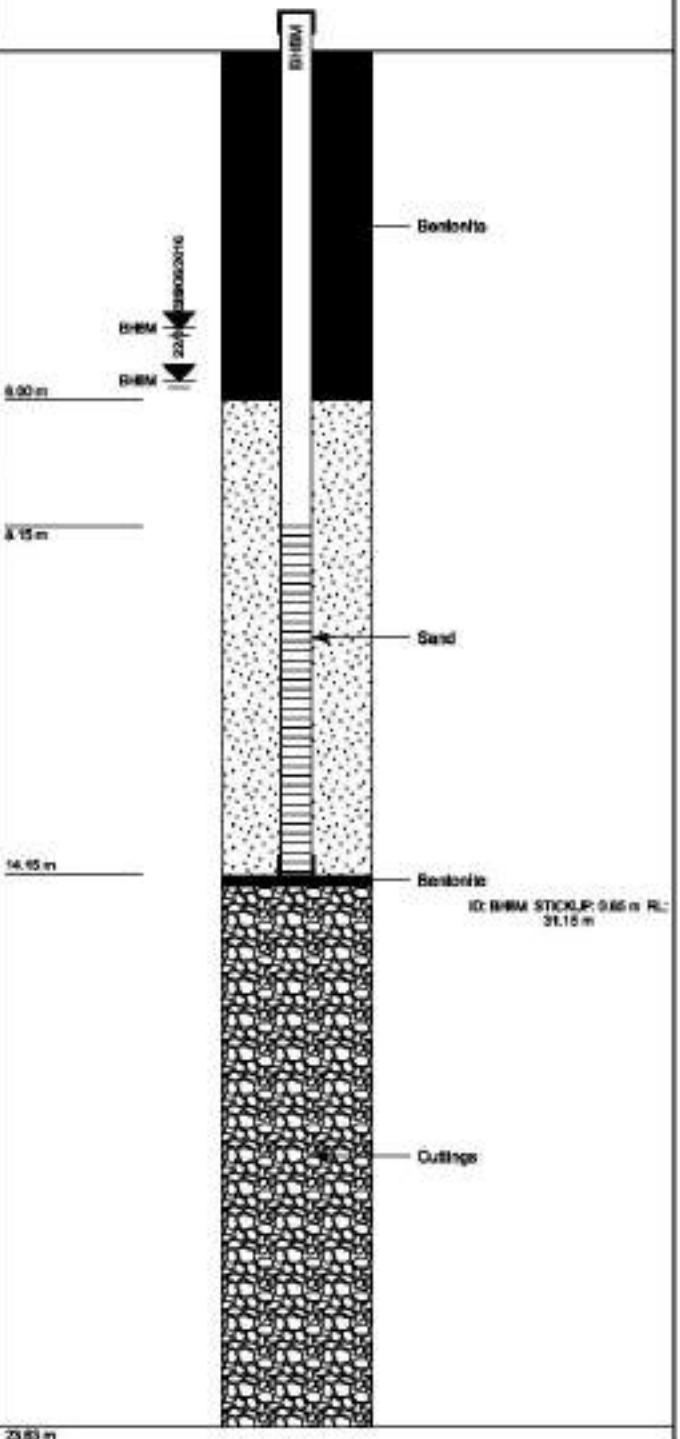
Hole ID: **BH8M**

CLIENT	: DelCorp Constructions (NSW) Pty Ltd	POSITION	: Lot 4	SHEET	: 1 OF 1
CONTRACTOR	: Rockwell Drilling Pty Ltd	EASTING	: 313606.6 m	LOGGED BY	: JZ
PROJECT	: Proposed Residential Development	NORTHING	: 6257536.4 m	DRILL DATE	: 20/06/2016 - 21/06/2016
LOCATION	: Darcy & Hawkesbury Road, Westmead	COORD. SYS.	: MGA94 Zone 56		
PROJECT No.	: E23033	GROUND RL	: 30.30 m AHD		

Method	Drilling Water	Depth (m)	Elevation (m AHD)	Graphic Log	Soil / Rock Description
		0	30		
ADVT	GWNE during and at completion of auger drilling	5	25		FILL: Silty CLAY; brown-grey-red, with fine to coarse, sub-angular to sub-rounded shale and ironstone gravel, with trace of brick fragments.
					SHALE; grey-orange-brown, extremely to distinctly weathered, extremely low to very low strength.
					From 4.5 m, grey-red.
NMLC	90-100% RETURN	10	20		From 6.5 m, distinctly weathered, very low to low strength.
					SHALE; bedding dipping 0-5 degrees, dark grey-brown.
					CORE LOSS; 210 mm thick.
					SHALE; bedding dipping 0-5 degrees, dark grey-brown.
		15	15		SHALE; bedding dipping 0-10 degrees, dark grey.
		20	10		
					Hole Terminated at 23.63 m Converted to monitoring well.

PIEZOMETER CONSTRUCTION DETAILS

ID	Type	Stick Up & RL	Tip Depth & RL	Installation Date	Static Water Level
BH8M	Standpipe	0.65 m 30.45 m	14.15 m 16.15 m		6.50m



CHECKED BY : SK
CHECKED DATE : 01/07/2016

REMARK
Converted to monitoring well.

Form Number: D0N03 RL

BOREHOLE: BH9

Project	Proposed Residential Development	East	313631.9 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257472.4 m MGA94 Zone 56	Sheet	1 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	22/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	23/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 23/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

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	R	GWANE during and at completion of auger drilling	0	30.30				-	FILL: Silty CLAY; low to medium plasticity, dark brown-dark grey-red, with fine to medium, sub-angular to angular gravel, with trace of fine to medium sandstone gravel.			FILL
					SPT 0.50-0.95 m 4,6,9 N=15 BH9_0.5-0.95							
			1		SPT 1.50-1.95 m 6,10,18 N=28 BH9_1.5-1.95					M [<PL]	-	
			2									
			3	3.00 27.30	SPT 3.00-3.15 m 18/150mm HB N=SPT BH9_3.0-3.15			-	SHALE: grey-red-brown, extremely to distinctly weathered, extremely low to very low strength.			WEATHERED ROCK
	F				BH9_3.5-4.0 D 3.50-4.00 m							
			4									
			5							-	-	
			6	5.50 24.80	BH9_5.5-6.0 D 5.50-6.00 m				From 5.5 m, distinctly weathered, very low to low strength.			ROCK
	H				BH9_6.5-7.0 D 6.50-7.00 m							
			7	7.00					Continued as Cored Borehole			
			8									
			9									
			10									

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

BOREHOLE: BH9

Project	Proposed Residential Development	East	313631.9 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257472.4 m MGA94 Zone 56	Sheet	2 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	22/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	23/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 23/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	90-100% RETURN	89	34 (48)	0							
				1							
				2							
				3							
				4							
				5							
				6							
				7	7.00		Continuation from non-cored borehole				
					23.30		SHALE; bedding dipping 0-5 degrees, dark brown-dark grey.	DW		7.00-7.88: BPx12 0° PR S CN 7.07: JT5 PR S CN 7.40-7.49: DS 90 mm. 7.53-7.57: DS 40 mm. 7.70-7.73: DS Clay 30 mm.	
				8	7.88 22.42		CORE LOSS; 310 mm thick.				
					8.19 22.11		SHALE; bedding dipping 0-5 degrees, dark brown-dark grey.	DW		8.19-8.86: BPx3 0° PR S CN 8.19-8.25: CS 60 mm. 8.35-8.41: DS 50 mm. 8.43-8.46: DS 30 mm. 8.61: JT 5° CU S CN 8.75-8.78: DS 30 mm.	
				9	8.86 21.45		SHALE; bedding dipping 0-5 degrees, dark grey.	FR		9.16: BP 5° PR S CN 9.69: BP 5° PR S CN	
		100	97 (95)	10							

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

BOREHOLE: BH9

Project	Proposed Residential Development	East	313631.9 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257472.4 m MGA94 Zone 56	Sheet	3 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	22/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	23/6/16
Client	DelCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 23/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	90-100% RETURN	100	97 (96)	10			SHALE; bedding dipping 0-5 degrees, dark grey.	FR		10.17-10.23: CS 60 mm. 10.38-10.41: CS 30 mm. 10.63: BP 0° PR S CN 10.79: BP 5° PR S CN 11.08: BP 0° PR S CN 11.20: BP 0° PR S CN 12.00: BP 0° PR S CN 12.72: JT 5° CU S CN 12.80: JT 10 - 30° ST S CN 13.11: BP 0° PR S CN 13.29: BP 0° PR S CN 13.67: BP 0° PR S CN 13.96: BP 0° PR S CN 15.26: BP 0° PR S CN 15.42: BP 0° PR S CN 16.03: BP 0° PR S CN 16.23: BP 0° PR S CN 16.30: JT 45° CU S CN 16.49: BP 0° PR S CN 16.92-16.98: JT 45° CU S CN 17.30: BP 0° PR S CN 17.96: BP 0° PR S CN 18.37-18.42: JT 45° CU S CN 18.62: BP 0° PR S CN	
		100	100 (97)	11							
				12							
				13							
				14							
				15							
		100	99 (95)	16							
				17							
				18							
	60-70% RETURN	100	49 (55)	19	19.00 11.30		From 19.0-21.0 m, highly fractured, with frequent joints.			19.10: JT 5 - 10° ST S CN 19.26: JT 15° CU S CN 19.33: BP 0° PR S CN 19.40: JT 5 - 10° UN S CN 19.44: JT 10 - 30° CU S CN 19.52-19.62: JT 60° PR S CN 19.78: BP 0° PR S CN	
				20							

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

BOREHOLE: BH9

Project	Proposed Residential Development	East	313631.9 m		
Location	Darcy & Hawkesbury Road, Westmead	North	6257472.4 m MGA94 Zone 56	Sheet	4 OF 4
Position	Lot 4	Surface RL	30.30 m AHD	Date Started	22/6/16
Job No.	E23033	Contractor	Rockwell Drilling Pty Ltd	Date Completed	23/6/16
Client	DeiCorp Constructions (NSW) Pty Ltd	Drill Rig	Hanjin D88	Logged JZ	Date: 23/6/16
		Inclination	-90°	Checked SK	Date: 1/7/16

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR	RQD (%CR)	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa	DEFECT DESCRIPTION & Additional Observations	AVERAGE DEFECT SPACING (mm)
NMLC	80-95% RETURN	100	49 (85)	20			SHALE; bedding dipping 0-5 degrees, dark grey.	FR		19.82-19.86: JT 45° CU S CN 19.92: BP 0° PR S CN 19.93: BP 0° PR S CN 19.96: BP 0° PR S CN 20.01: JT 70° UN S CN 20.04: JT 45° ST S CN 20.16: JT 5° ST S CN 20.23: JT 10° CU S CN 20.38: JT 10° ST S CN 20.47: CS 120 mm. 20.69: JT 10° CU S CN 20.72-20.73: DS 10 mm. 20.77: JT 10° UN S CN 20.96: JT 5° CU S CN 21.20: JT 5° CU S CN 21.25: JT 10° UN S CN 21.36: JT 10° UN S CN 21.67: BP 0° PR S CN 22.09: BP 0° PR S CN 22.49: BP 0° PR S CN 23.36: JT 5° PR S CN 23.66: BP 0° PR S CN 23.66-23.72: JT 45° PR S CN	
		100	96 (93)	21 22 23							
				23.72	6.58		Hole Terminated at 23.72 m Backfilled with drilling spoil.				
				24 25 26 27 28 29 30							

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

CORE PHOTOGRAPH OF BOREHOLE: BH9

Project:	Proposed Residential Development	East:	313831.9 m	Depth Range:	7.00 m to 16.00 m
Location:	Darcy & Hawkesbury Road, Westmead	North	6257472.4 m MGA94 Zone 56	Contractor:	Rockwell Drilling Pty Ltd
Position:	Lot 4	Surface RL:	30.30 m AHD	Drill Rig:	Hanjin DB8
Job No. :	E23033	Inclination:	-90°	LOGGED: JZ	DATE: 23/6/16
Client:	DeiCorp Constructions (NSW) Pty Ltd	Box:	1-2 of 4	CHECKED: SK	DATE: 1/7/16
		Hole Depth:	23.72 m		

CORE PHOTOGRAPH OF BOREHOLE: BH9

Project:	Proposed Residential Development	East:	313831.9 m	Depth Range:	16.00 m to 23.72 m
Location:	Darcy & Hawkesbury Road, Westmead	North	6257472.4 m MGA94 Zone 56	Contractor:	Rockwell Drilling Pty Ltd
Position:	Lot 4	Surface RL:	30.30 m AHD	Drill Rig:	Hanjin DB8
Job No. :	E23033	Inclination:	-90°	LOGGED: JZ	DATE: 23/6/16
Client:	DeiCorp Constructions (NSW) Pty Ltd	Box:	3-4 of 4	CHECKED: SK	DATE: 1/7/16
		Hole Depth:	23.72 m		

APPENDIX B

LABORATORY CERTIFICATES

MOISTURE CONTENT TEST REPORT

Client:	Environmental Investigations	**Job No:**	S16252
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Report No:**	S13503-MC
Project:	UWS Campus Westmead (E23033)		

Test Procedure:

- [x] 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:**	Various
Preparation:	Prepared in accordance with the test method		

Sample No.	Source	Sample Description	Moisture Content %
S13503	BH1 0.65-0.95m	silty CLAY	28.7
S13504	BH1 3.5-3.8m	GRAVEL	9.6
S13505	BH2M 2.0-2.5m	GRAVEL	5.2
S13506	BH2M 3.5-4.0m	GRAVEL	7.9
S13507	BH3 3.5-4.0m	GRAVEL	2.7
S13508	BH4 0.7-0.95m	silty CLAY	19.6
S13509	BH4 4.0-4.4m	silty sandy GRAVEL	8.0
S13510	BH5 3.5-4.0m	GRAVEL	4.2
S13511	BH6 3.5-4.0m	GRAVEL	9.3
S13512	BH6 5.5-6.0m	GRAVEL	7.7
S13513	BH7 7.5m	GRAVEL	4.1
S13514	BH8M 5.5-6.0m	GRAVEL	13.3
S13515	BH8M 6.5-7.0m	silty sandy GRAVEL	7.9
S13516	BH9 3.5-4.0m	clayey GRAVEL	12.7
S13517	BH9 5.5-6.0m	GRAVEL	9.1
S13518	BH9 6.5-7.0m	GRAVEL	5.9

Notes:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

1/07/2016

Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
Unit 8/10
Bradford Street
Alexandria NSW 2015

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13519-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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
S13519	BH5 5.55m	Shale	Diametral	-	48.0	0.04	0.02	0.02	
			Axial	48.0	32.0	0.21	0.11	0.10	
S13520	BH5 5.85m	Shale	Diametral	-	48.0	0.03	0.01	0.01	
			Axial	48.0	19.0	0.30	0.25	0.22	
S13521	BH5 6.35m	Shale	Diametral	-	51.0	0.02	0.01	0.01	
			Axial	51.0	15.0	0.19	0.20	0.16	
S13522	BH5 6.75m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	20.0	0.57	0.45	0.38	
S13523	BH5 7.15m	Shale	Diametral	-	50.0	0.02	0.01	0.01	
			Axial	50.0	20.0	0.29	0.23	0.20	
S13524	BH5 7.75m	Shale	Diametral	-	50.0	0.03	0.01	0.01	
			Axial	50.0	26.0	0.49	0.30	0.27	
S13525	BH5 8.25m	Shale	Diametral	-	50.0	0.10	0.04	0.04	
			Axial	50.0	35.0	0.92	0.41	0.40	
S13526	BH5 8.55m	Shale	Diametral	-	50.0	0.14	0.06	0.06	
			Axial	50.0	20.0	0.61	0.48	0.41	
S13527	BH5 9.30m	Shale	Diametral	-	50.0	0.06	0.02	0.02	
			Axial	50.0	28.0	0.47	0.26	0.24	
S13528	BH5 9.70m	Shale	Diametral	-	50.0	0.10	0.04	0.04	
			Axial	50.0	25.0	0.35	0.22	0.20	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

MACQUARIE GEOTECH

Macquarie Geotech
Unit 8/10
Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13529-PL
Job No:	S18252	**Date Tested:**	29/6/16

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13529	BH5 10.30m	Shale	Diametral	-	50.0	0.20	0.08	0.08	
			Axial	50.0	23.0	0.46	0.31	0.28	
S13530	BH5 10.75m	Shale	Diametral	-	44.0	3.00	1.55	1.46	
			Axial	44.0	20.0	0.84	0.75	0.63	
S13531	BH5 11.25m	Shale	Diametral	-	50.0	0.03	0.01	0.01	
			Axial	50.0	20.0	0.73	0.57	0.49	
S13532	BH5 11.80m	Shale	Diametral	-	50.0	0.08	0.03	0.03	
			Axial	50.0	29.0	0.65	0.35	0.33	
S13533	BH5 12.10m	Shale	Diametral	-	50.0	0.11	0.04	0.04	
			Axial	50.0	20.0	0.52	0.41	0.35	
S13534	BH5 12.65m	Shale	Diametral	-	50.0	0.12	0.05	0.05	
			Axial	50.0	20.0	0.73	0.57	0.49	
S13535	BH5 13.25m	Shale	Diametral	-	50.0	0.09	0.04	0.04	
			Axial	50.0	25.0	0.79	0.50	0.45	
S13536	BH5 13.80m	Shale	Diametral	-	51.0	0.12	0.05	0.05	
			Axial	51.0	28.0	0.45	0.25	0.23	
S13537	BH5 14.30m	Shale	Diametral	-	50.0	0.03	0.01	0.01	
			Axial	50.0	29.0	1.01	0.55	0.51	
S13538	BH5 14.70m	Shale	Diametral	-	50.0	0.10	0.04	0.04	
			Axial	50.0	35.0	1.19	0.53	0.52	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

MACQUARIE GEOTECH

Macquarie Geotech
Unit 8/10
Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13535-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13539	BH5 15.30m	Shale	Diametral	-	50.0	0.22	0.09	0.09	
			Axial	50.0	21.0	1.24	0.93	0.81	
S13540	BH5 15.80m	Shale	Diametral	-	50.0	0.08	0.03	0.03	
			Axial	50.0	33.0	1.35	0.64	0.62	
S13541	BH5 16.30m	Shale	Diametral	-	50.0	0.14	0.06	0.06	
			Axial	50.0	26.0	2.95	1.78	1.62	
S13542	BH5 16.75m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	20.0	0.93	0.73	0.63	
S13543	BH5 17.25m	Shale	Diametral	-	50.0	0.48	0.19	0.19	
			Axial	50.0	31.0	1.07	0.54	0.51	
S13544	BH5 17.75m	Shale	Diametral	-	50.0	1.26	0.51	0.51	
			Axial	50.0	30.0	3.77	1.97	1.86	
S13545	BH5 18.30m	Shale	Diametral	-	51.0	0.40	0.15	0.16	
			Axial	51.0	28.0	6.21	3.42	3.18	
S13546	BH5 18.80m	Shale	Diametral	-	50.0	1.37	0.55	0.55	
			Axial	50.0	34.0	2.87	1.33	1.28	
S13547	BH5 19.30m	Shale	Diametral	-	50.0	1.02	0.41	0.41	
			Axial	50.0	24.0	1.14	0.75	0.67	
S13548	BH5 19.75m	Shale	Diametral	-	50.0	0.74	0.30	0.30	
			Axial	50.0	30.0	0.84	0.44	0.41	

Comments:

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

NATA Accredited Laboratory Number: 14874

MACQUARIE GEOTECH

Macquarie Geotech
Unit 8/10
Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13545-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13549	BH5 20.25m	Shale	Diametral	-	50.0	0.37	0.15	0.15	
			Axial	50.0	25.0	2.77	1.74	1.57	
S13550	BH5 20.70m	Shale	Diametral	-	50.0	0.75	0.30	0.30	
			Axial	50.0	34.0	0.96	0.44	0.43	
S13551	BH5 21.25m	Shale	Diametral	-	50.0	1.00	0.40	0.40	
			Axial	50.0	37.0	2.06	0.87	0.86	
S13552	BH5 21.75m	Shale	Diametral	-	50.0	0.80	0.32	0.32	
			Axial	50.0	36.0	1.91	0.83	0.82	
S13553	BH5 22.25m	Shale	Diametral	-	50.0	0.05	0.02	0.02	
			Axial	50.0	30.0	0.60	0.31	0.30	
S13554	BH5 22.80m	Shale	Diametral	-	50.0	0.17	0.07	0.07	
			Axial	50.0	30.0	0.44	0.23	0.22	
S13555	BH5 23.20m	Shale	Diametral	-	51.0	4.75	1.83	1.84	
			Axial	51.0	35.0	1.11	0.49	0.48	
S13556	BH5 23.75m	Shale	Diametral	-	50.0	0.64	0.26	0.26	
			Axial	50.0	30.0	0.98	0.51	0.48	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

MACQUARIE GEOTECH

Macquarie Geotech
Unit 8/10
Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13551-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13557	BH6 7.30m	Shale	Diametral	-	50.0	0.02	0.01	0.01	
			Axial	50.0	32.0	0.49	0.24	0.23	
S13558	BH6 7.95m	Shale	Diametral	-	50.0	0.14	0.06	0.06	
			Axial	50.0	15.0	0.68	0.71	0.57	
S13559	BH6 8.25m	Shale	Diametral	-	51.0	0.05	0.02	0.02	
			Axial	51.0	16.0	0.42	0.40	0.33	
S13560	BH6 8.70m	Shale	Diametral	-	50.0	0.12	0.05	0.05	
			Axial	50.0	18.0	0.79	0.69	0.58	
S13561	BH6 9.10m	Shale	Diametral	-	50.0	0.03	0.01	0.01	
			Axial	50.0	18.0	0.56	0.49	0.41	
S13562	BH6 9.70m	Shale	Diametral	-	51.0	0.14	0.05	0.05	
			Axial	51.0	27.0	4.50	2.57	2.37	
S13563	BH6 10.30m	Shale	Diametral	-	50.0	0.06	0.02	0.02	
			Axial	50.0	23.0	0.50	0.34	0.30	
S13564	BH6 10.65m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	15.0	0.53	0.56	0.45	
S13565	BH6 11.25m	Shale	Diametral	-	50.0	0.03	0.01	0.01	
			Axial	50.0	23.0	0.72	0.49	0.44	
S13566	BH6 11.75m	Shale	Diametral	-	50.0	0.12	0.05	0.05	
			Axial	50.0	23.0	0.54	0.37	0.33	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

MACQUARIE GEOTECH

Macquarie Geotech
Unit 8/10
Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13557-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13567	BH6 12.20m	Shale	Diametral	-	51.0	0.03	0.01	0.01	
			Axial	51.0	20.0	0.76	0.59	0.51	
S13568	BH6 12.70m	Shale	Diametral	-	50.0	0.05	0.02	0.02	
			Axial	50.0	25.0	0.75	0.47	0.43	
S13569	BH6 13.25m	Shale	Diametral	-	50.0	0.17	0.07	0.07	
			Axial	50.0	31.0	1.20	0.61	0.58	
S13570	BH6 13.75m	Shale	Diametral	-	50.0	0.07	0.03	0.03	
			Axial	50.0	22.0	0.71	0.51	0.44	
S13571	BH6 14.20m	Shale	Diametral	-	51.0	0.02	0.01	0.01	
			Axial	51.0	23.0	0.44	0.29	0.26	
S13572	BH6 14.75m	Shale	Diametral	-	51.0	0.14	0.05	0.05	
			Axial	51.0	31.0	3.11	1.54	1.47	
S13573	BH6 15.15m	Shale	Diametral	-	50.0	0.61	0.24	0.24	
			Axial	50.0	27.0	1.18	0.69	0.63	
S13574	BH6 15.60m	Shale	Diametral	-	50.0	0.18	0.07	0.07	
			Axial	50.0	37.0	1.29	0.55	0.54	
S13575	BH6 16.25m	Shale	Diametral	-	51.0	0.20	0.08	0.08	
			Axial	51.0	23.0	5.50	3.68	3.28	
S13576	BH6 16.70m	Shale	Diametral	-	50.0	1.44	0.58	0.58	
			Axial	50.0	29.0	5.38	2.91	2.72	

Comments:

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13567-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13577	BH6 17.25m	Shale	Diametral	-	50.0	0.75	0.30	0.30	
			Axial	50.0	25.0	2.78	1.75	1.58	
S13578	BH6 17.70m	Shale	Diametral	-	50.0	0.84	0.34	0.34	
			Axial	50.0	28.0	1.10	0.62	0.57	
S13579	BH6 18.25m	Shale	Diametral	-	50.0	0.69	0.28	0.28	
			Axial	50.0	27.0	0.89	0.52	0.48	
S13580	BH6 18.75m	Shale	Diametral	-	49.0	0.12	0.05	0.05	
			Axial	49.0	30.0	2.31	1.23	1.16	
S13581	BH6 19.25m	Shale	Diametral	-	50.0	0.58	0.23	0.23	
			Axial	50.0	31.0	1.46	0.74	0.70	
S13582	BH6 19.75m	Shale	Diametral	-	50.0	0.88	0.35	0.35	
			Axial	50.0	20.0	2.05	1.61	1.38	
S13583	BH6 20.20m	Shale	Diametral	-	50.0	0.05	0.02	0.02	
			Axial	50.0	31.0	1.23	0.62	0.59	
S13584	BH6 20.75m	Shale	Diametral	-	50.0	0.02	0.01	0.01	
			Axial	50.0	30.0	1.06	0.56	0.52	

Comments:

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13573-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13585	BH7 8.80m	Shale	Diametral	-	50.0	0.10	0.04	0.04	
			Axial	50.0	21.0	0.86	0.64	0.56	
S13586	BH7 9.15m	Shale	Diametral	-	50.0	0.06	0.02	0.02	
			Axial	50.0	23.0	0.55	0.38	0.33	
S13587	BH7 9.75m	Shale	Diametral	-	51.0	0.08	0.03	0.03	
			Axial	51.0	25.0	0.81	0.50	0.45	
S13588	BH7 10.25m	Shale	Diametral	-	50.0	0.02	0.01	0.01	
			Axial	50.0	20.0	0.48	0.38	0.32	
S13589	BH7 10.75m	Shale	Diametral	-	50.0	0.11	0.04	0.04	
			Axial	50.0	32.0	0.45	0.22	0.21	
S13590	BH7 11.20m	Shale	Diametral	-	50.0	0.20	0.08	0.08	
			Axial	50.0	17.0	0.28	0.26	0.21	
S13591	BH7 11.60m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	18.0	0.58	0.51	0.42	
S13592	BH7 12.20m	Shale	Diametral	-	49.0	1.92	0.80	0.79	
			Axial	49.0	29.0	1.07	0.59	0.55	
S13593	BH7 12.80m	Shale	Diametral	-	51.0	0.06	0.02	0.02	
			Axial	51.0	20.0	0.80	0.62	0.53	
S13594	BH7 13.25m	Shale	Diametral	-	50.0	0.11	0.04	0.04	
			Axial	50.0	28.0	0.53	0.30	0.28	

Comments:

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Date:

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13583-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13595	BH7 13.75m	Shale	Diametral	-	50.0	0.17	0.07	0.07	
			Axial	50.0	18.0	0.42	0.37	0.31	
S13596	BH7 14.15m	Shale	Diametral	-	50.0	0.14	0.06	0.06	
			Axial	50.0	26.0	0.74	0.45	0.41	
S13597	BH7 14.75m	Shale	Diametral	-	51.0	0.11	0.04	0.04	
			Axial	51.0	20.0	1.16	0.89	0.77	
S13598	BH7 15.25m	Shale	Diametral	-	50.0	0.10	0.04	0.04	
			Axial	50.0	20.0	0.82	0.64	0.55	
S13599	BH7 15.70m	Shale	Diametral	-	50.0	0.02	0.01	0.01	
			Axial	50.0	31.0	0.86	0.44	0.41	
S13600	BH7 16.25m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	27.0	0.74	0.43	0.40	
S13601	BH7 16.75m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	25.0	0.81	0.51	0.46	
S13602	BH7 17.35m	Shale	Diametral	-	50.0	1.12	0.45	0.45	
			Axial	50.0	26.0	2.52	1.52	1.39	
S13603	BH7 17.80m	Shale	Diametral	-	50.0	0.31	0.12	0.12	
			Axial	50.0	32.0	3.30	1.62	1.55	
S13604	BH7 18.40m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	28.0	2.38	1.34	1.24	

Comments:

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Date:

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13588-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13605	BH7 18.85m	Shale	Diametral	-	50.0	0.82	0.33	0.33	
			Axial	50.0	25.0	1.48	0.93	0.84	
S13606	BH7 19.35m	Shale	Diametral	-	50.0	0.94	0.38	0.38	
			Axial	50.0	36.0	1.34	0.58	0.57	
S13607	BH7 19.80m	Shale	Diametral	-	50.0	1.07	0.43	0.43	
			Axial	50.0	42.0	1.51	0.56	0.57	
S13608	BH7 20.30m	Shale	Diametral	-	50.0	0.84	0.34	0.34	
			Axial	50.0	26.0	4.01	2.42	2.21	
S13609	BH7 20.80m	Shale	Diametral	-	50.0	0.87	0.35	0.35	
			Axial	50.0	33.0	1.33	0.63	0.61	
S13610	BH7 21.30m	Shale	Diametral	-	50.0	0.13	0.05	0.05	
			Axial	50.0	38.0	2.77	1.15	1.14	

Comments:

Authorised Signatory:

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29/06/2016

Date:

NATA Accredited Laboratory Number: 14874

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13598-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13610	BH8M 7.45m	Shale	Diametral	-	48.0	0.02	0.01	0.01	
			Axial	48.0	20.0	0.13	0.11	0.09	
S13611	BH8M 7.95m	Shale	Diametral	-	51.0	0.02	0.01	0.01	
			Axial	51.0	20.0	0.13	0.10	0.09	
S13612	BH8M 8.25m	Shale	Diametral	-	47.0	0.01	0.00	0.00	
			Axial	47.0	24.0	0.12	0.08	0.07	
S13613	BH8M 8.80m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	26.0	1.19	0.72	0.66	
S13614	BH8M 9.20m	Shale	Diametral	-	51.0	0.02	0.01	0.01	
			Axial	51.0	25.0	0.70	0.43	0.39	
S13615	BH8M 9.85m	Shale	Diametral	-	51.0	0.03	0.01	0.01	
			Axial	51.0	28.0	0.45	0.25	0.23	
S13616	BH8M 10.20m	Shale	Diametral	-	51.0	0.19	0.07	0.07	
			Axial	51.0	22.0	0.45	0.31	0.28	
S13617	BH8M 10.75m	Shale	Diametral	-	50.0	0.07	0.03	0.03	
			Axial	50.0	22.0	0.68	0.49	0.43	
S13618	BH8M 11.30m	Shale	Diametral	-	50.0	0.05	0.02	0.02	
			Axial	50.0	29.0	0.40	0.22	0.20	
S13619	BH8M 11.80m	Shale	Diametral	-	50.0	0.25	0.10	0.10	
			Axial	50.0	24.0	0.82	0.54	0.48	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

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Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13602-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13620	BH8M 12.25m	Shale	Diametral	-	50.0	0.13	0.05	0.05	
			Axial	50.0	20.0	0.84	0.66	0.57	
S13621	BH8M 12.80m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	35.0	2.91	1.31	1.27	
S13622	BH8M 13.25m	Shale	Diametral	-	51.0	0.31	0.12	0.12	
			Axial	51.0	33.0	1.36	0.63	0.61	
S13623	BH8M 13.75m	Shale	Diametral	-	50.0	0.32	0.13	0.13	
			Axial	50.0	29.0	4.37	2.37	2.21	
S13624	BH8M 14.25m	Shale	Diametral	-	50.0	0.17	0.07	0.07	
			Axial	50.0	25.0	1.23	0.77	0.70	
S13625	BH8M 14.80m	Shale	Diametral	-	50.0	0.52	0.21	0.21	
			Axial	50.0	34.0	3.04	1.40	1.36	
S13626	BH8M 15.20m	Shale	Diametral	-	50.0	0.18	0.07	0.07	
			Axial	50.0	22.0	2.59	1.85	1.62	
S13627	BH8M 15.85m	Shale	Diametral	-	50.0	0.05	0.02	0.02	
			Axial	50.0	35.0	2.63	1.18	1.15	
S13628	BH8M 16.25m	Shale	Diametral	-	50.0	0.37	0.15	0.15	
			Axial	50.0	28.0	2.40	1.35	1.25	
S13629	BH8M 16.80m	Shale	Diametral	-	50.0	0.55	0.22	0.22	
			Axial	50.0	30.0	5.18	2.71	2.55	

Comments:

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29/06/2016

Date:

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13612-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13630	BH8M 17.30m	Shale	Diametral	-	50.0	0.21	0.08	0.08	
			Axial	50.0	36.0	1.49	0.65	0.64	
S13631	BH8M 17.80m	Shale	Diametral	-	50.0	0.45	0.18	0.18	
			Axial	50.0	35.0	0.79	0.35	0.35	
S13632	BH8M 18.20m	Shale	Diametral	-	50.0	0.39	0.16	0.16	
			Axial	50.0	36.0	1.15	0.50	0.49	
S13633	BH8M 18.70m	Shale	Diametral	-	50.0	0.21	0.08	0.08	
			Axial	50.0	36.0	1.35	0.59	0.58	
S13634	BH8M 19.25m	Shale	Diametral	-	51.0	0.14	0.05	0.05	
			Axial	51.0	24.0	1.45	0.93	0.84	
S13635	BH8M 19.80m	Shale	Diametral	-	50.0	0.03	0.01	0.01	
			Axial	50.0	29.0	0.92	0.50	0.47	
S13636	BH8M 20.25m	Shale	Diametral	-	50.0	0.02	0.01	0.01	
			Axial	50.0	26.0	1.30	0.79	0.72	
S13637	BH8M 20.70m	Shale	Diametral	-	50.0	0.04	0.02	0.02	
			Axial	50.0	20.0	1.25	0.98	0.84	
S13638	BH8M 21.15m	Shale	Diametral	-	50.0	0.10	0.04	0.04	
			Axial	50.0	19.0	1.26	1.04	0.88	
S13639	BH8M 21.80m	Shale	Diametral	-	50.0	0.06	0.02	0.02	
			Axial	50.0	29.0	0.62	0.34	0.31	

Comments:

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13622-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13640	BH8M 22.10m	Shale	Diametral	-	51.0	0.07	0.03	0.03	
			Axial	51.0	36.0	1.05	0.45	0.44	
S13641	BH8M 22.75m	Shale	Diametral	-	50.0	0.33	0.13	0.13	
			Axial	50.0	29.0	0.38	0.21	0.19	
S13642	BH8M 23.40m	Shale	Diametral	-	51.0	0.08	0.03	0.03	
			Axial	51.0	27.0	0.40	0.23	0.21	

Comments:

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

NATA Accredited Laboratory Number: 14874

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Unit 8/10
Bradford Street
Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13628-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13645	BH9 7.10m	Shale	Diametral	-	50.0	0.07	0.03	0.03	
			Axial	50.0	20.0	0.20	0.16	0.13	
S13646	BH9 7.95m	Shale	Diametral	-	51.0	0.02	0.01	0.01	
			Axial	51.0	20.0	0.08	0.06	0.05	
S13647	BH9 8.40m	Shale	Diametral	-	49.0	0.02	0.01	0.01	
			Axial	49.0	20.0	0.21	0.17	0.14	
S13648	BH9 8.85m	Shale	Diametral	-	50.0	0.21	0.08	0.08	
			Axial	50.0	22.0	1.00	0.71	0.63	
S13649	BH9 9.25m	Shale	Diametral	-	50.0	0.05	0.02	0.02	
			Axial	50.0	36.0	1.36	0.59	0.58	
S13650	BH9 9.80m	Shale	Diametral	-	50.0	0.43	0.17	0.17	
			Axial	50.0	29.0	1.23	0.67	0.62	
S13651	BH9 10.10m	Shale	Diametral	-	50.0	0.35	0.14	0.14	
			Axial	50.0	33.0	1.10	0.52	0.50	
S13652	BH9 10.75m	Shale	Diametral	-	50.0	1.04	0.42	0.42	
			Axial	50.0	34.0	0.63	0.29	0.28	
S13653	BH9 11.25m	Shale	Diametral	-	50.0	0.29	0.12	0.12	
			Axial	50.0	25.0	0.54	0.34	0.31	
S13654	BH9 11.70m	Shale	Diametral	-	50.0	0.07	0.03	0.03	
			Axial	50.0	25.0	0.95	0.60	0.54	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

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Alexandria NSW

POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13638-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13655	BH9 12.25m	Shale	Diametral	-	50.0	0.42	0.17	0.17	
			Axial	50.0	33.0	1.52	0.72	0.70	
S13656	BH9 12.65m	Shale	Diametral	-	50.0	0.03	0.01	0.01	
			Axial	50.0	23.0	0.84	0.57	0.51	
S13657	BH9 13.25m	Shale	Diametral	-	50.0	1.57	0.63	0.63	
			Axial	50.0	30.0	1.59	0.83	0.78	
S13658	BH9 13.75m	Shale	Diametral	-	50.0	1.04	0.42	0.42	
			Axial	50.0	26.0	5.18	3.13	2.85	
S13659	BH9 14.25m	Shale	Diametral	-	50.0	0.68	0.27	0.27	
			Axial	50.0	33.0	3.86	1.84	1.77	
S13660	BH9 14.75m	Shale	Diametral	-	50.0	0.62	0.25	0.25	
			Axial	50.0	31.0	5.55	2.81	2.67	
S13661	BH9 15.20m	Shale	Diametral	-	50.0	0.32	0.13	0.13	
			Axial	50.0	31.0	3.47	1.76	1.67	
S13662	BH9 15.70m	Shale	Diametral	-	50.0	0.21	0.08	0.08	
			Axial	50.0	33.0	3.09	1.47	1.41	
S13663	BH9 16.20m	Shale	Diametral	-	50.0	0.72	0.29	0.29	
			Axial	50.0	23.0	4.91	3.35	2.97	
S13664	BH9 16.70m	Shale	Diametral	-	50.0	0.02	0.01	0.01	
			Axial	50.0	30.0	1.92	1.01	0.95	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

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29/06/2016

Date:

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13644-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13665	BH9 17.25m	Shale	Diametral	-	50.0	1.63	0.65	0.65	
			Axial	50.0	29.0	2.61	1.41	1.32	
S13666	BH9 17.80m	Shale	Diametral	-	50.0	0.48	0.19	0.19	
			Axial	50.0	33.0	1.25	0.59	0.57	
S13667	BH9 18.25m	Shale	Diametral	-	50.0	0.90	0.36	0.36	
			Axial	50.0	34.0	1.67	0.77	0.75	
S13668	BH9 18.80m	Shale	Diametral	-	50.0	2.15	0.86	0.86	
			Axial	50.0	37.0	3.75	1.59	1.57	
S13669	BH9 19.25m	Shale	Diametral	-	50.0	0.45	0.18	0.18	
			Axial	50.0	30.0	0.93	0.49	0.46	
S13670	BH9 19.75m	Shale	Diametral	-	51.0	0.02	0.01	0.01	
			Axial	51.0	35.0	0.78	0.34	0.34	
S13671	BH9 20.20m	Shale	Diametral	-	50.0	0.10	0.04	0.04	
			Axial	50.0	26.0	1.00	0.60	0.55	
S13672	BH9 20.80m	Shale	Diametral	-	50.0	0.61	0.24	0.24	
			Axial	50.0	38.0	1.67	0.69	0.69	
S13673	BH9 21.15m	Shale	Diametral	-	50.0	0.32	0.13	0.13	
			Axial	50.0	30.0	0.85	0.45	0.42	
S13674	BH9 21.75m	Shale	Diametral	-	50.0	0.90	0.36	0.36	
			Axial	50.0	32.0	1.98	0.97	0.93	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

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29/06/2016

Date:

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POINT LOAD STRENGTH INDEX REPORT

Client:	Environmental Investigations	**Moisture Content Condition:**	As received
Address:	Suite 6.01, 55 Miller Street, Pyrmont, NSW 2009	**Storage History:**	Core boxes
Project:	UWS Campus Westmead (E23033)	**Report No:**	S13645-PL
Job No:	S18252	**Date Tested:**	28/06/2016

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

Sampling: Sampled by Client **Date Sampled:** Various

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 $I_{S(50)}$ (MPa)	Notes
S13675	BH9 22.25m	Shale	Diametral	-	50.0	0.57	0.23	0.23	
			Axial	50.0	33.0	2.54	1.21	1.16	
S13676	BH9 22.75m	Shale	Diametral	-	50.0	0.58	0.23	0.23	
			Axial	50.0	29.0	0.59	0.32	0.30	
S13677	BH9 23.10m	Shale	Diametral	-	50.0	0.93	0.37	0.37	
			Axial	50.0	31.0	0.90	0.46	0.43	
S13678	BH9 23.65m	Shale	Diametral	-	50.0	0.63	0.25	0.25	
			Axial	50.0	26.0	0.54	0.33	0.30	

Comments:

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Chris Lloyd

29/06/2016

Date:

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ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	James Zhao
Client	Environmental Investigations
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Project	E23033 - WSU Daroy and Hawkesbury Rd
Order Number	E23033
Samples	4

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
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SGS Reference	SE154029 R0
Date Received	27/6/2016
Date Reported	1/7/2016

COMMENTS

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

SIGNATORIES

Dong Liang
Metals/Inorganics Team Leader

Huong Crawford
Production Manager

pH in soil (1:5) [AN101] Tested: 29/6/2016

PARAMETER	UOM	LOR	BH3 1.0-1.35 SOIL - 15/6/2016 SE154029.001	BH8 4.5-4.8 SOIL - 20/6/2016 SE154029.002
pH	pH Units	-	6.1	5.3

Conductivity and TDS by Calculation - Soil [AN106] Tested: 29/6/2016

PARAMETER	UOM	LOR	BH3 1.0-1.35 SOIL 15/6/2016 SE154029.001	BH8 4.5-4.8 SOIL 20/6/2016 SE154029.002
Conductivity of Extract (1:5 dry sample basis)	µS/cm	1	110	150

Soluble Anions (1:5) in Soil by Ion Chromatography [AN245] Tested: 29/6/2016

PARAMETER	UOM	LOR	BH3 1.5-1.95 SOIL 15/6/2016 SE154029.001	BH8 4.5-4.8 SOIL 20/6/2016 SE154029.002
Chloride	mg/kg	0.25	72	68
Sulphate	mg/kg	5	160	75

Moisture Content [AN002] Tested: 27/6/2016

PARAMETER	UOM	LOR	BH3 1.0-1.95 SOIL 15/6/2016 SE154029.001	BH8 4.5-4.8 SOIL 20/6/2016 SE154029.002
% Moisture	%w/w	0.5	12	10

pH in water (AN101) Tested: 28/6/2016

PARAMETER	UOM	LOR	BH2M WATER 23/6/2016 SE154029.003
pH**	No unit	-	7.1

Conductivity and TDS by Calculation - Water [AN106] Tested: 28/6/2016

PARAMETER	UOM	LOR	BH2M WATER 23/6/2016 SE154029.003
Conductivity @ 25 C	µS/cm	2	4600

Anions by Ion Chromatography in Water [AN245] Tested: 28/6/2016

PARAMETER	UOM	LOR	BH2M WATER 23/6/2016 SE154029.003
Chloride	mg/L	0.05	1200
Sulphate, SO4	mg/L	1	150

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 eluant 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.

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 Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

APPENDIX C

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 D

IMPORTANT INFORMATION

Important Information

eiaustralia

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 EI Australia ("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

This report is the subject of copyright and shall not be reproduced either totally or in part without the express permission of this Company. 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.