GEOTECHNICAL INVESTIGATION REPORT FOR SSDA6

SYDNEY INTERNATIONAL EXHIBITION AND ENTERTAINMENT PRECINCT - ICC HOTEL

Lend Lease Development Pty Ltd

GEOTLCOV24303AH-AH Rev 1
26 August 2013

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26 August 2013

Lend Lease Development Pty Ltd
The Bond, 30 Hickson Road
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Attention: Michael Antonelli

Dear Sir

RE: **GEOTECHNICAL INVESTIGATION REPORT FOR SSDA6**
SYDNEY INTERNATIONAL EXHIBITION AND ENTERTAINMENT PRECINCT - ICC HOTEL

Coffey is pleased to present this geotechnical investigation carried out for the proposed International Convention Centre Hotel, within the Sydney International Convention, Exhibition and Entertainment Precinct.

If you have any questions regarding our report please contact the undersigned on 9406 1000.

For and on behalf of Coffey Geotechnics Pty Ltd

Mark George

Senior Engineering Geologist

Distribution: Original held by Coffey Geotechnics Pty Ltd
Two hard copies to Lend Lease Development Pty Ltd
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1 INTRODUCTION

This report supports a State Significant Development Application (SSDA) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The Application (referred to as SSDA6) seeks approval for construction of the International Convention Centre (ICC) Hotel component of the Sydney International Convention, Exhibition and Entertainment Precinct (SICEEP) at Darling Harbour.

This SSDA follows SSDA1, which seeks approval for the core convention, exhibition and entertainment facilities of the SICEEP Project; SSDA2, a staged application that sets out a Concept Proposal for a new mixed use neighbourhood at Darling Harbour known as 'The Haymarket'; and a number of detailed proposals (SSDA3, SSDA4, and SSDA5) for use of development plots within The Haymarket. SSDAs 1 and 2 were submitted to the Department of Planning and Infrastructure (DoPI) in March 2013, and the SSDAs 3-5 were submitted in May 2013.

The ICC Hotel forms part of the SICEEP Project, which will deliver Australia's global city with new world class convention, exhibition and entertainment facilities and support the NSW Government's goal to "make NSW number one again".

1.1 Overview of Proposed Development

The proposal relates to a SSDA for the ICC Hotel component of the SICEEP Project. The hotel is located at the northern end of the precinct and comprises a single building with up to 656 keys. The hotel is being developed by Lend Lease and is consistent with Darling Harbour Live's Preferred Precinct Plan.

More specifically, this SSDA seeks approval for the following components of the development:

- Demolition of existing site improvements;
- Associated tree removal and replanting;
- Construction and use of a single hotel tower providing for up to 656 keys and including guest facilities, restaurant and ballroom;
- Public domain improvements including integration with existing / proposed works; and
- Extension, realignment and augmentation of physical infrastructure / utilities as required.

1.2 Background

The NSW Government considers that a precinct-wide renewal and expansion of the existing convention, exhibition and entertainment centre facilities at Darling Harbour is required, and is committed to Sydney reclaiming its position on centre stage for hosting world-class events with the creation of the Sydney International Convention, Exhibition and Entertainment Precinct.

Following an extensive and rigorous Expressions of Interest and Request for Proposals process, a consortium comprising AEG Ogden, Lend Lease, Capella Capital and Spotless was announced by the NSW Government in December 2012 as the preferred proponent to transform Darling Harbour and create SICEEP.

Key features of the Preferred Precinct Plan include:

- Delivering world-class convention, exhibition and entertainment facilities, including:
- Up to 40,000m^2 exhibition space;
- Over 8,000m^2 of meeting rooms space, across 40 rooms;
- Overall convention space capacity for more than 12,000 people;
- A ballroom capable of accommodating 2,000 people; and
- A premium, red-carpet entertainment facility with a capacity of 8,000 persons.
- Providing a hotel complex at the northern end of the precinct, immediately adjacent to the new International Convention Centre.
- A vibrant and authentic new neighbourhood at the southern end of the precinct, called 'The Haymarket', including apartments, student accommodation, community facilities, shops, cafes and restaurants.
- Renewed and upgraded public domain that has been increased by a hectare, including an outdoor event space for up to 27,000 people at an expanded Tumbalong Park.
- Improved pedestrian connections linking to the proposed Goods Line (formerly Ultimo Pedestrian Network) drawing people between Central, Chinatown and Cockle Bay Wharf as well as east-west between Ultimo/Pyrmont and the City.

1.3 Site Description

The SICEEP Site is located within Darling Harbour. Darling Harbour is a 60 hectare waterfront precinct on the south-western edge of the Sydney Central Business District that provides a mix of functions including recreational, tourist, entertainment and business.

With an area of approximately 20 hectares, the SICEEP Site is generally bound by the Light Rail Line to the west, Harbourside shopping centre and Cockle Bay to the north, Darling Quarter, the Chinese Garden and Harbour Street to the east, and Hay Street to the south. The SICEEP Site has been divided into three redevelopment areas – Bayside, Darling Central and The Haymarket.

The ICC Hotel Site (refer to **Figure 1**):

- is located within the northern end of the Bayside precinct;
- is bound by Harbourside Shopping Centre to the north and east, the International Convention Centre to the south and Darling Drive to the west; and
- occupies an area of approximately 3,730m^2.

Figure 1 – Aerial Photograph of the SICEEP Site and Redevelopment Areas

1.4 Planning Approvals Strategy

The SICEEP Project will result in the lodgement of numerous SSDAs for the various components of the redevelopment project. SSDAs have already been lodged for the PPP component of the SICEEP Project (comprising the convention centre, exhibition centre, entertainment facility and ancillary commercial premises and associated public domain upgrades), the Stage 1 Concept Proposal for The Haymarket, and the Stage 2 detailed proposals for three of the development plots within The Haymarket. Future applications will be lodged for the remaining development plots within The Haymarket Site.

This Application relates to a SSDA6 for the ICC Hotel component of the SICEEP Project and is consistent with Darling Harbour Live's Preferred Precinct Plan.

1.5 Report Scope

This report presents the results of geotechnical site investigation carried out by Coffey Geotechnics Pty Ltd (Coffey) for Lend Lease Development Pty Ltd (LLD) within the northern extent of the Sydney International Convention, Exhibition and Entertainment Precinct (SICEEP) site.

This report includes the following:

- Logs of nine geotechnical boreholes and core photographs drilled as part of the current investigation;
- A geotechnical ground model using the current investigation data together with historic site information, such as historical maps, borehole drilling and laboratory testing;
- Design parameters and recommendations for: excavation, retention, shallow foundations, deep foundations and durability assessment;
- Assessment of groundwater conditions;
- Pile testing requirements, both static and dynamic tests;
- Parameters for earthquake impact assessment;
- Assessment of aggressive soil conditions; and
- Trafficability of site conditions during construction.

It is noted that Coffey has previously undertaken an assessment for the ICC Hotel development of the site (Ref. GEOTLCOV24303AH dated 30 July 2013). The current report differs from the previous report in accommodating a revised building size and incorporating comments received from Infrastructure NSW.

1.6 Available Information

Previous geotechnical information across the SICEEP precinct site has been compiled and the results are presented in the Coffey report "*Sydney International Convention, Exhibition and Entertainment Precinct – Geotechnical Investigation Report*" reference GEOTLCOV24303AC-AD, dated 25 May 2012 prepared for Infrastructure NSW, and held by LLD. This report summarises site investigations carried out by Coffey, or information gathered by others for previous projects. Within this earlier report a method of referencing previous data was developed, with projects ranging from R1 to R18. Site investigations undertaken subsequent to the May 2012 report include reference projects R19 and R20 undertaken by Coffey for LLD. Selected data from these previous investigations has been used in the assessments presented in this report. Reference projects within the ICC Hotel site, used to supplement the current geotechnical assessment are summarised in the following Table 1.1.

Table 1.1 – Results of Previous Investigations Used in Preparation of this Report

Ref No.	Description of Previous Project
R6	Coffey & Partners Pty Ltd, " Darling Harbour Development Maritime Structures Geotechnical Investigation Zones 1 to 6" May 1985 (S7559/1-AE)*
R7	Coffey & Partners Pty Ltd, " Darling Harbour Development Project Convention Centre – Geotechnical Investigation" June 1985 (S7559/3-AD)
R18	Coffey Geosciences Pty Ltd, "Proposed Convention and Exhibition Centre", May 2003
R20	Coffey Environments Pty Ltd, "Environmental Site Assessment", June 2013

* *Report not available for publication from Coffey Geotechnics; however the information in the report was used to develop the rock contour plan and cross sections presented as Figure 2 to Figure 5.*

Information supplied by LLD (including the draft Combined Services Plan, provided by Hyder Consulting Pty Ltd, drawing HO-CI-0701 Rev 03 dated 18/7/13) indicates the presence of a significant network of buried services across the site, including the position of a 2.4 m wide stormwater channel passing through the centre of the site. It is understood that the stormwater channel is constructed of a concrete box culvert, approximately 1.8 m high. Information provided by LLD indicates that surrounding soils and bedrock were excavated to construct the channel.

2 SITE CONDITIONS

2.1 Topography

The proposed ICC Hotel development is located in the south western corner of Cockle Bay. The site is situated between the Harbourside Shopping Centre and Darling Drive, in a roughly triangular parcel of land approximately 3,730m^2 in size. The western bank of Cockle Bay typically consists of a narrow strip of level ground, backed by steeply rising ground up to the Pyrmont Street ridge line, which lies approximately 15m above the bay.

Approximately 30m to the west of the site, across the light rail tracks, the ground level rises steeply with a sandstone cut face of approximately 3m to 5m high within the Novotel hotel car park. The edge of the Cockle Bay wharves is approximately 100m to the east of the site.

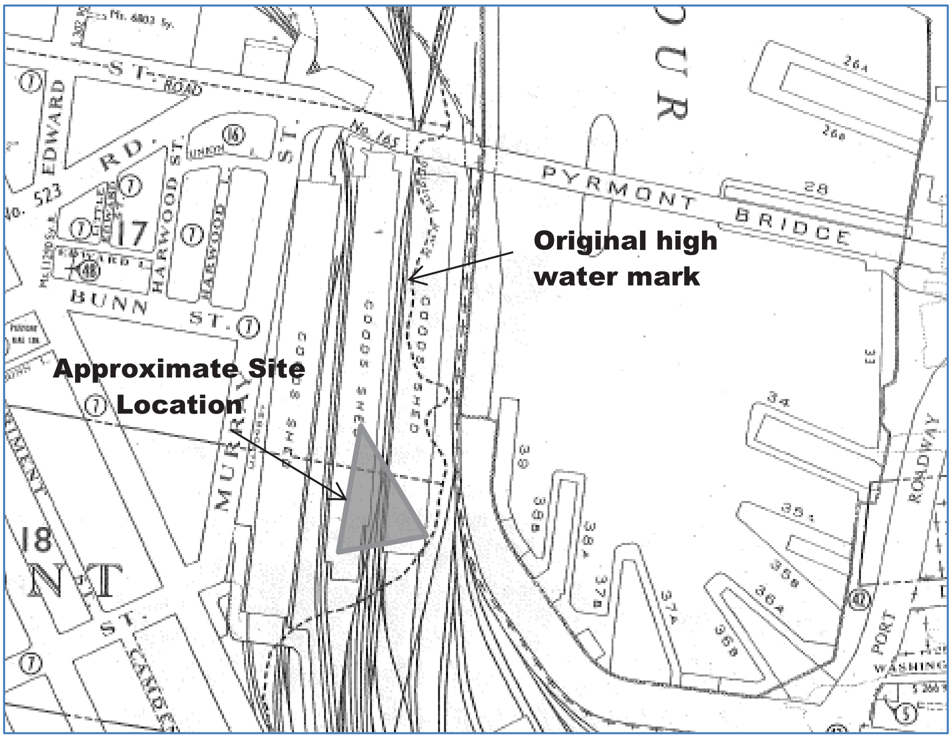
2.2 Geology

A review of the Sydney 1:100,000 Geological Sheet (Sheet No. 9130) produced by the NSW Geological Survey indicates the western portion of the site is underlain by Hawkesbury Sandstone, described as medium to coarse grained sandstone with very minor shale and laminite lenses. Quaternary age alluvial sediments comprising silty to peaty quartz sand, silt and clay are shown below the south eastern and southern half of the site.

Previous investigations undertaken at the site and surrounding areas confirm the presence of Hawkesbury Sandstone across the site, overlain by granular fill. Fine to medium grained alluvial sand is found below the fill and above the weathered sandstone, in a number of previous boreholes.

2.3 Site History

A review of historic records held by Coffey and presented in earlier reports indicates that the ICC Hotel site was initially developed during the construction of rail goods lines when industry commenced in the Darling harbour area in the late nineteenth century. Available records indicate the site is close to the original shoreline, as shown on the following figure.



The above figure presents details of the site in 1970 when it was occupied by a rail goods shed, which were removed sometime between 1970 and 1986. It is anticipated that the construction of the rail infrastructure resulted in significant filling of the local area, together with excavation for footings and buried services. It is understood that development of the Darling Harbour public precinct in its current form, was undertaken shortly after the removal of the rail infrastructure.

A detailed review of the site history is included in the Coffey Environmental Site Assessment, reference GEOTLCOV24303AH-AD dated June 2013, submitted to LLD.

3 SCOPE OF GEOTECHNICAL INVESTIGATIONS

Site investigation works within the ICC Hotel site were undertaken between 14 May 2013 and 7 June 2013 and included the following activities:

- Borehole drilling;
- Laboratory testing on soil and rock samples; and
- Standpipe piezometer installation.

3.1 Borehole Drilling

A total of ten boreholes were drilled to depths of between 0.45m and 20.8m below ground level. Borehole locations are shown on the attached Figure 1.

Appendix A presents the borehole engineering logs and core photographs, together with soil and rock description explanation sheets.

Track mounted drilling rigs from Numac Drilling Services Pty Ltd (Numac) were mobilised to the site to undertake the drilling programme. A single borehole, BH209, was drilled by hand auger.

Engineering Geologists and Geotechnical Engineers from Coffey were in full time attendance on site during the drilling operations. The Coffey staff members were responsible for positioning of the boreholes, logging of the boreholes and recording of the in-situ testing. Water levels were measured during the drilling process (where possible) and are presented on the borehole logs.

Soils were drilled using solid flight auger drilling methods with a tungsten carbide drill bit. When drilling within soil profiles, Standard Penetration Tests (SPT) were undertaken at approximately 1.5 m intervals to assess strength and to obtain samples for visual classification and testing.

All boreholes were drilled using town water and advanced through rock using triple barrel NMLC sized drilling techniques. Rock core was placed in purpose built steel boxes with one metre of core per row. The Coffey site representative logged and photographed the core on site. Core trays were transported to the Coffey Sydney core storage area on completion of logging. The engineering borehole logs were prepared using the commercially available gINT software; version 8.30.02.39 provided by Bentley Software, Inc., USA.

Point Load Index testing of rock core samples was undertaken at approximately 1 m spacing, with both diametral and axial tests conducted where possible. The results of the point load strength index tests are presented on the engineering logs.

3.2 Laboratory Testing

Rock testing was conducted at Coffey's NATA accredited geotechnical laboratory on samples obtained from boreholes BH202, BH205, BH206 and BH208. Laboratory testing scheduled included Uniaxial Compressive Strength with deformation measurement, to AS4133.1.1.1 and AS4133.4.3.

Soil samples from boreholes BH201, BH203 and BH206 were sent to Eurofins MGT laboratory in Lane Cove, NSW for chemical analysis. Samples were tested for pH, Chloride and Sulphate content.

3.3 Standpipe Piezometers

A total of three boreholes (BH203, BH204 and BH205) were completed as standpipe piezometers. 50mm diameter PVC standpipes were installed to varying depths with a slotted section and gravel pack filter at the base of the boreholes, with an upper bentonite seal. Standpipe piezometers were completed with a steel gatic cover flush with the surrounding ground concreted in place and locked with Allen key screws.

3.4 Survey of Test Locations

Co-ordinate positions and ground surface levels have been interpolated from a ground survey drawing supplied by LLD, reference 75717_Merged_200513_DA, dated 24 May 2013.

4 RESULTS OF INVESTIGATION

4.1 Subsurface Conditions

The geotechnical conditions at the site comprise the following main features;

- Manmade fill directly below the hardstanding;
- Localised sand deposits above a weathered bedrock profile
- Hawkesbury Sandstone across the site;
- Buried service trenches; and
- Shallow groundwater levels.

Based on the available information Coffey has developed contours of the top of the extremely weathered/highly weathered sandstone bedrock presented as Figure 2. The rock contours typically follow the alignment of the former shoreline in the vicinity of the site. Due to the previous site uses and extensive buried services (including a 2.4 m wide stormwater channel) it is anticipated that bedrock may have been excavated and backfilled during the installation of services. The resulting localised variations in rock level may not be reflected in the contour plans.

The Hawkesbury Sandstone bedrock comprises a generally thin weathered profile grading into fresh, medium and high strength rock.

Table 4.1 presents a summary of subsurface conditions encountered in the boreholes.

Table 4.1 – Summary of Subsurface Conditions

Unit	Approx. Depth to Top of Unit (m)	Approx. Unit Thickness (m)	Material Description
1 – Fill	0	0.4 to 3.9	Asphalt and concrete paving hardstanding, overlying SAND and Gravelly SAND.
2 – Alluvium	Observed in three boreholes at 2.5 m, 2.9 m and 3 m	0.4 and 0.7	SAND: Medium to coarse, dark grey and brown. Typically loose to medium dense, and moist.
3 – Residual Soil	0.6 to 3.4	0.2 to 0.5 with 1.5 m observed at one location	Silty SAND: fine to coarse, orange brown mottled grey. Typically medium dense to dense.

Unit	Approx. Depth to Top of Unit (m)	Approx. Unit Thickness (m)	Material Description
4A – Class IV and Class V Sandstone	0.8 to 4.1 generally deepest at the southern boundary	Absent to 1.5 (typically 0.4 to 0.5)	SANDSTONE: Fine to medium grained, orange brown mottled pale grey, highly to moderately weathered, low to medium strength, frequent zones of clay seams and highly to moderately fractured or fragmented.
4B – Class III Sandstone	1.2 to 4.5	1.3 to 4.7 (typically 3m to 4m)	SANDSTONE: Fine to medium grained, pale grey with grey laminae, fresh, medium to high strength. Moderately fractured, may occur as zones within the lower Unit 4D material.
4C – Shale Interbed (Class III Shale)	6 to 7 (absent in places)	Typically 1 m	INTERLAMINATED SANDSTONE AND SHALE: Highly fractured, extremely to moderately weathered, low and medium strength, dark grey and grey This marker bed is present at a similar depth across much of the site.
4D – Class II or better Sandstone	8 to 9	Not proven	SANDSTONE: Fresh and high strength, pale grey.

Notes:

- Rock classified in accordance with Pells et al (1998) “Foundations on Sandstone and Shale in the Sydney Region” Aust. Geomech. Jnl, Dec 1998.
- The materials, depths and thicknesses in Table 4.1 are based on the available borehole information and may not represent the variation in material types and the maximum or minimum depth and thickness values across the site.

Coffey has attempted to classify the bedrock within the site based upon available cored boreholes. Localised variations in rock quality may occur and impact on the rock class at particular footing locations.

Generally, the subsurface information indicates that the buried rock profile is consistent with the original natural shoreline geometry, with evidence to suggest that the northern section of the site has been previously excavated to create the present day, level site.

The rocks encountered are classified based on the Sydney rock classification system given in the footnote of the above table. There are 5 classes of Sandstone (Class V to Class I) and 5 classes of Shale (Class V to Class I), based on strength, fracturing, and amount of defects such as sheared zones and clay seams. Class V is the poorest quality and Class I the best quality, within the respective rock types.

Three cross-sections across the notional external walls of the ICC Hotel building footprint have been produced using the latest borehole information and select data from previous investigations. Figures 3 to 5 present the cross sections with the approximate boundaries of the above geotechnical units.

4.2 Groundwater Levels

Groundwater inflows during borehole drilling, where observed, were typically measured between 2.2 m and 3.1 m below ground surface (from RL-0.1 m to RL0.4 m AHD). Groundwater levels measured on 7 June 2013 during groundwater sampling indicate levels ranging from RL0.4 m to RL0.7 m AHD.

Based on site investigation data of similar sites in the area, the near surface water table is likely to respond strongly to tidal variations within Darling Harbour. The existing Highest Astronomical Tide (HAT) for Darling Harbour is 1.175 m AHD.

A design groundwater level should be based on existing data and the NSW Government policy in relation to sea level rise, with policy benchmarks of a 0.4 m rise by 2050 and 0.9 m rise by 2100 (above 1990 mean sea levels).

During standpipe development groundwater was pumped from the wells, with a minimum of three well volumes removed or pumped dry, whichever occurred sooner. Both boreholes BH203 and BH205 were pumped dry after removal of 1 litre and 4 litres, respectively. Both these wells were constructed with response zones across the Fill/Weathered bedrock profile. The standpipe installed at BH204, with a response zone constructed across a deeper, granular Fill/Alluvium/Residual soil profile, was developed fully after removal of 12 litres.

5 LABORATORY TEST RESULTS

5.1 Uniaxial Compressive Strength & Point Load Index Strength Testing

Selected samples of rock core were submitted for Uniaxial Compressive Strength (UCS) testing with measurement of deformation parameters. Test results are presented within Appendix B.

Table 5.1 – Summary of Uniaxial Compressive Strength Testing

Rock Unit	No. of Tests	UCS (MPa)		
		Minimum	Maximum	Average
Unit 4B	2	34	52	43
Unit 4D	2	32	46.9	39.5

Point Load Strength Index (PLSI) testing was performed on core obtained during the investigation at approximately 1 m intervals. The PLSI, Is50, values obtained from this testing are presented on the engineering borehole logs presented within Appendix A.

5.2 Soil Chemical Testing

Laboratory chemical test results are presented in Appendix B. The following table presents a summary of the Sulphate, Chloride and pH soil testing.

Table 5.2 – Groundwater Chemistry Test Results

Test	No. of Tests	Concentration		
		Maximum	Minimum	Average
Chloride (mg/kg)	3	<10	<10	<10
Sulphate (as S) (mg/kg)	3	22	<10	13
pH	3	9.5	8.5	9.0

6 DISCUSSION AND RECOMMENDATIONS

6.1 Excavations

6.1.1 Excavation Conditions

Coffey understands that the proposed development currently includes a single level basement construction to the south of the existing stormwater culvert, with bulk excavation extending to approximately RL 0m AHD. A lift core is proposed, situated adjacent to the stormwater culvert alignment, extending to approximately RL -2.5m AHD. Such excavations are therefore expected to be within Unit 1, Fill, Unit 2 Alluvium, Unit 3 Residual Soil and Unit 4A and Unit 4B Sandstone.

Excavation of Units 1-3 and 4A, should be able to be achieved using an excavator bucket or tracked loader. Where excavations in Units 4B to 4D are required, the use of a rock saw and impact hammer, or ripping using a Class 300c or larger bulldozer may be required. In confined spaces, ripping is likely to be impracticable once the better quality rock is encountered.

The engineering logs, core photographs and rock cores should be inspected by prospective excavation contractors to make their own judgement as to likely productivity of specific plant.

6.1.2 Excavation Induced Vibrations

The use of hydraulic impact hammers for bulk excavation, trimming sides of excavations and for detailed excavation will cause vibrations that could damage vibration sensitive structures and services. Particular attention should be made to the large concrete stormwater channel directly adjacent to northern extent of proposed basement. Where excavations extend close to the stormwater channel, or nearby vibration sensitive structures, consideration should be given for the use of rock saws. Vibration limits close to buried services may be relatively stringent compared to those typically adopted for nearby structures. Vibration limits will be based on a number of factors, including, but not limited to, service age, service condition and service construction. The vibration limits for buried services should be assessed on a case by case basis in consultation with the asset owners following dilapidation surveys.

Recommended limits of ground movement and vibration during construction on the historic seawater inlet pipes (located below the northern sector of the hotel footprint) have been reported in the Pells Sullivan and Meynink (PSM) report, reference PSM1986-021R – Rev.2 dated 15 August 2013.

Where excavations extend below the toe of shoring rock saws may be used to avoid both overbreak and excessive vibrations, and allow detailed excavation to be undertaken.

Dilapidation surveys should be carried out on neighbouring buildings or services assessed to be sensitive to vibrations prior to commencing excavation and vibration monitoring carried out during excavation to confirm that vibrations are not causing damage to these sensitive structures.

A further assessment of the ground conditions above and close to the stormwater channel should be made following removal of the hardstanding area to confirm the position, the construction materials/methodology and assess the effect on the surrounding materials. Rock levels around the stormwater channel will depend on the methodology adopted during its construction and are not known at this stage.

6.1.3 Excavation Batter Slopes

The stability of excavations in the soil units, Units 1 to 3, will be highly influenced by the presence of groundwater. Where shallow excavations above the groundwater level are required during construction the following batter angles are recommended.

Table 6.1 – Shallow Batter Slopes in Soil Materials

Unit	Description	Temporary Exposed Batter	Permanent Batter Exposed
1	Fill	1.5H:1V	Retain
2	Alluvium	Unlikely to be exposed above the water table	
3	Residual Soil	1.5H:1V	2H:1V
4A	Class IV/V Sandstone	1H:1V	1.5H:1V

Where excavations are required below the water table, such as for the installation of buried services etc. shoring, internal strutting or similar should be adopted, using the recommendations in the following section.

6.2 Retention Systems

6.2.1 Retention System Options

The approximate layout of the basement bulk excavation levels is presented in Figures 3 and 5, indicating a basement floor level typically within Unit 4A and 4B sandstone. Permanent retention of

Units 1 to 4A material is required for basement construction. Suitable retention systems may include, but not limited to, secant piled walls, soldier pile walls, contiguous piled walls and diaphragm walls. It is anticipated that the type of retention system will be governed on the groundwater control measures required (e.g. a drained or tanked basement). The types of retention structures are discussed further below, with a brief discussion of each system in relation to the proposed development site.

Secant pile walls require a significant skill in workmanship and quality to be installed correctly to provide an adequate groundwater cut off. Cased continuous flight auger piles could be adopted to improve construction control of verticality. By providing a sufficient overlap between ‘hard’ and ‘soft’ piles in the construction of the wall, the likelihood of unacceptable groundwater seepage during excavation is reduced. Where seepage is observed during excavation localised grout sealing may be possible. Secant pile wall construction may be most suited to the area to the south of the site, where retention of soil units below the groundwater is required. It is presently unclear as to the nature, extent or depth of the fill surrounding the stormwater culvert directly north of the lift core excavations. Deeper, water bearing sediments may be present, which may require a cut off wall constructed into the underlying bedrock.

Soldier pile wall construction may be suited to areas where retention of soils above the water table is required. However, soldier pile walls are not watertight, therefore, unsuitable for areas of the site requiring groundwater cut-off, such as the deeper fill to the south of the site or adjacent to the stormwater channel. Where soldier pile walls may be used, infill panels may be constructed using fibre reinforced shotcrete or shotcrete and mesh.

Similarly, a contiguous piled wall may be used where groundwater cut-off is not required.

A diaphragm wall can provide the necessary seepage cut off provided the toe of wall panels are adequately socketed into the bedrock. The size and type of equipment used to construct a diaphragm wall will require careful selection to form a seal at the toe. Construction of a diaphragm wall is generally suited for construction of deep basements where significant water bearing fill or alluvial deposits overly bedrock, and may not be suited to the scale of excavations for the proposed hotel site.

Sheet pile walls may be considered for use as a retention system, however, due to the shallow depth to rock and limited thickness of a weathered bedrock profile it is likely that a driven sheet piled wall would experience difficulties in driving into the underlying sandstone and it may not be possible to achieve the required embedment to provide adequate toe support. Sheet piling close to buried services is not advised due to the risk of vibration induced or direct damage.

Water inflow through the retaining wall will depend on the type and workmanship of the wall. A well-constructed diaphragm wall with its toe socketed into the bedrock could be considered almost impermeable. Wall permeability will be less certain for a secant pile wall and will depend on workmanship to maintain adequate interlock of the piles. Water inflow below the base of soldier pile walls is likely to be unacceptable where groundwater levels are above the base of the infill panels.

If an anchored system is adopted, water is likely to flow into the excavation at the head of the anchors if located below the surrounding groundwater level. Consideration needs to be given to providing water management issues such as sealing of anchor heads, seepage collection systems and the ability to dispose of water off site.

It is anticipated that vertical excavations within Class III or better sandstone can be achieved below a retention structure, where suitable toe support is adopted. Recommendations for support of rock excavation are discussed in Section 6.4.

6.2.2 Retention Wall Design Parameters

Where shallow excavations requiring shoring or similar the parameters in the following table should be used to assist design within Soil/Weathered bedrock profile.

Table 6.2 – Retaining Wall Design Parameters for Soil and Weathered Rock

Unit	Description	Bulk Unit Weight (kN/m3)	Effective Cohesion (kPa)	Effective Friction Angle (degrees)	Undrained Shear Strength (kPa)	Elastic Modulus (MPa)	Poisson's Ratio
1	Fill	18-20	0	28	-	5-15	0.35
2	Alluvium	19	0	30	-	5-10	0.35
3	Residual Soil	21	5	25	-	30	0.3
4A	Class IV/V Sandstone	23	20	35	250	80	0.3

The design of shoring systems is geotechnically complex, and best carried out using soil-structure interaction analysis methods. For preliminary design, we have provided some recommended earth pressure coefficients for the various units in Table 6.3 below. However, it must be pointed out that these values are based on empirical methods and may not provide satisfactory solutions in some cases.

Table 6.3 – Recommended Earth Pressure Coefficients for Preliminary Design

Unit	Description	'Active' Earth Pressure Coefficient, K_a	'At Rest' Earth Pressure Coefficient, K_0 (1)
1	Fill	0.4	0.5
2	Alluvium	0.35	0.5
3	Residual Soil	0.35	0.5
4A	Class IV/V Sandstone	0.27	0.5

Note

1) Values provided assume a lateral movement of the wall of about 0.2% of the wall height is allowed to occur. *In situ* "at rest" earth pressure coefficient may be significantly higher for Unit 4A.

Active earth pressure coefficients should be adopted where wall movements of about 1% of the wall height can be tolerated. At rest pressure coefficients should be adopted where less movement can be tolerated. However, it should be understood that a well-constructed wall will still undergo movements of the order of 0.1% to 0.3% of the wall height where at rest pressures are adopted.

It is anticipated that the retention structure is likely to provide a groundwater cut off into the underlying bedrock, therefore the systems should be designed for hydrostatic pressures. Applicable surcharge loads should be added to earth pressures.

For preliminary design purposes, a design groundwater level of 2 m AHD is suggested which would account for sea level use over 50 year design life.

6.3 Ground Anchor Design Parameters

Internal strutting of the retention walls is likely to be impractical, therefore, single or multiple anchors may be required founded within the sandstone.

Reduction in anchor capacity may be required to allow for group effects. Anchors should be checked for an anchor pullout failure mechanism assuming a 45° failure cone in addition to bond strength.

For the preliminary design of anchors, the following ultimate bond stresses are recommended:

Table 6.4 – Recommended Bond Stresses for Ground Anchors and Soil Nails

Unit	Description	Ultimate Bond Stress (kPa)(1)
4A	Class IV/V Sandstone	200
4B	Class III Sandstone	1200

Note

1) For bond lengths not less than 3m and not more than 7m (except for a single bore multianchor system)

The recommended values are given on the provision that each anchor is proof loaded to 1.3 times maximum working load (temporary anchors) and to 1.5 times maximum working load (permanent anchors) prior to locking off at the required working load.

6.4 Excavation Induced Ground Movements

Adjacent ground movements are likely to occur due to the excavation, with the magnitude and extent dependant on the ground conditions, and retention system chosen. Within the retained fill and extremely weathered rock profile the magnitude of adjacent ground movements will depend upon the ground conditions, design lateral pressures, stiffness of the retention system, sequence of construction, and workmanship. Lateral movements of the adjacent ground surface due to the fill, soils and extremely weathered rock profile would be expected to be of the order of 0.1% to 0.5% of the retained depth providing good workmanship is employed.

Within an unsupported rock excavation, additional lateral movement will occur due to relief of *in situ* horizontal stresses. Relatively high natural horizontal stresses can occur within the Hawkesbury Sandstone.

Stress redistribution measurements have been made at distances of up to 1.5 times basement depth from excavations in the Sydney CBD. These show, typically, that at a distance approximately equal to the depth of basement, movements are likely to be about 30% of the displacement around the perimeter of the excavation. However, this approximation will be affected by local geological structures and should only be used as a rough guide.

Based on past experience of deep basements in Hawkesbury Sandstone in the Sydney CBD, typical lateral movements are of the order of 0.5mm to 2mm per metre of excavation, depending on rock quality and presence of bedding seams.

Usually, the risk of potential damage to nearby structures is difficult to quantify and it is not possible to avoid movement for excavations of this type. Particular attention should be made to the proximity of the stormwater culvert, adjacent to the northern edge of the lift core excavation, and discussions with the asset owners should be undertaken to assess the likely tolerance of the structure. Potential damage may range from cosmetic cracking of masonry work to structural impacts. Adequate allowance should be made for repair of such damage after construction. A dilapidation survey should be carried out on all adjacent structures prior to commencement of excavation and analysis of deformation due to excavation is recommended to assess impacts on nearby structures.

6.5 Bedrock Excavation Support

Vertical excavations should be feasible in the Class III or better sandstone below the retention system. However, some support in the form of shotcreting and rock bolting is likely to be required and specific support requirements can only be assessed during excavation. An experienced geotechnical engineer/engineering geologist should carry out regular inspections as excavation progresses (at least every 2 m depth of excavation). For estimating purposes, we recommend allowance for the following support within Unit 4B material:

- Localised pattern bolting in fractured zones.
- Mesh supported by 0.5 m long dowels and shotcrete (minimum 75 mm thick) or fibre reinforced shotcrete of fractured zones.
- Isolated bolting of potential wedges.

Where retention system piles lie in close proximity to the edge of an excavation there is a risk of blocks falling out and removing support before the rock can be inspected. The rock should be inspected once the excavation has extended not greater than 1m below the base of retention system to assess whether adverse jointing requires bolting.

Where long-term support is required below the site retention system rock bolts must be provided with a high level of corrosion protection if they cannot be maintained (i.e. inspected and replaced, if necessary). Multiple layers of corrosion protection such as encapsulating bolts in both grout and PVC sheaths may be required. Proprietary products such as ‘CT’ rock bolts or equivalent should be suitable for bolting the rock faces. Such bolts have a mechanical anchor to allow a nominal tension to be applied and are then fully cement grouted to act as a dowel.

6.6 Foundation Design Parameters

Based on the site conditions suitable foundation options for the proposed development include shallow pad/piled footings and bored piles founded on the sandstone rock. If no basement excavations are proposed the depth to rock is likely to exceed the practicable depth for shallow footings unless they are shored. Bored piles will require casing through the fill and natural soils.

As a guide, strip, pad or bored piles founded on sandstone may be designed in accordance with the limit state design parameters in the following Table 6.5

Table 6.5 - Foundation Design Parameters

Unit$^{\text{(Note 1)}}$	Limit State Design Values		
	Ultimate End Bearing (MPa)	Ultimate Shaft Adhesion (kPa)	Elastic Modulus (MPa)
Units 1-3	-	20	20
4A Class IV and V Sandstone	3	150	100
4B Class III Sandstone	50$^{\text{(Note 2)}}$	800	800
4C Class III Shale	25	350	500
4D Class II or better sandstone	80$^{\text{(Note 3)}}$	1500	1600

Notes:

(1) Rock classification according to Pells et al (1998). These are generalised rock classification for the purpose of foundation design only and should not be used for assessment of rock excavatability or pile drillability.
(2) End bearing should be reduced if a pile toe is within 3 pile diameter of the underlying Unit 4C.
(3) Maximum limit state design stress level of concrete likely to govern

The above bearing pressure values assume a minimum embedment of 0.3m into the relevant bearing stratum. Bearing pressure values are dependent on level of assessment carried out during construction.

The Unit 4A Sandstone is generally relatively thin across the site and has been classified as varying from Class V to Class IV due to the relatively low and variable strength and variable defects of the sandstone. The design values for Unit 4A Sandstone may be adopted for relatively lightly loaded footings or piles. However, where the Sandstone is Class IV the parameters are conservative. For heavily loaded structures we recommend that footings be taken to the better quality and more uniform Unit 4B or Unit 4D Sandstone to obtain the benefit of higher end bearing and shaft adhesion values.

The nominated modulus values are applicable at the anticipated working stress values. Non-linear effects should be considered depending on operating stress levels

Base of piles or shallow footings should be cleaned of debris prior to concrete pouring. A clean pile socket of roughness category R2 (defined as grooves of depth 1 mm to 4 mm and width greater than 2mm at spacing of 50 mm to 200 mm) or better is required to achieve the values provided above. Shaft adhesion values may have to be reduced if rock sockets are smear or polish is present.

For Limit State Design, the selection of geotechnical strength reduction factors is dependent on the confidence in the selected design parameters and analysis model and results. For rock sockets comprising both side shear and end bearing resistance, we recommend a geotechnical strength reduction factor, ϕ_g, for Hawkesbury Sandstone of 0.7. The relatively high ϕ_g value given for Hawkesbury Sandstone is due to a well-established geological environment where there are substantial field testing data in the Sydney region.

For uplift capacity the shaft adhesion value in Table 6.5 should be multiplied by 0.6, in addition to the geotechnical strength reduction. In addition to shaft adhesion, the uplift capacity should be checked for a cone pullout failure mode assuming a cone angle of 90° considering the submerged weight of the soil or rock and adopting a factor of safety of 1 against pullout. Uplift capacity for groups of piles will need to take into account interaction between piles which will lead to lower individual pile capacities.

For footings on rock the settlement characteristics of the footing rather than ultimate load capacity often governs the design. The serviceability limit state should be assessed using the elastic modulus values presented in Table 6.5.

Where there are localised excavations close to a major footing such as the stormwater channel, bearing pressures may need to be downgraded by 50% unless the entire base of the footing should lie outside a line projected upwards at 45^{o} from the toe of the base of the excavation.

Prior to concreting, all shallow footings should be observed by a Geotechnical Engineer or Engineering Geologist to assess the exposed sandstone. Where the required ultimate bearing pressure for shallow, pad or strip footings is greater than 3 MPa an assessment should also include spoon testing (or cored boreholes) to assess whether defects below the base of the footing are within tolerable limits for the respective rock class. For piles, a geotechnical engineer should be engaged to observe piling and depending on the adopted design parameters proof coring may be required to confirm rock class at individual pile locations. Where an ultimate end bearing pressure of 3 MPa or greater is adopted initial allowance should be made for coring all pile or pile group locations. This requirement may be able to be reduced once pile layouts are known. In addition to verification of rock class by cored boreholes and observation of piling, pile load testing may also be required depending on the design loads and the settlement tolerances adopted. The need for pile testing should be assessed once footing layouts and loads are known, combined with an assessment of the confidence level required in the predicted settlements.

Integrity testing on 15% to 25% of the production piles initially to assess the structural integrity of the pile shaft should be undertaken. Further integrity testing may be required if any of the piles in the initial test program fails to demonstrate satisfactory performance. There are two methods of conducting integrity testing: (a) sonic testing by hitting the pile head with a rubber mallet and recording the wave signal, and (b) sonic tube logging method by installing 4 access tubes the full-length of the pile via the reinforcing cage, and conducting cross-hole testing at say 0.5m intervals. The latter method is much more accurate and provides detailed cross-sectional images, and is recommended if piles are to be cast under bentonite. For bored piles cast in dry holes, the sonic testing (method a) is considered to be adequate.

6.7 Basement Construction Options

A number of options may be available for construction of the proposed basement, these include;

1. Full cut off wall, drained basement (Option 1).

2. Full cut off wall, tanked basement (Option 2).

The construction of a full cut off wall, embedded into the underlying bedrock is likely to provide an acceptable watertight barrier during construction, dependant on the method of construction adopted. Option 1 would require a drainage blanket beneath the floor slabs and a permanent pump out groundwater system to remove groundwater seepages through the bedrock, but without the requirement of tension piles/tie down anchors to hold the basement slab down against hydrostatic groundwater pressure. Option 2 would remove the requirement for a permanent groundwater management system, however a thicker watertight basement floor and tie down system would be required to resist hydrostatic forces.

The choice of basement construction will affect up front capital costs, ongoing maintenance costs, and risks associated with groundwater seepage and disposal. The following table summarises the advantages and disadvantages of the different construction methods.

Table 6.6 - Basement Construction Options

Basement Option	Comments
Option 1: Full cut off, drained basement e.g. secant pile wall/diaphragm wall with drained basement slab	Thinner floor slab and no requirement for tension piles or tie-down anchors. Significant emphasis must be placed on the high quality installation of wall systems to minimise seepage through wall units. Lift core floor slab design would require the inclusion of permanent sub floor drainage system to operate for the total life of the building. Development consent likely to be required for the disposal of extracted water, and approval of the NSW Office of Water would be needed. Provided the basement walls are well constructed such that they form an impermeable barrier to retain the soil and groundwater within the fill and alluvium we expect that the seepage from the bedrock below the toe of the basement wall should be manageable. However, this option may require a detailed hydrogeological modelling to be carried out to assess seepage inflow rate.
Option 2: Full cut off, fully tanked e.g. secant pile wall/diaphragm wall and fully tanked basement slab	Least risk design option, with negligible risk of groundwater impacts. Likely to be most expensive. Requires the installation of tension piles and/or tie-down anchors (tie-down anchors will require implementation of a long term maintenance programme) Minimal requirement for disposal of groundwater seepage during design life of structure.

6.8 Groundwater Management

The fill material across the site is assessed to be highly permeable. It is anticipated that the near surface water table responds strongly to tidal variations. Therefore, groundwater inflows into excavations below the water table without appropriate cut-off to the underlying sandstone are unlikely to be controllable without significant pumping and waste water disposal.

It is recommended that a barrier to groundwater flow through the soils such as a secant or diaphragm wall is constructed to control groundwater ingress as excavations progress below the groundwater table. Where a well-constructed cut-off wall is adopted in the soils groundwater inflows through the underlying sandstone may be controllable through sump pumping if there are no high permeability features within the rock. It is recommended that further permeability testing is carried out to assess potential groundwater ingress through the bedrock, in the form of falling head or water pressure testing.

6.9 Seismic Design Considerations

Selection of seismic parameters for the site should follow the requirements of AS 1170.4-2007 Structural Design Actions – Part 4: Earthquake Action in Australia.

A hazard factor (Z) of 0.08 is appropriate for the ICC Hotel site. Typically less than 3m of soil or completely weathered rock was observed across the site. Furthermore, the UCS of the sandstone bedrock typically falls below 50 MPa. Therefore the site sub-soil class of Class B_e – Rock should be adopted, as defined in Section 4 of AS 1170.4.

6.10 Aggressivity to Concrete and Steel

Comparison of the laboratory test results on soil samples with the criteria set out in Table 6.4.2(C) of AS2159-2009 (assuming highly permeable ground conditions which are in water) indicates that the soil tested can be classified as ‘mild’ exposure classification with respect to buried concrete and steel. On the basis of these results, no special protective measures should be required other than to ensure that dense, compacted concrete is used and appropriate minimum cover to steel reinforcement is provided.

6.11 Site Trafficability during Construction

Typically granular fill will be exposed following removal of the current hardstand surfacing. Site trafficability is likely to be governed by the density and variability of the fill and position of the groundwater level below the excavation depth. Under normal construction traffic comprising wheel mounted and track mounted machinery we would expect that a working platform of roadbase, high quality ripped sandstone or recycled concrete would be required. Typically, we would expect a working platform of 200 mm thickness to be adequate for general traffic.

For heavy plant such as piling rigs and mobile cranes, specific working platform designs should be carried out. These are likely to require a compacted granular working platform and may need to incorporate cement stabilisation, geotextile separator and/or geogrid reinforcement layers.

Where excavations extend into the Class III or better sandstone it is not expected that working platforms for normal site plant are required.

7 LIMITATIONS

The assessments provided herein are based on discrete/specific investigation methodologies used in accordance with normal practices and standards. As more information becomes available during construction, the geotechnical interpretation and recommendations should be reviewed in the light of this information.

In addition, subsurface conditions can change over relatively short distances and the subsurface conditions revealed at the test locations may not be representative of subsurface conditions across the site. We recommend that a geotechnical engineer/engineering geologist be engaged during construction to confirm that subsurface conditions are consistent with design assumptions.

The attached document entitled “Important Information About Your Coffey Report” presents additional information on the uses and limitations of this report.

For and on behalf of Coffey Geotechnics Pty Ltd

Mark George

Senior Engineering Geologist

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

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

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

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.
Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

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* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures

LEGEND

- ⊕ PREVIOUS BOREHOLE LOCATIONS
- ⊕ BOREHOLE LOCATIONS OF CURRENT INVESTIGATION
- ‐ · · ‐ APPROXIMATE SITE FOOTPRINT

revision	description	drawn	approved	date
	A - APPROXIMATE SITE BOUNDARY AMMENDED	AW	MG	26/07/13
	B - APPROXIMATE SITE BOUNDARY AMMENDED	AW	MG	20/08/13

N

5 0 5 15 25

Scale (metres) 1:500

drawn	MG / LH
approved	MG
date	20 / 08 / 13
scale	1:500
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: LEND LEASE DEVELOPMENT PTY LTD

project: GEOTECHNICAL REPORT FOR SSDA6
SYDNEY INTERNATIONAL CONVENTION EXHIBITION
AND ENTERTAINMENT PRECINCT (SICEEP)
- ICC HOTEL

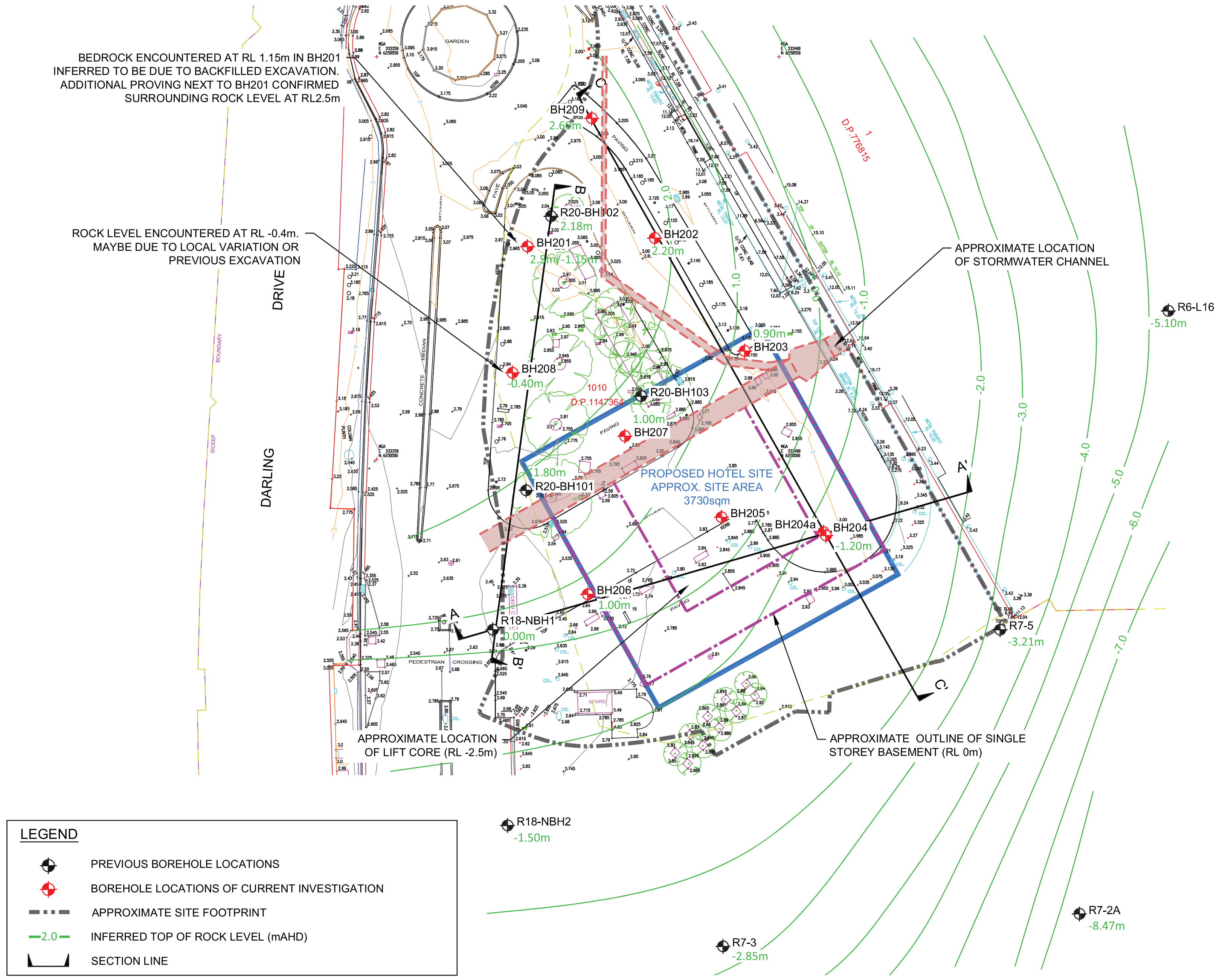
title: BOREHOLE LOCATION PLAN

project no: GEOTLCOV24303AH-AH

figure no: FIGURE 1

PLOT DATE: 20/08/2013 10:52:05 AM DWG FILE: F:\GEOTECHNICS\1.PROJECTS\GEOTLCOV243\GEOTLCOV24303AH LEND LEASE - ICC HOTEL\8. FIGURES\GEOTLCOV24303AH-AH.DWG

NOTES:
1. INFERRED ROCK LEVEL CONTOURS ARE APPROXIMATE ONLY. VARIATIONS MAY OCCUR DUE TO GEOLOGICAL FEATURES AND MAN-MADE EXCAVATIONS.
2. ACTUAL ROCK LEVELS ARE LIKELY TO OCCUR AS A SERIES OF STEPS AND BENCHES RATHER THAN GRADUAL SLOPE CHANGE



revision	description	drawn	approved	date
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	B - APPROXIMATE SITE BOUNDARY AMMENDED	AW	MG	20/08/13

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Scale (metres) 1:500

drawn	MG / LH
approved	MG
date	20 / 08 / 13
scale	1:500
original size	A3

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client: LEND LEASE DEVELOPMENT PTY LTD
project: GEOTECHNICAL REPORT FOR SSDA6
SYDNEY INTERNATIONAL CONVENTION EXHIBITION
AND ENTERTAINMENT PRECINCT (SICEEP)
- ICC HOTEL
title: INTERPOLATED ROCK CONTOUR PLAN
project no: GEOTLCOV24303AH-AH
figure no: FIGURE 2

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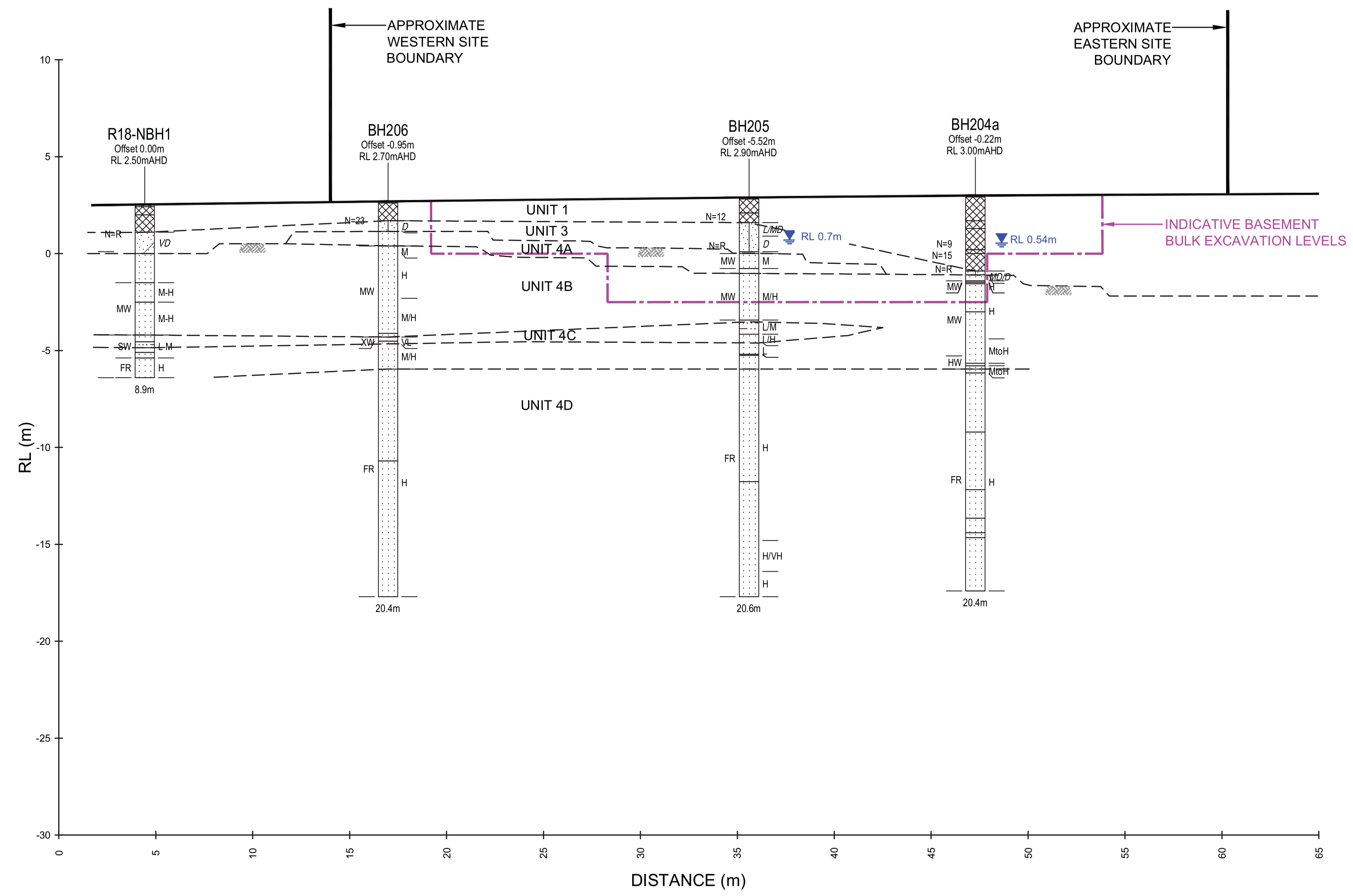

SECTION A-A'

LEGEND

- ◬ CONCRETE
- ▩ FILL
- ⁞ SANDSTONE
- ☰ SHALE
- ■ ASPHALT
- ⁘ SAND
- ▤ INTERLAMINATED SILTSTONE & SANDSTONE
- ▥ SILTY SAND
- ▦ INTERBEDDED SHALE & SANDSTONE
- ☐ NO CORE
- ▨ CLAYEY SAND
- ▤ INTERBEDDED SILTSTONE & SANDSTONE
- DX WEATHERING (SEE EXPLANATION SHEETS)
- N*=17 STANDARD PENETRATION TEST RESULT
- ▼ WATER LEVEL RECORDED DURING GROUNDWATER SAMPLING

revision	description	drawn	approved	date
	A - APPROXIMATE SITE BOUNDARY AMMENDED	AW	MG	26/07/13

2.5 0 5 10
Scale (metres) 1:250

drawn	MG / LH
approved	MG
date	20 / 08 / 13
scale	1:250
original size	A3

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client:	LEND LEASE DEVELOPMENT PTY LTD
project:	GEOTECHNICAL REPORT FOR SSDA6 SYDNEY INTERNATIONAL CONVENTION EXHIBITION AND ENTERTAINMENT PRECINCT (SICEEP) - ICC HOTEL
title:	SECTION A-A'
project no: GEOTLCOV24303AH-AH	figure no: FIGURE 3

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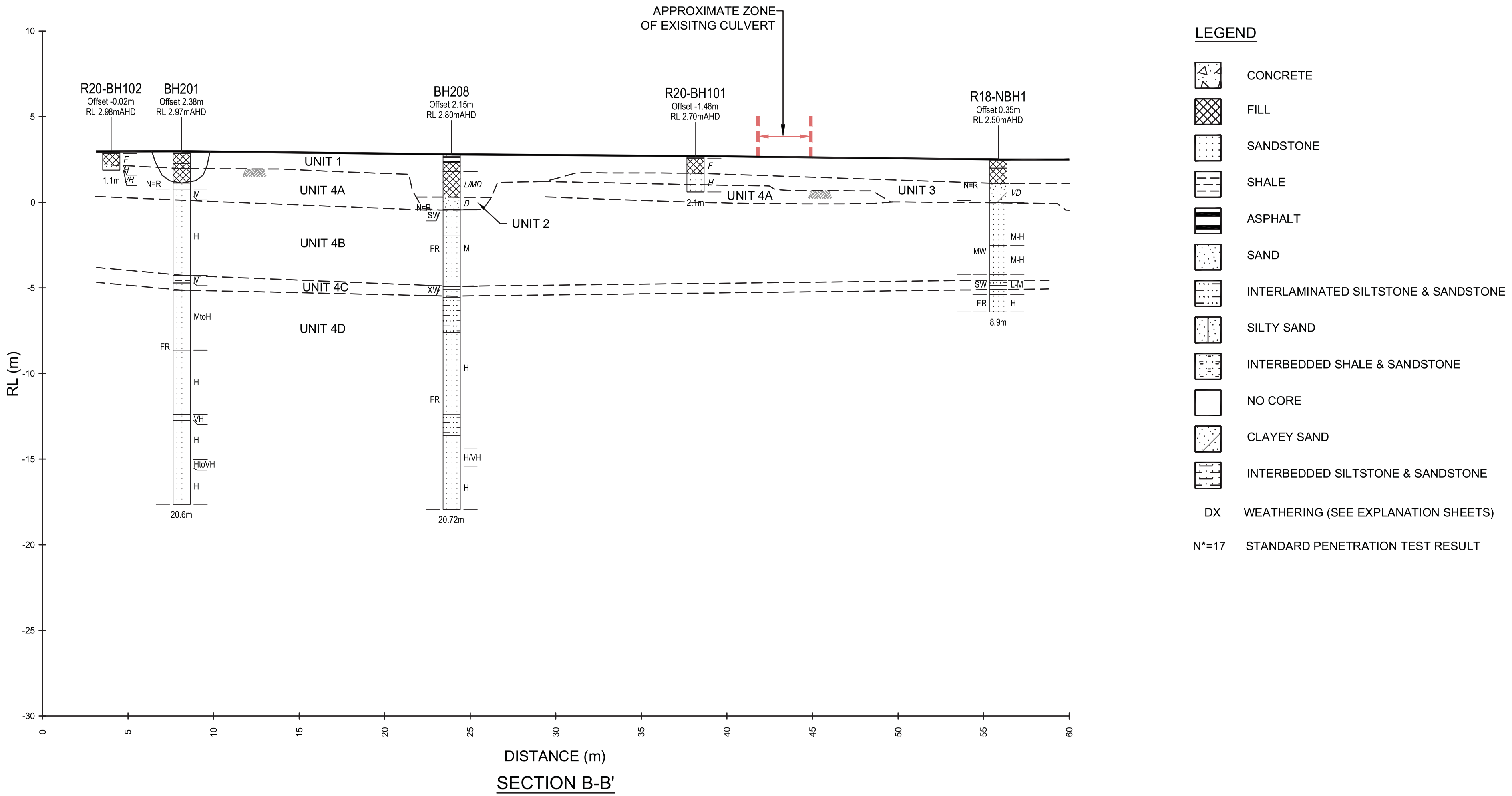

SECTION B-B'

revision	description	drawn	approved	date
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Scale (metres) 1:250

drawn	MG / LH
approved	MG
date	20 / 08 / 13
scale	1:250
original size	A3

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client:	LEND LEASE DEVELOPMENT PTY LTD
project:	GEOTECHNICAL REPORT FOR SSDA6 SYDNEY INTERNATIONAL CONVENTION EXHIBITION AND ENTERTAINMENT PRECINCT (SICEEP) - ICC HOTEL
title:	SECTION B-B'
project no: GEOTLCOV24303AH-AH	figure no: FIGURE 4

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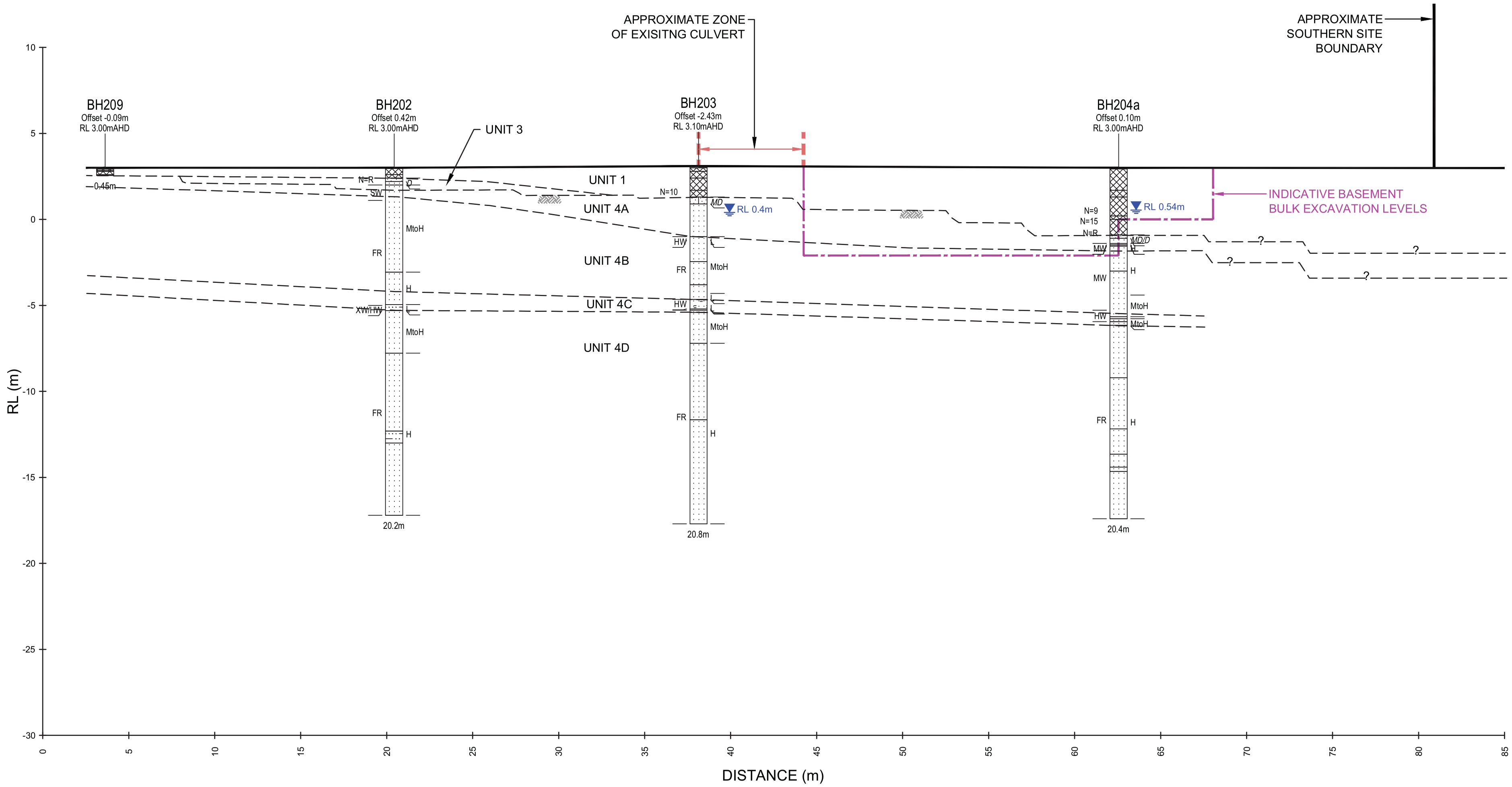

SECTION C-C'

LEGEND

◺	CONCRETE	▤	INTERLAMINATED SILTSTONE & SANDSTONE
▦	FILL	◫	SILTY SAND
⠿	SANDSTONE	▩	INTERBEDDED SHALE & SANDSTONE
☰	SHALE	☐	NO CORE
■	ASPHALT	◪	CLAYEY SAND
⠿	SAND	▤	INTERBEDDED SILTSTONE & SANDSTONE

DX WEATHERING (SEE EXPLANATION SHEETS)

N*=17 STANDARD PENETRATION TEST RESULT

▼ WATER LEVEL RECORDED DURING GROUNDWATER SAMPLING

revision	description	drawn	approved	date
	A - APPROXIMATE SITE BOUNDARY AMMENDED	AW	MG	26/07/13

2.5 0 5 10
Scale (metres) 1:250

drawn	MG / LH
approved	MG
date	20 / 08 / 13
scale	1:250
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	LEND LEASE DEVELOPMENT PTY LTD
project:	GEOTECHNICAL REPORT FOR SSDA6 SYDNEY INTERNATIONAL CONVENTION EXHIBITION AND ENTERTAINMENT PRECINCT (SICEEP) - ICC HOTEL
title:	SECTION C-C'
project no:	GEOTLCOV24303AH-AH
figure no:	FIGURE 5

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Appendix A

Borehole Engineering Logs and Core Photographs

Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 μm to 2.36 mm
	medium	200 μm to 600 μm
	fine	75 μm to 200 μm

MOISTURE CONDITION

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

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH s_u (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

Soil Description Explanation Sheet (2 of 2)

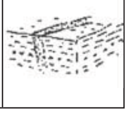
SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60 mm and basing fractions on estimated mass)							**USC**	**PRIMARY NAME**
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.36 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.36 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
			DRY STRENGTH	**DILATANCY**	**TOUGHNESS**			
		SILTS & CLAYS Liquid limit less than 50	None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS	Readily identified by colour, odour, spongy feel and frequently by fibrous texture.						Pt	PEAT

- Low plasticity – Liquid Limit w_L less than 35%.
- Medium plasticity – w_L between 35% and 50%.
- High plasticity – w_L greater than 50%.

COMMON DEFECTS IN SOIL

TERM	**DEFINITION**	**DIAGRAM**
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	**DEFINITION**	**DIAGRAM**
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance	In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.
Defect	Discontinuity or break in the continuity of a substance or substances.
Mass	Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME Simple rock names are used rather than precise geological classification.

PARTICLE SIZE Grain size terms for sandstone are:

Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm

FABRIC Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:

Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	**RS**	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	**XW**	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	**HW**	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	**MW**	The whole of the rock substance is discoloured, usually by iron staining or bleaching , to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	**SW**	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	**FR**	Rock substance unaffected by weathering.

Notes on Weathering:

1. AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726.
2. Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

ROCK SUBSTANCE STRENGTH TERMS

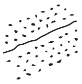
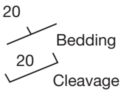
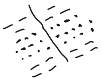
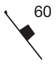
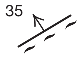
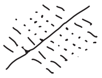
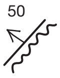
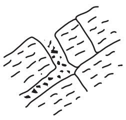
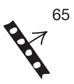
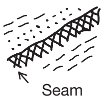
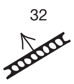
Term	Abbreviation	Point Load Index, $I_{s(50)}$ (MPa)	Field Guide
Very Low	**VL**	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

Notes on Rock Substance Strength:

1. In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
2. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
3. The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index $I_{s(50)}$. The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.			
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

DEFECT SHAPE	TERMS
Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS

Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

BLOCK SHAPE TERMS

Blocky	Approximately equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greate than cross section

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

coffey geotechnics

Engineering Log - Borehole

Borehole ID.	**BH201**
sheet:	1 of 4
project no.	**GEOTLCOV24303AH**
date started:	**28 May 2013**
date completed:	**28 May 2013**
logged by:	**DB**
checked by:	**DS**

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,368.70; N: 6,250,526.40 (Datum Not Specified)
surface elevation : 2.97m (Datum Not Specified)
angle from horizontal: 90°

drill model: DP520
mounting: Track
hole diameter : 100 mm

drilling information

method & support	samples & field tests	RL (m)	depth (m)
DT			
HA	E		
AD/T	E	2	1.0
	E		
	SPT 1/50mm HB N*=R	1	2.0
		0	3.0
		-1	4.0
		-2	5.0
		-3	6.0
		-4	7.0

material substance

material description SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components	moisture condition
BRICK PAVERS: 0.08m.	D
CONCRETE: 0.04m.	M
FILL: Sandy GRAVEL: fine to medium, subangular to angular, dark grey to pale brown, sand is medium to coarse grained, with some lime.	
FILL: Gravelly SAND: medium to coarse, pale-grey to dark brown, sub-angular, sandstone gravel, trace clay.	
FILL: SAND: fine to medium, pale-brown to pale-grey, trace fine to medium grained, dark grey to pale-grey sandstone and shale gravel. trace fine metal chicken wire and rubber fragments, observed at base of auger	
SANDSTONE: fine to medium, pale-grey, slightly weathered, medium to high strength.	
Borehole BH201 continued as cored hole	

structure and additional observations

PAVEMENT

STABILISED ROADBASE

PID = 0ppm at 0.6m, no odour or staining

FILL

PID = 0ppm at 1.0m, no odour or staining

PID = 0ppm at 1.6m, no odour or staining

BEDROCK

SPT bouncing at 1.95m

hand penetrometer (kPa): 100 200 300 400

method
- AD auger drilling*
- AS auger screwing*
- RR roller/tricone
- W washbore
- CT cable tool
- HA hand auger
- DT diatube
- B blank bit
- V V bit
- T TC bit
- * bit shown by suffix
- e.g. AD/T

support
- M mud
- N nil
- C casing

penetration

1 2 3 no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests

U##	undisturbed sample ##mm diameter
D	disturbed sample
B	bulk disturbed sample
E	environmental sample
HP	hand penetrometer (kPa)
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
VS	vane shear peak/remouded (uncorrected kPa)
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Engineering Log - Cored Borehole

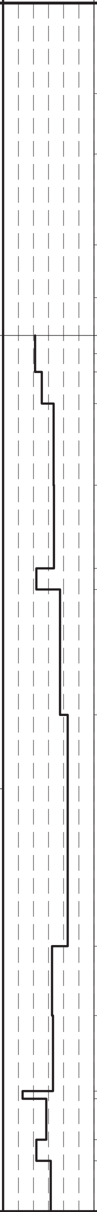
Borehole ID.	**BH201**
sheet:	2 of 4
project no.	**GEOTLCOV24303AH**
client:	**Lend Lease Development Pty Ltd**
principal:	
project:	**SICEEP - International Convention Centre (ICC) Hotel**
location:	**Darling Harbour, Sydney**
date started:	**28 May 2013**
date completed:	**28 May 2013**
logged by:	**DB**
checked by:	**DS**

position: E: 333,368.70; N: 6,250,526.40 (Datum Not Specified) surface elevation : 2.97m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

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

method & support	water	RL (m)	depth (m)	material description ROCK TYPE: grain characterisics, colour, structure, minor components	weathering & alteration	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other)
		2	1.0					
		1	2.0	start coring at 2.20m				
NMLC				**SANDSTONE**: medium grained, pale-grey to orange-white, indistinctly cross bedded at 0-10°, with some dark grey laminae at 0-10°	FR			SM, 0°, PL, 25mm, HP Clay PT, 0°, PL, Clay CO
						a=0.66 d=0.54		PT, 0°, PL, RO, Clay CO
		0	3.0					PT, 5°, PL, RO, CO, Carbon
							90%	PT, 5°, CU, RO, Clay CO JT, 10°, PL, RO, CN
		-1	4.0			a=2.25 d=2.13		
								PT, 5°, PL, RO, Clay CO
		-2	5.0	5.2 - 6.2m: massive		a=1.38 d=2.01 a=2.20 d=1.77		
		-3	6.0			a=1.74 d=1.67		PT, 0 - 5°, PL, RO, Clay CO
							96%	PT, 5°, PL, RO, CO, Carbon
		-4	7.0			a=1.53 d=1.64		PT, 0°, PL, RO, Clay CO SM, 0°, PL, 20mm, HP Clay
				SHALE: dark grey, indistinctly bedded at 0-5°				SM, 0 - 20°, IR, 15mm, HP Clay SM, 0°, PL, 25mm, HP Clay
				SANDSTONE: medium to coarse grained, pale grey, pebbly				



estimated strength & Is50: VL L M H VH EH (× = axial; ○ = diametral)

method & support
- DT diatube
- AS auger screwing
- AD auger drilling
- RR roller/tricone
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn
- RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

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

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CS crushed seam
- SM seam
- DB drilling break

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole ID.	**BH201**
sheet:	3 of 4
project no.	**GEOTLCOV24303AH**
client:	**Lend Lease Development Pty Ltd**
principal:	
project:	**SICEEP - International Convention Centre (ICC) Hotel**
location:	**Darling Harbour, Sydney**
date started:	**28 May 2013**
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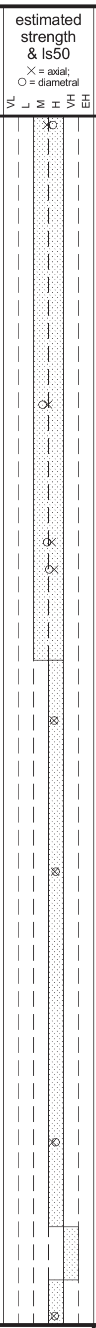
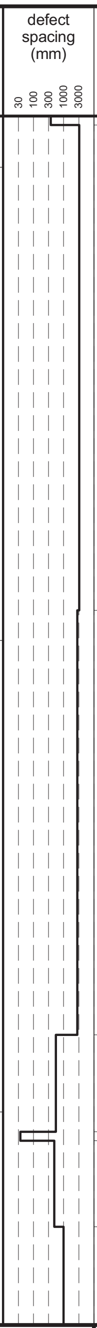
position: E: 333,368.70; N: 6,250,526.40 (Datum Not Specified) surface elevation : 2.97m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

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

method & support	water	RL (m)	depth (m)	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other)
NMLC				**SANDSTONE**: medium grained, pale-grey to orange-white, indistinctly cross bedded at 0-10°, with some dark grey laminae	FR	a=0.84 d=1.35	96%	PT, 5°, PL, VR, CO, Carbon
		-6	9.0					
		-7	10.0			a=0.93 d=0.60	100%	
		-8	11.0			a=1.21 d=0.85 a=1.49 d=1.00		PT, 0 - 10°, PL, RO, Sandy clay CO
				SANDSTONE: medium grained, pale-grey to orange-white, massive, with some carbonaceous flecks < 25mm diameter				
		-9	12.0			a=1.45 d=1.48		
		-10	13.0			a=1.54 d=1.64	100%	
		-11	14.0					JT, 35°, IR, VR, CN
				shale breccia - 25mm thickness shale breccia - 50mm thickness		a=1.31 d=1.64		JT, 25°, PL, RO, CN JT, 35°, PL, RO, CN
		-12	15.0				94%	PT, 0°, PL, RO, Clay CO
				SANDSTONE: fine grained, pale-grey to grey, indistinctly bedded at 0°, with some dark grey laminations				





CDF_0_9_04AL.GLB Log COF BOREHOLE: CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:09

method & support
- DT diatube
- AS auger screwing
- AD auger drilling
- RR roller/tricone
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

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

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CS crushed seam
- SM seam
- DB drilling break

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

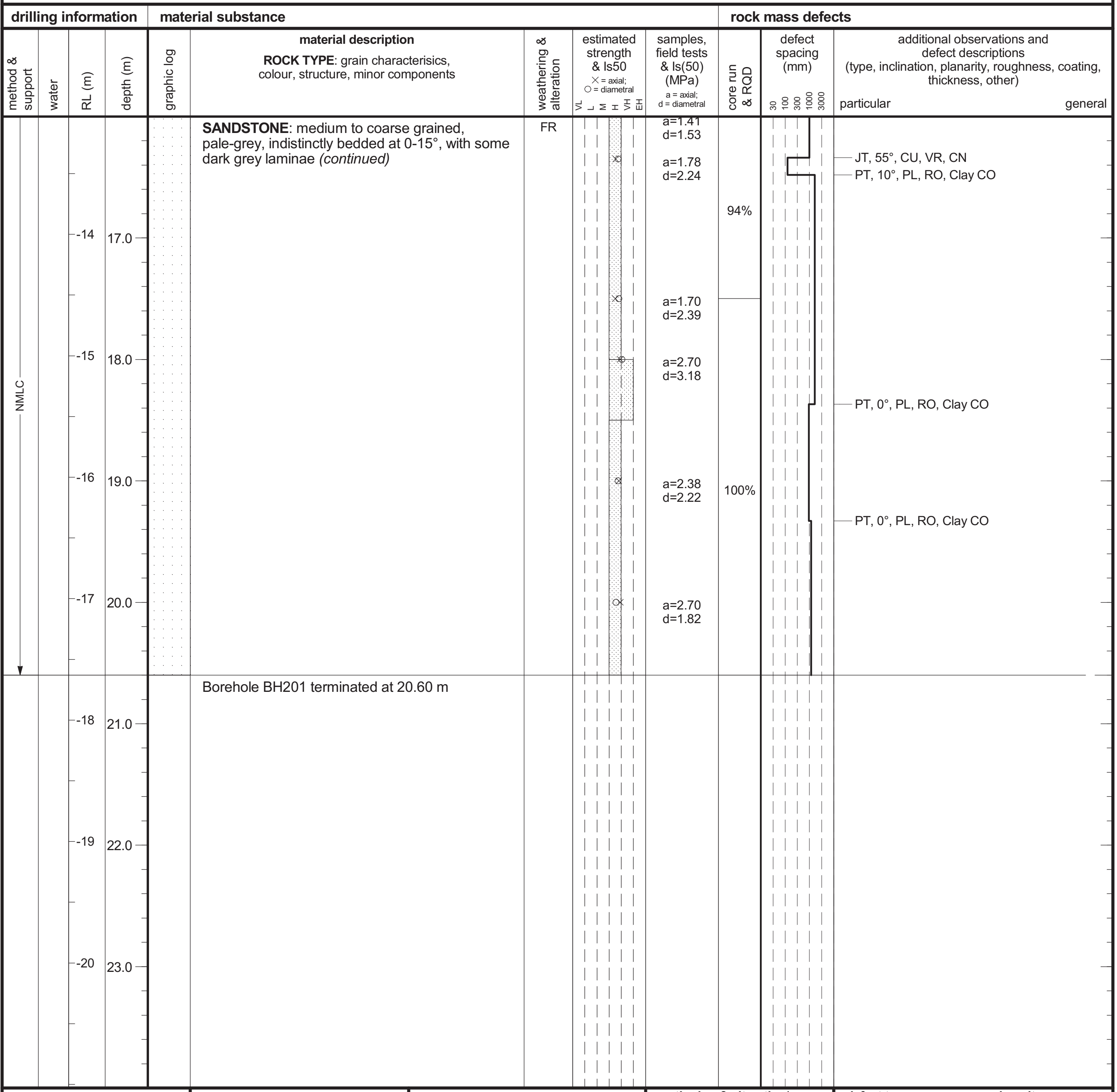
coating
- CN clean
- SN stain
- VN veneer
- CO coating

Engineering Log - Cored Borehole

Borehole ID.	**BH201**
sheet:	4 of 4
project no.	**GEOTLCOV24303AH**
client:	**Lend Lease Development Pty Ltd**
date started:	**28 May 2013**
principal:	
date completed:	**28 May 2013**
project:	**SICEEP - International Convention Centre (ICC) Hotel**
logged by:	**DB**
location:	**Darling Harbour, Sydney**
checked by:	**DS**

position: E: 333,368.70; N: 6,250,526.40 (Datum Not Specified) surface elevation : 2.97m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm



drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 × = axial; ○ = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular general
NMLC					**SANDSTONE**: medium to coarse grained, pale-grey, indistinctly bedded at 0-15°, with some dark grey laminae *(continued)*	FR		a=1.41 d=1.53			
								a=1.78 d=2.24			JT, 55°, CU, VR, CN PT, 10°, PL, RO, Clay CO
									94%		
		-14	17.0								
								a=1.70 d=2.39			
		-15	18.0					a=2.70 d=3.18			
											PT, 0°, PL, RO, Clay CO
		-16	19.0					a=2.38 d=2.22	100%		
											PT, 0°, PL, RO, Clay CO
		-17	20.0					a=2.70 d=1.82			
					Borehole BH201 terminated at 20.60 m						
		-18	21.0								
		-19	22.0								
		-20	23.0								

method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD

- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

roughness

SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

coating

CN	clean
SN	stain
VN	veneer
CO	coating

PointID : BH201a Depth Range: 2.20 - 11.00 m

drawn		**coffey geotechnics** SPECIALISTS MANAGING THE EARTH	client:	Lend Lease Development Pty Ltd			
approved			project:	SICEEP - International Convention Centre (ICC) Hotel Darling Harbour, Sydney			
date	**07/06/2013**		title:	**CORE PHOTOGRAPH** **BH201**			
scale	**N.T.S.**						
original size	**A4**		project no:	GEOTLCOV24303AH	fig no:	**FIGURE 1**	rev:

PointID : BH201a Depth Range: 11.00 - 20.60 m

drawn		client:	Lend Lease Development Pty Ltd
approved		project:	SICEEP - International Convention Centre (ICC) Hotel Darling Harbour, Sydney
date	07/06/2013	title:	**CORE PHOTOGRAPH** **BH201**
scale	**N.T.S.**	project no:	GEOTLCOV24303AH
original size	**A4**	fig no:	**FIGURE 2**
		rev:	

coffey
geotechnics
SPECIALISTS MANAGING
THE EARTH

coffey geotechnics

Engineering Log - Borehole

Borehole ID.	**BH202**
sheet:	1 of 4
project no.	*GEOTLCOV24303AH*
client:	*Lend Lease Development Pty Ltd*
principal:	
project:	*SICEEP - International Convention Centre (ICC) Hotel*
location:	*Darling Harbour, Sydney*
date started:	*23 May 2013*
date completed:	*23 May 2013*
logged by:	*CL*
checked by:	*DS*

position: E: 333,384.50; N: 6,250,527.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T HQ Casing				3				**ASPHALT**: 0.05m.	D			**PAVEMENT**
HA			E					**Gravelly SAND**: fine coarse, dark grey, fine to medium grained igneous gravel.				**ROADBASE** PID = 0.4ppm at 0.2m
AD/T			E E				SP	**Gravelly SAND**: fine coarse, grey mottled brown, fine to medium grained gravel.		D		**FILL** PID = 0ppm at 0.5m
			SPT 15/100mm N*=R					**SAND**: fine, orange brown, with a trace of sandstone gravel.				**RESIDUAL SOIL** PID = 0ppm at 0.6m
				2	1.0			**SANDSTONE**: pale grey mottled orange brown, moderately weathered to slightly weathered, medium strength.				**BEDROCK**
								Borehole BH202 continued as cored hole				
				1	2.0							
				0	3.0							
				-1	4.0							
				-2	5.0							
				-3	6.0							
				-4	7.0							

method

AD	auger drilling*
AS	auger screwing*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*	bit shown by suffix
e.g.	AD/T

support

M	mud	N	nil
C	casing		

penetration

1 2 3 no resistance ranging to refusal

water

10-Oct-12 water level on date shown

▶ water inflow

◀ water outflow

samples & field tests

U##	undisturbed sample ##mm diameter
D	disturbed sample
B	bulk disturbed sample
E	environmental sample
HP	hand penetrometer (kPa)
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
VS	vane shear peak/remouded (uncorrected kPa)
R	refusal

classification symbol & soil description

based on Unified Classification System

moisture

D	dry
M	moist
W	wet

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Engineering Log - Cored Borehole

Borehole ID. **BH202**
sheet: 2 of 4
project no. **GEOTLCOV24303AH**

client: ***Lend Lease Development Pty Ltd***
principal:
project: ***SICEEP - International Convention Centre (ICC) Hotel***
location: ***Darling Harbour, Sydney***

date started: ***23 May 2013***
date completed: ***23 May 2013***
logged by: ***CL***
checked by: ***DS***

position: E: 333,384.50; N: 6,250,527.50 (Datum Not Specified)
surface elevation : 3.00m (Datum Not Specified)
angle from horizontal: 90°
drill model: DP520
mounting: Track
Casing Diameter : HQ

drilling information

method & support: NMLC (from 1.0 m)

RL (m): 3, 2, 1, 0, -1, -2, -3, -4
depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0

material substance

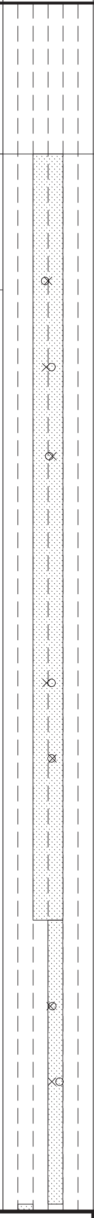
start coring at 1.00m

SANDSTONE: fine to medium grained, pale grey, with dark grey laminae, distinctly cross bedded at 0-15°
1.30m to 1.70m: some iron staining

weathering & alteration: SW (from 1.0 m); FR (from approx. 1.9 m)

SANDSTONE: medium to coarse grained, pale grey, with some dark grey shale lentices, iron stained from 6.07m to 6.28m, some iron staining from 7.3m to 7.65m

estimated strength & Is50 (× = axial; ○ = diametral): VL L M H VH EH

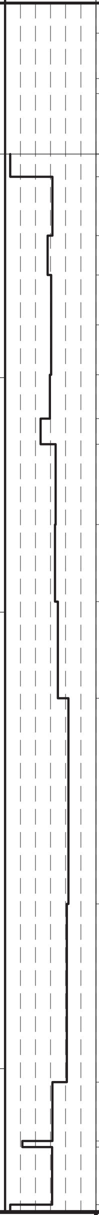


samples, field tests & Is(50) (MPa) (a = axial; d = diametral):
- a=0.96 d=0.76
- a=0.83 d=1.24
- a=1.34 d=1.04
- a=0.84 d=1.25
- a=1.35 d=1.24
- a=1.15 d=1.32
- a=1.27 d=2.29

rock mass defects

core run & RQD: 90%; 100%; 99%; 70%

defect spacing (mm): 30, 100, 300, 1000, 3000



additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) — particular / general:
- 180 mm, XW zone
- JT, 45°, ST, RO, CO
- PT, 0°, PL, RO, SN
- PT, 0°, PL, RO, CO
- PT, 0°, PL, RO, CN
- SM XW, 10 mm
- PT, 0°, PL, RO, CN
- PT, IR, RO, CO
- PT, 0°, PL, RO, CN
- PT, 5°, PL, RO, CO
- SM, 40 mm
- PT, 0°, PL, RO, CO
- PT, 0°, PL, RO, CO
- PT, 0°, PL, RO, CN

method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL: water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD

- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

roughness

SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

coating

CN	clean
SN	stain
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole ID.	**BH202**
sheet:	3 of 4
project no.	**GEOTLCOV24303AH**
date started:	**23 May 2013**
date completed:	**23 May 2013**
logged by:	**CL**
checked by:	**DS**

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,384.50; N: 6,250,527.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ

method & support	water	RL (m)	depth (m)	material description	weathering & alteration	samples, field tests & Is(50) (MPa)	core run & RQD	additional observations and defect descriptions
NMLC				**INTERLAMINATED SHALE (80%) & SANDSTONE (20%)**: shale dark grey, sandstone fine grained, grey *(continued)*	XW / HW		70%	SM XW/HW, 350 mm
				SANDSTONE: fine grained, pale grey, with dark grey laminae, distinctly cross bedded at 0-15°	FR			PT, 0°, PL, RO, CO
						a=1.49 d=1.46		
		-6	9.0					
						a=0.80 d=0.88	94%	
		-7	10.0					
				SANDSTONE: fine to medium grained, pale grey, with some carbonaceous flecks, massive		a=1.47 d=1.65		PT, 5°, PL, RO, CO SM XW, 30 mm
		-8	11.0			a=1.38 d=1.50		
		-9	12.0			a=1.36 d=1.56	100%	
		-10	13.0					
						a=2.08 d=2.14		
		-11	14.0				99%	
						a=1.85 d=1.89		
		-12	15.0					
				15.21m to 15.24m: shale band				PT, 0°, PL, RO, CN PT, 0°, PL, RO, CN
				INTERLAMINATED SHALE (30%) & SANDSTONE (70%): fine grained, pale grey, shale is dark grey		a=2.85 d=1.51	96%	

method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

10/10/12, water level on date shown

water inflow

complete drilling fluid loss

partial drilling fluid loss

25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

core recovered (graphic symbols indicate material)

no core recovered

core run & RQD

barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

roughness

SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

coating

CN	clean
SN	stain
VN	veneer
CO	coating

coffey geotechnics

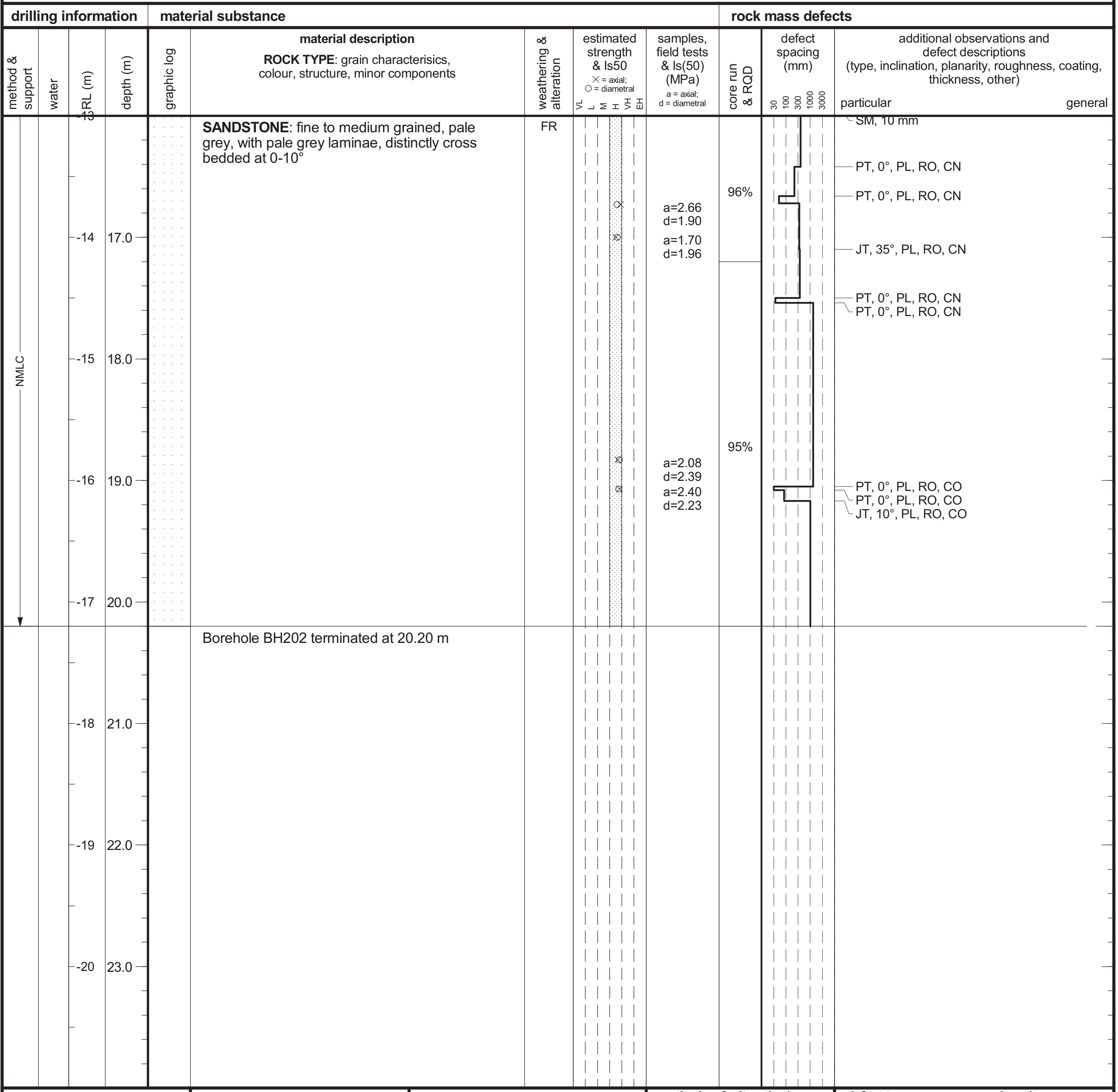
Engineering Log - Cored Borehole

Borehole ID.	**BH202**
sheet:	4 of 4
project no.	**GEOTLCOV24303AH**

client:	***Lend Lease Development Pty Ltd***	date started:	***23 May 2013***
principal:		date completed:	***23 May 2013***
project:	***SICEEP - International Convention Centre (ICC) Hotel***	logged by:	***CL***
location:	***Darling Harbour, Sydney***	checked by:	***DS***

position: E: 333,384.50; N: 6,250,527.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track Casing Diameter : HQ



SANDSTONE: fine to medium grained, pale grey, with pale grey laminae, distinctly cross bedded at 0-10°

Borehole BH202 terminated at 20.20 m

method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

10/10/12, water level on date shown

water inflow

complete drilling fluid loss

partial drilling fluid loss

25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

core recovered (graphic symbols indicate material)

no core recovered

core run & RQD

barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

roughness

SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

coating

CN	clean
SN	stain
VN	veneer
CO	coating

PointID : BH202 Depth Range: 1.00 - 7.00 m

drawn	
approved	
date	**07/06/2013**
scale	**N.T.S.**
original size	**A4**

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SPECIALISTS MANAGING
THE EARTH

client: Lend Lease Development Pty Ltd

project: SICEEP - International Convention Centre (ICC) Hotel
Darling Harbour, Sydney

title: **CORE PHOTOGRAPH**
BH202

project no: GEOTLCOV24303AH

fig no: **FIGURE 3**

rev:

PointID : BH202 Depth Range: 7.00 - 12.00 m

drawn	
approved	
date	07/06/2013
scale	N.T.S.
original size	A4

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SPECIALISTS MANAGING
THE EARTH

client: Lend Lease Development Pty Ltd

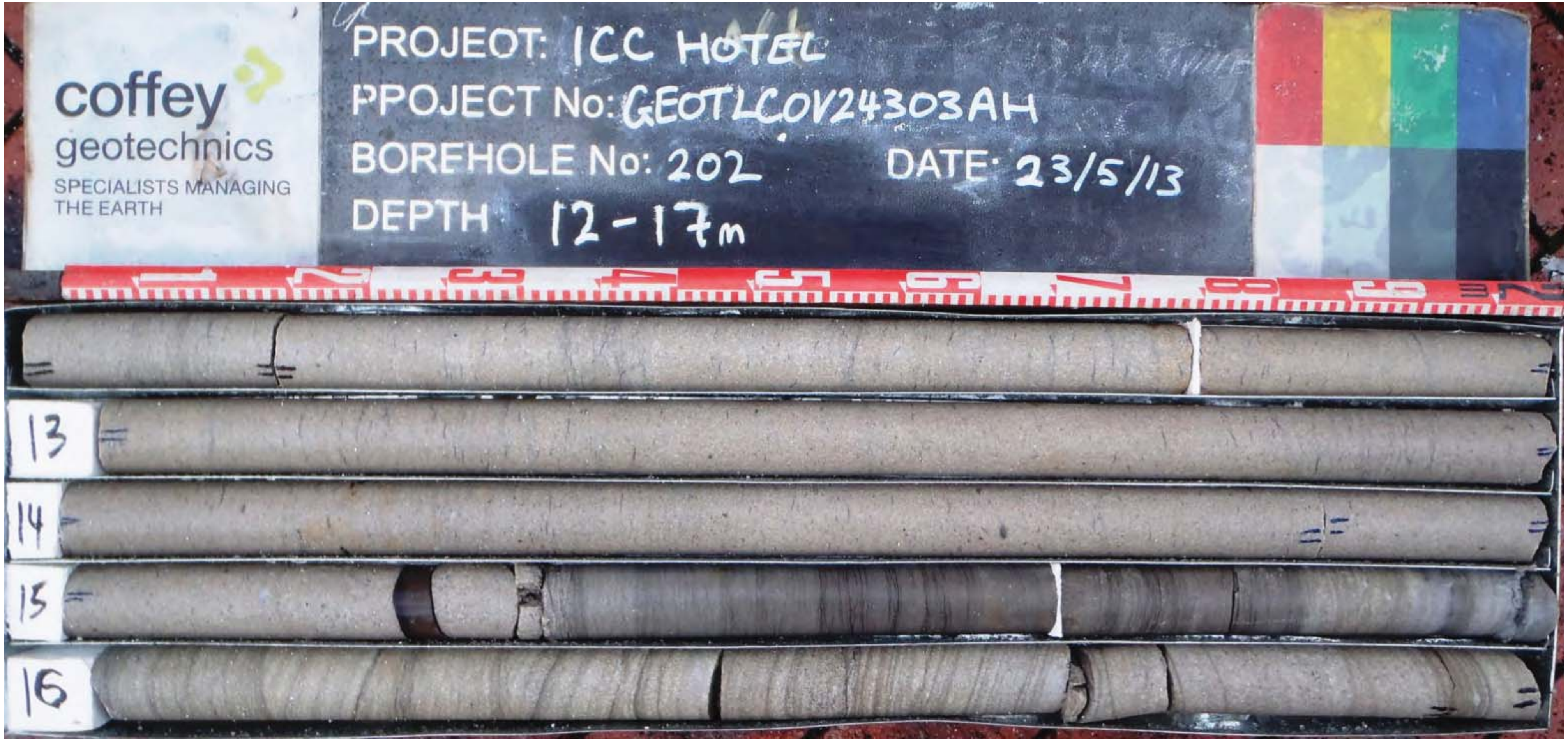
project: SICEEP - International Convention Centre (ICC) Hotel
Darling Harbour, Sydney

title: **CORE PHOTOGRAPH**
BH202

project no: GEOTLCOV24303AH

fig no: **FIGURE 4**

rev:



PointID : BH202 Depth Range: 12.00 - 17.00 m

drawn	
approved	
date	07/06/2013
scale	N.T.S.
original size	A4

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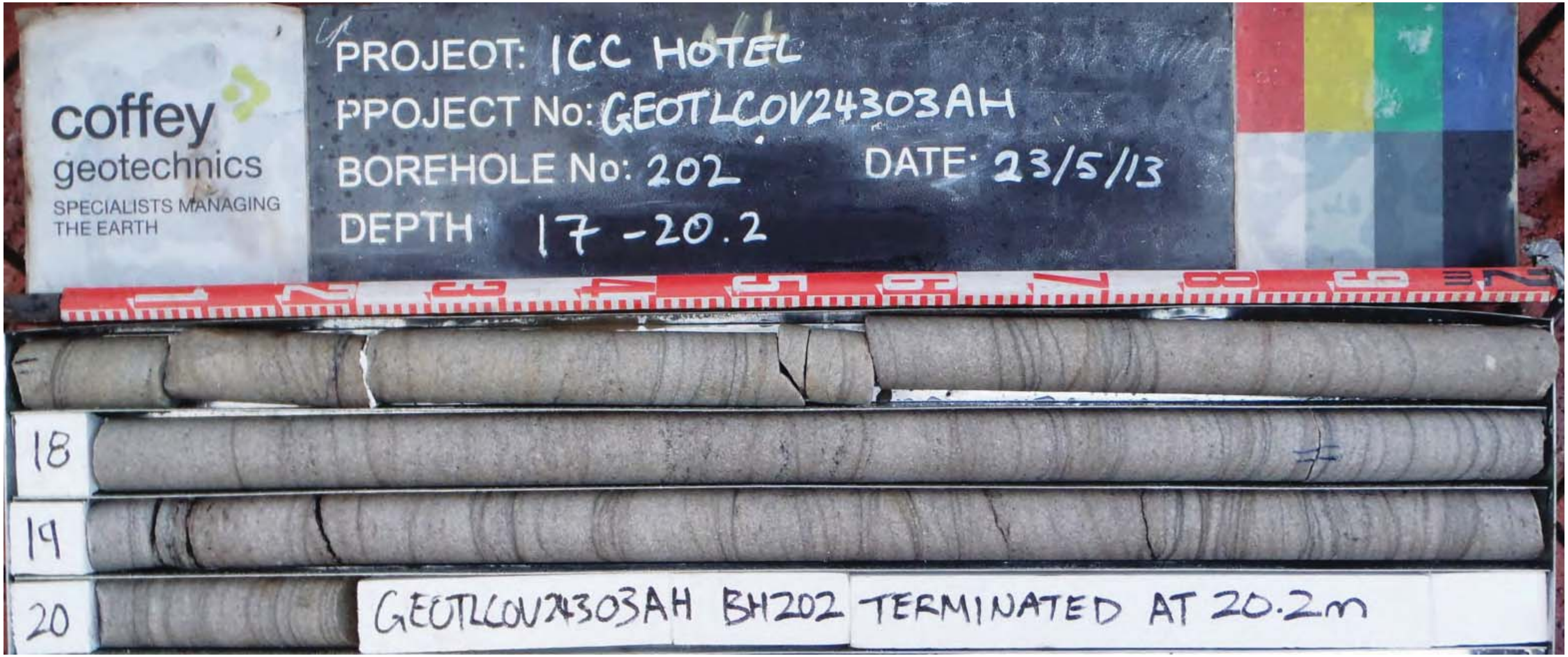
SPECIALISTS MANAGING
THE EARTH

client: Lend Lease Development Pty Ltd

project: SICEEP - International Convention Centre (ICC) Hotel
Darling Harbour, Sydney

title: **CORE PHOTOGRAPH**
BH202

project no: GEOTLCOV24303AH
fig no: **FIGURE 5**
rev:



PointID : BH202 Depth Range: 17.00 - 20.20 m

drawn	
approved	
date	**07/06/2013**
scale	**N.T.S.**
original size	**A4**

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geotechnics
SPECIALISTS MANAGING
THE EARTH

client: Lend Lease Development Pty Ltd

project: SICEEP - International Convention Centre (ICC) Hotel
Darling Harbour, Sydney

title: **CORE PHOTOGRAPH**
BH202

project no:	GEOTLCOV24303AH	fig no:	**FIGURE 6**	rev:	

coffey geotechnics

Engineering Log - Borehole

Borehole ID. **BH203**
sheet: 1 of 4
project no. **GEOTLCOV24303AH**

client: **Lend Lease Development Pty Ltd**
principal:
project: **SICEEP - International Convention Centre (ICC) Hotel**
location: **Darling Harbour, Sydney**

date started: **24 May 2013**
date completed: **24 May 2013**
logged by: **CL**
checked by: **DS**

position: E: 333,395.70; N: 6,250,513.50 (Datum Not Specified)
surface elevation : 3.10m (Datum Not Specified)
angle from horizontal: 90°
drill model: DP520
mounting: Track
hole diameter : 125 mm

drilling information | **material substance**

method & support	water	samples & field tests	depth (m)	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	structure and additional observations
HA			0.0–0.1		**BRICK PAVERS**: 0.1m.	M		**PAVEMENT**
HA		E	0.1–0.3		**FILL: Gravelly SAND**: fine to coarse, black, fine to coarse gravel.			**FILL** PID = 0ppm at 0.1m, no odour or staining
HA		E	0.3–0.6		**FILL: Gravelly SAND**: fine to coarse, grey black, fine to coarse gravel.			PID = 0ppm at 0.3m, no odour or staining
HA / AD/T		E	0.6–1.4		**FILL: Gravelly SAND**: fine to coarse, dark brown, fine to coarse gravel.			PID = 0ppm at 0.9m, no odour or staining
AD/T		E SPT 1, 1, 9 N=10	1.4–1.8		**FILL: Gravelly Clayey SAND**: fine, yellow brown mottled pale grey, orange brown and red brown, fine to medium grained gravel, high plasticity clay.			PID = 0ppm at 1.4m, no odour or staining
AD/T			1.8–2.2	SM	**Silty SAND**: fine to medium, mottled orange brown and grey, with a trace of fine to medium grained sandstone gravel.		MD	**RESIDUAL SOIL**
AD/T	▶		2.2–4.1		**SANDSTONE**: fine to medium, pale grey, highly weathered, low strength.			**BEDROCK**
			4.1		Borehole BH203 continued as cored hole			

RL (m): 3, 2, 1, 0, -1, -2, -3, -4
depth (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0
penetration: 1 2 3
hand penetrometer (kPa): 100 200 300 400

method
AD auger drilling*
AS auger screwing*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
* bit shown by suffix
e.g. AD/T

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests

U##	undisturbed sample ##mm diameter
D	disturbed sample
B	bulk disturbed sample
E	environmental sample
HP	hand penetrometer (kPa)
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
VS	vane shear peak/remouded (uncorrected kPa)
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

CDF_0_9_04AL.GLB Log COF BOREHOLE: NON CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:12

coffey geotechnics

Engineering Log - Cored Borehole

Borehole ID. **BH203**
sheet: 2 of 4
project no. **GEOTLCOV24303AH**

client: ***Lend Lease Development Pty Ltd***
principal:
project: ***SICEEP - International Convention Centre (ICC) Hotel***
location: ***Darling Harbour, Sydney***

date started: ***24 May 2013***
date completed: ***24 May 2013***
logged by: ***CL***
checked by: ***DS***

position: E: 333,395.70; N: 6,250,513.50 (Datum Not Specified) surface elevation : 3.10m (Datum Not Specified) angle from horizontal: 90°
drill model: DP520 mounting: Track hole diameter : 125 mm

drilling information				material substance						rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 × = axial; ○ = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
		3										
		2	1.0									
		1	2.0									
		0	3.0									
		-1	4.0		start coring at 4.10m							
					SANDSTONE: fine to medium grained, pale grey, with some grey laminae distinctly cross bedded at 0-5°	HW						
						FR					PT, 0°, PL, RO, CN	
							○×	a=0.90 d=0.41			PT, 0°, PL, RO, CN	
									100%			
		-2	5.0								XW SM, 10mm	
							○×	a=1.12 d=0.67			PT, 0°, PL, RO, CN	
					SANDSTONE: fine to medium grained, pale grey, with a trace of sideritic flecks, massive							
		-3	6.0									
									99%			
							⊗	a=0.86 d=0.90				
		-4	7.0		**SANDSTONE**: medium to coarse grained, pale grey, with some orange brown laminae, distinctly across bedded at 0-5°							
											PT, 0°, PL, RO, CN	
					becoming with dark grey shale lenticles							
							○	d=0.22			PT, 0°, PL, RO, CN PT, 0°, PL, RO, CN	
						HW			64%			

method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD

- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

roughness

SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

coating

CN	clean
SN	stain
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole ID. **BH203**
sheet: 3 of 4
project no. **GEOTLCOV24303AH**

client: ***Lend Lease Development Pty Ltd***
principal:
project: ***SICEEP - International Convention Centre (ICC) Hotel***
location: ***Darling Harbour, Sydney***

date started: ***24 May 2013***
date completed: ***24 May 2013***
logged by: ***CL***
checked by: ***DS***

position: E: 333,395.70; N: 6,250,513.50 (Datum Not Specified)
surface elevation : 3.10m (Datum Not Specified)
angle from horizontal: 90°
drill model: DP520
mounting: Track
hole diameter : 125 mm

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 × = axial; ○ = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		-5			**INTERLAMINATED SHALE (80%) & SANDSTONE (20%)**: shale is dark grey, sandstone is fine grained, pale grey, distinctly laminated at 0° *(continued)*	HW					XW SM, 40mm PT, 0°, PL, RO, CN XW SM, 150mm
					NO CORE: 0.08 m	FR					
									64%		
					SANDSTONE: fine grained, pale grey, pebbly			a=1.15 d=1.50			
		-6	9.0		**SANDSTONE**: fine grained, pale grey, with grey laminations, distinctly cross bedded at 0-5°						
								a=0.66 d=0.51			XW SM, 10mm PT, 0°, PL, RO, CN JT, 10°, PL, RO, CN
		-7	10.0					a=1.50 d=1.34			
					SANDSTONE: fine to medium grained, pale grey, with some carbonaceous flecks, massive						
									94%		
		-8	11.0								
								a=1.38 d=1.30			JT, 45°, PL, RO, CN JT, 25°, PL, RO, CN
		-9	12.0								
								a=1.45 d=1.35			PT, 0°, PL, RO, CN
									100%		
		-10	13.0					d=1.40			
		-11	14.0								
									98%		
					SANDSTONE: fine to medium grained, pale grey, with grey laminae, distinctly across bedded at 0-5°			a=1.36 d=1.16			
		-12	15.0								
								a=2.36 d=1.46			JT, 10°, PL, RO, CN XW SM, 10mm
					with some dark grey shale						
											PT, 0°, PL, RO, CN
					shale band						

method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD

- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

roughness

SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

coating

CN	clean
SN	stain
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole ID.	**BH203**
sheet:	4 of 4
project no.	**GEOTLCOV24303AH**
date started:	**24 May 2013**
date completed:	**24 May 2013**
logged by:	**CL**
checked by:	**DS**

client: ***Lend Lease Development Pty Ltd***

principal:

project: ***SICEEP - International Convention Centre (ICC) Hotel***

location: ***Darling Harbour, Sydney***

position: E: 333,395.70; N: 6,250,513.50 (Datum Not Specified) surface elevation : 3.10m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 125 mm

drilling information				material substance						rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 × = axial; ○ = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
		-13			**SANDSTONE**: fine to medium grained, pale grey, with grey laminae, distinctly across bedded at 0-5° *(continued)*	FR			100% 100%		PT, 0°, PL, RO, CN	
							×	a=1.39 d=0.96			PT, 0°, PL, RO, CN PT, 0°, PL, RO, CN	
		-14	17.0									
							⊗	a=2.23 d=2.07				
									96%			
		-15	18.0								XW SM, Clay, 20mm	
							×	a=1.95 d=1.42				
		-16	19.0									
											JT, 45°, PL, RO, CN PT, 0°, PL, RO, CN	
							○	d=1.30				
		-17	20.0						97%			
					with dark grey sideritic laminae and patches of siderite							
							⊗	a=2.02 d=2.10				
					Borehole BH203 terminated at 20.80 m							
		-18	21.0									
		-19	22.0									
		-20	23.0									

CDF_0_9_04AL.GLB Log COF BOREHOLE: CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:09

method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD

- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

roughness

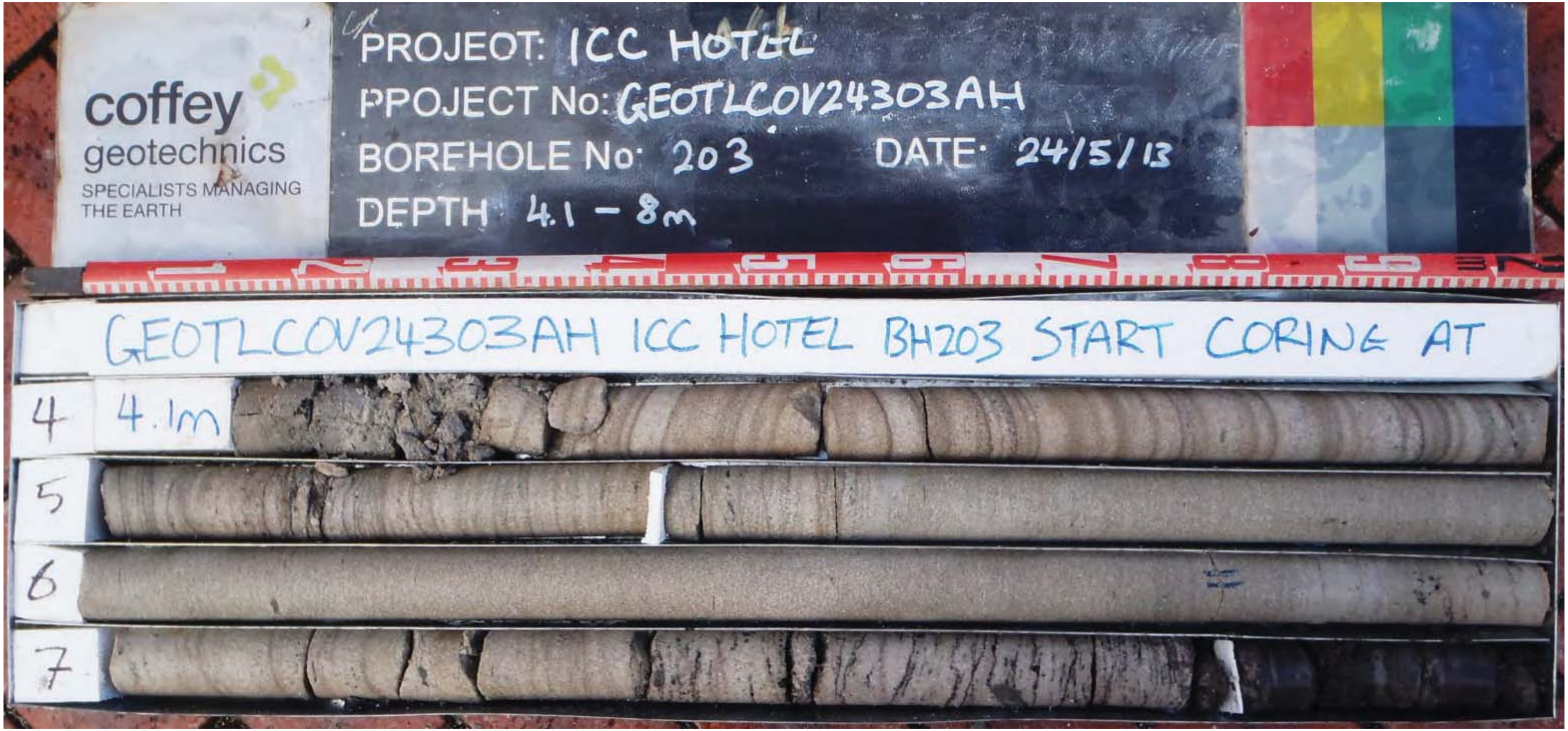
SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

coating

CN	clean
SN	stain
VN	veneer
CO	coating



PointID : BH203 Depth Range: 4.10 - 8.00 m

drawn	
approved	
date	**07/06/2013**
scale	**N.T.S.**
original size	**A4**

coffey
geotechnics
SPECIALISTS MANAGING
THE EARTH

client: Lend Lease Development Pty Ltd

project: SICEEP - International Convention Centre (ICC) Hotel
Darling Harbour, Sydney

title: **CORE PHOTOGRAPH**
BH203

project no: GEOTLCOV24303AH
fig no: **FIGURE 7**
rev:

PointID : BH203 Depth Range: 8.00 - 13.00 m

drawn	
approved	
date	07/06/2013
scale	N.T.S.
original size	A4

coffey
geotechnics
SPECIALISTS MANAGING THE EARTH

client: Lend Lease Development Pty Ltd

project: SICEEP - International Convention Centre (ICC) Hotel
Darling Harbour, Sydney

title: **CORE PHOTOGRAPH**
BH203

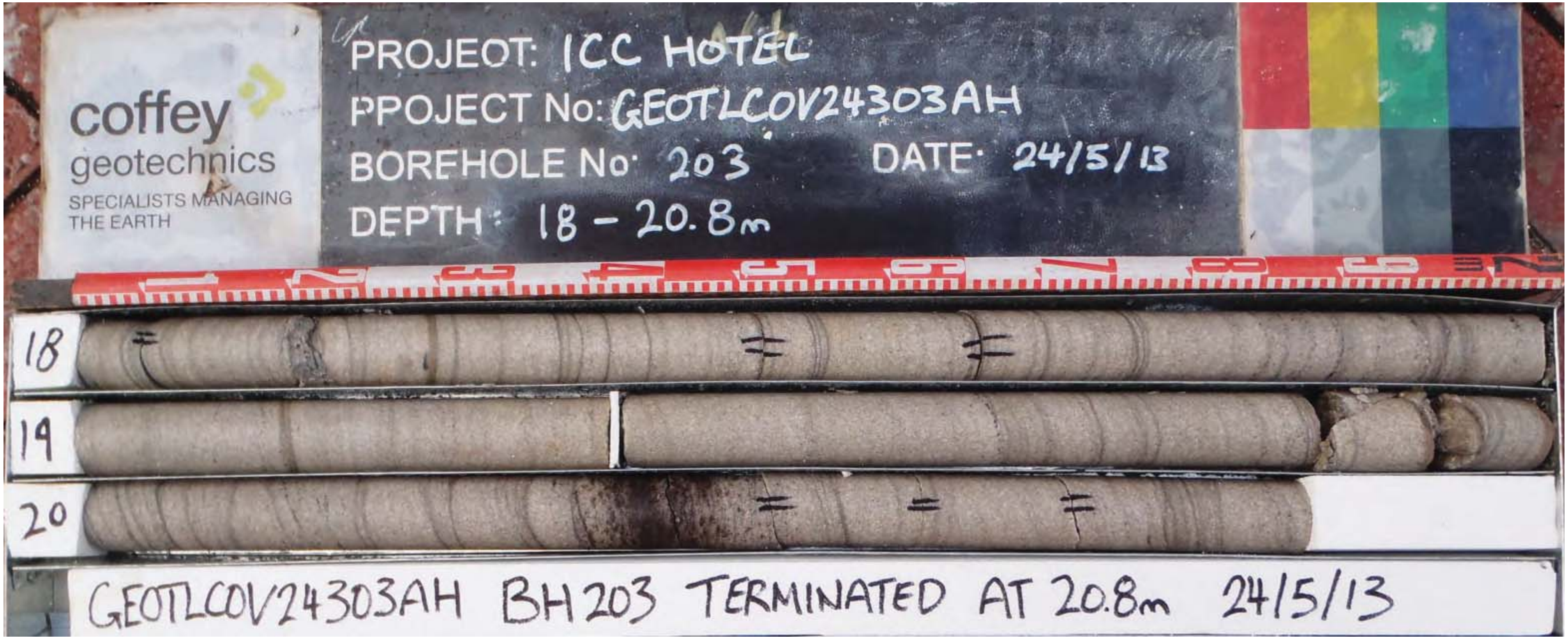
project no: GEOTLCOV24303AH

fig no: **FIGURE 8**

rev:

PointID : BH203 Depth Range: 13.00 - 18.00 m

drawn		coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	Lend Lease Development Pty Ltd
approved			project:	SICEEP - International Convention Centre (ICC) Hotel Darling Harbour, Sydney
date	07/06/2013		title:	CORE PHOTOGRAPH BH203
scale	N.T.S.			
original size	A4		project no: GEOTLCOV24303AH	fig no: FIGURE 9 rev:



PointID : BH203 Depth Range: 18.00 - 20.80 m

drawn		coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	Lend Lease Development Pty Ltd
approved			project:	SICEEP - International Convention Centre (ICC) Hotel Darling Harbour, Sydney
date	07/06/2013		title:	**CORE PHOTOGRAPH** **BH203**
scale	**N.T.S.**			
original size	**A4**		project no: GEOTLCOV24303AH	fig no: **FIGURE 10** rev:

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Engineering Log - Borehole

Borehole ID.	**BH204**
sheet:	1 of 1
project no.	***GEOTLCOV24303AH***
client:	***Lend Lease Development Pty Ltd***
principal:	
project:	***SICEEP - International Convention Centre (ICC) Hotel***
location:	***Darling Harbour, Sydney***
date started:	***14 May 2013***
date completed:	***14 May 2013***
logged by:	***JW***
checked by:	***DS***

position: E: 333,405.80; N: 6,250,490.50 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetro-meter (kPa) 100 200 300 400	structure and additional observations
DT				3				**CONCRETE**: 0.15m.				**PAVEMENT**
HA			E E E					**FILL: SAND**: fine, grey, with some fine to medium sandstone gravel.	D			**FILL** PID = 0.1ppm at 0.3m, no odour or staining PID = 0ppm at 0.6m, no odour or staining PID = 0ppm at 0.8m, no odour or staining
				2	1.0			**FILL: SAND**: fine, dark grey, trace of fine gravel.	M			
AD/T			SPT 6, 5, 4 N*=9					**FILL: SAND**: fine, orange brown, trace of high plasticity clay.				PID = 0ppm at 1.3m, no odour or staining
			E	1	2.0			**FILL: Clayey SAND**: fine to medium, pale grey, orange pink, clay is high plasticity.				
			E E					**FILL: CLAY**: high plasticity, mottled dark grey, orange and red brown, trace of shale gravel.				PID = 0.1ppm at 2.5m, no odour or staining
		▶	SPT 3, 4, 3 N*=7	0	3.0		SP	**SAND**: medium to coarse, dark grey, black, trace of clay and with some plant roots.	M	MD		**ALLUVIUM** PID = 0ppm at 3.2m, no odour or staining
				-1	4.0		SP	**Clayey SAND**: medium to coarse, mottled pale grey, brown and dark red, trace of fine to medium sandstone gravel.		MD / D		**RESIDUAL SOIL**
								Borehole BH204 terminated at 4.25 m				
				-2	5.0							
				-3	6.0							
				-4	7.0							

CDF_0_9_04AL.GLB Log COF BOREHOLE: NON CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:12

method

AD	auger drilling*
AS	auger screwing*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*	bit shown by suffix
e.g.	AD/T

support

M	mud	N	nil
C	casing		

penetration

1 2 3 no resistance ranging to refusal

water

10-Oct-12 water level on date shown

▶ water inflow

◀ water outflow

samples & field tests

U##	undisturbed sample ##mm diameter
D	disturbed sample
B	bulk disturbed sample
E	environmental sample
HP	hand penetrometer (kPa)
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
VS	vane shear peak/remouded (uncorrected kPa)
R	refusal

classification symbol & soil description

based on Unified Classification System

moisture

D	dry
M	moist
W	wet

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Borehole

Borehole ID. **BH204a**
sheet: 1 of 4
project no. **GEOTLCOV24303AH**

client: *Lend Lease Development Pty Ltd*
principal:
project: *SICEEP - International Convention Centre (ICC) Hotel*
location: *Darling Harbour, Sydney*

date started: *07 Jun 2013*
date completed: *07 Jun 2013*
logged by: *RC*
checked by: *DS*

position: E: 333,405.50; N: 6,250,490.90 (Datum Not Specified)
surface elevation : 3.00m (Datum Not Specified)
angle from horizontal: 90°
drill model: DP520
mounting: Track
hole diameter : 100 mm

method & support	water	samples & field tests	RL (m)	depth (m)	classification symbol	material description SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	structure and additional observations
AD/T			3			**ASPHALT**: 0.07m.	D		**PAVEMENT**
						FILL: Gravelly SAND: fine to medium, dark grey, cement stabilised.			**FILL**
						becoming black			
			2	1.0					
						FILL: SAND: medium, pale brown, trace of white shell fragments.			
						FILL: Sandy CLAY: low plasticity, white and pale brown, medium grained sand with some ironstone gravel.	<Wp		
			1	2.0					
	▶						>Wp		
		SPT 1, 4, 5 N*=9				with some dark grey shale rock fragments within the fill	W		
			0	3.0					
		SPT 4, 10, 5 N*=15				**FILL: Silty SAND**: medium, dark grey, trace of shells.	W / >Wp		
						FILL: MIXTURE OF SAND AND CLAY: fine to medium, low plasticity, brown and grey.			
		SPT 5, 10, 16/30mm N*=R	-1	4.0	SM	**Silty SAND**: medium, dark grey, with some shells.	W	MD / D	**ALLUVIUM**
						SANDSTONE: medium grained, red brown, highly weathered, low strength			**BEDROCK**
						Borehole BH204a continued as cored hole			
			-2	5.0					
			-3	6.0					
			-4	7.0					

CDF_0_9_04AL.GLB Log COF BOREHOLE: NON CORED GEOTLCOV24303AH BH20X SERIES.GPJ <<DrawingFile>> 11/07/2013 15:12

method

AD	auger drilling*
AS	auger screwing*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*	bit shown by suffix
e.g.	AD/T

support

M	mud
C	casing
N	nil

penetration
1 2 3 no resistance ranging to refusal

water
10-Oct-12 water level on date shown
▶ water inflow
◀ water outflow

samples & field tests

U##	undisturbed sample ##mm diameter
D	disturbed sample
B	bulk disturbed sample
E	environmental sample
HP	hand penetrometer (kPa)
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
VS	vane shearpeak/remouded (uncorrected kPa)
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D	dry
M	moist
W	wet

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey geotechnics

Engineering Log - Cored Borehole

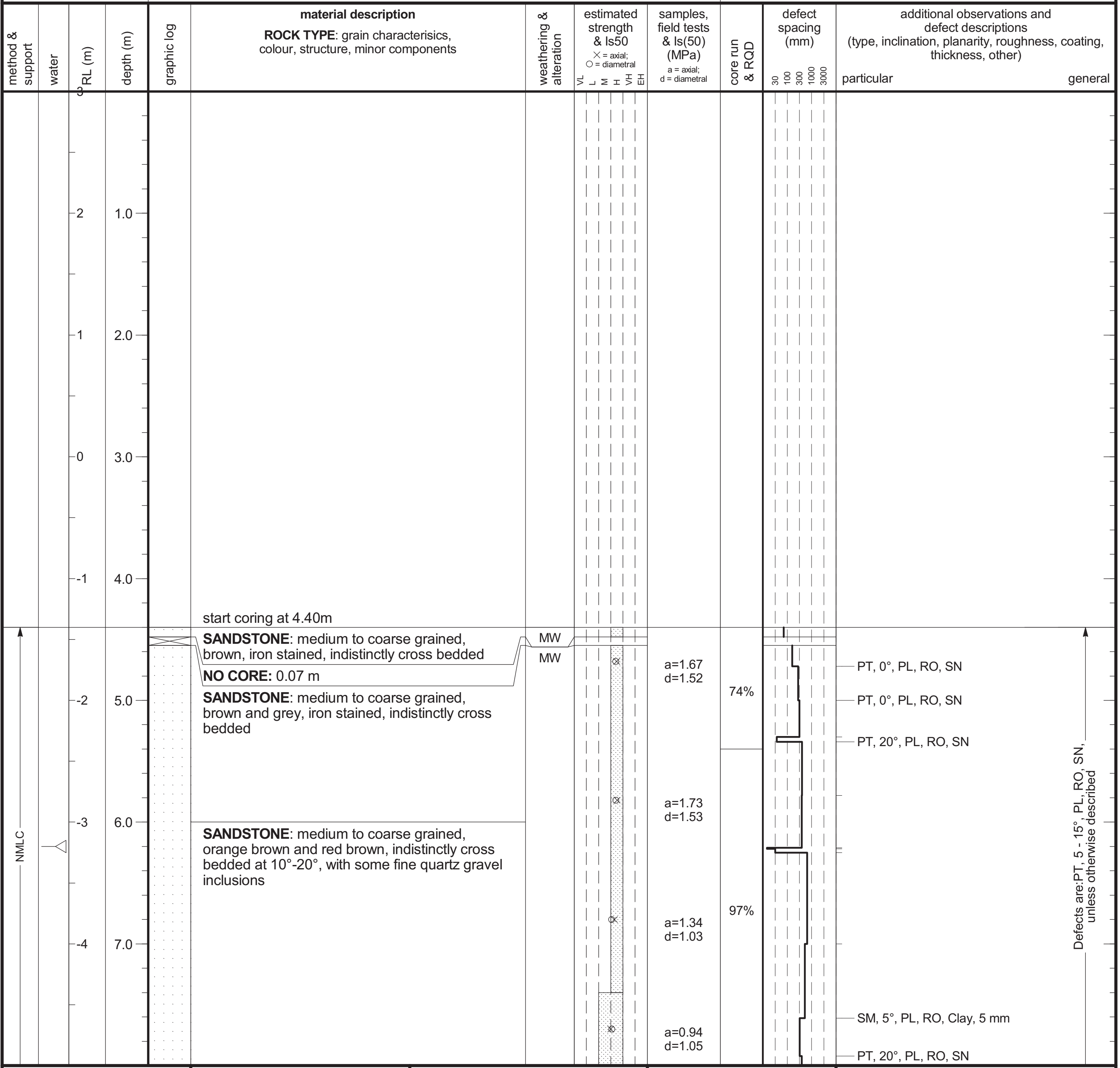
Borehole ID.	**BH204a**
sheet:	2 of 4
project no.	**GEOTLCOV24303AH**

client:	***Lend Lease Development Pty Ltd***	date started:	***07 Jun 2013***
principal:		date completed:	***07 Jun 2013***
project:	***SICEEP - International Convention Centre (ICC) Hotel***	logged by:	***RC***
location:	***Darling Harbour, Sydney***	checked by:	***DS***

position: E: 333,405.50; N: 6,250,490.90 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

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



start coring at 4.40m

SANDSTONE: medium to coarse grained, brown, iron stained, indistinctly cross bedded — MW

NO CORE: 0.07 m — MW

SANDSTONE: medium to coarse grained, brown and grey, iron stained, indistinctly cross bedded

SANDSTONE: medium to coarse grained, orange brown and red brown, indistinctly cross bedded at 10°-20°, with some fine quartz gravel inclusions

Samples: a=1.67 d=1.52; a=1.73 d=1.53; a=1.34 d=1.03; a=0.94 d=1.05

Core run & RQD: 74%; 97%

Defects (particular):
- PT, 0°, PL, RO, SN
- PT, 0°, PL, RO, SN
- PT, 20°, PL, RO, SN
- SM, 5°, PL, RO, Clay, 5 mm
- PT, 20°, PL, RO, SN

Defects (general): Defects are:PT, 5 - 15°, PL, RO, SN, unless otherwise described

method & support	
DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*	
RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength	
VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type	
PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

planarity	
PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

roughness	
SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

coating	
CN	clean
SN	stain
VN	veneer
CO	coating

coffey geotechnics

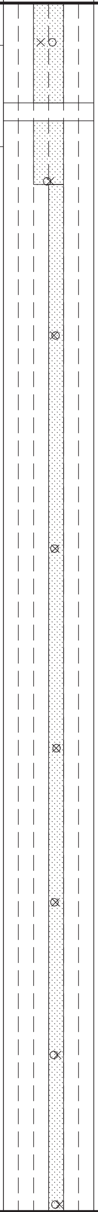
Engineering Log - Cored Borehole

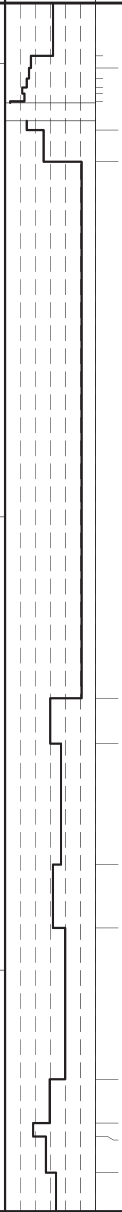
Borehole ID.	**BH204a**
sheet:	3 of 4
project no.	**GEOTLCOV24303AH**
client:	**Lend Lease Development Pty Ltd**
principal:	
project:	**SICEEP - International Convention Centre (ICC) Hotel**
location:	**Darling Harbour, Sydney**
date started:	**07 Jun 2013**
date completed:	**07 Jun 2013**
logged by:	**RC**
checked by:	**DS**

position: E: 333,405.50; N: 6,250,490.90 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

drilling information: method & support	water	RL (m)	depth (m)	material substance: material description — ROCK TYPE: grain characterisics, colour, structure, minor components	weathering & alteration	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	rock mass defects: additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC				**SANDSTONE**: medium to coarse grained, orange brown and red brown, indistinctly cross bedded at 10°-20°, with some fine quartz gravel inclusions *(continued)*	MW		97%	
					HW	a=0.52 d=1.27		PT, 30°, PL, RO, Clay VN
				NO CORE: 0.12 m				
				SANDSTONE: medium to coarse grained, orange brown and red brown, indistinctly cross bedded at 10°-20°, with some fine quartz gravel inclusions	FR			SM, 5°, PL, RO, Clay, 35 mm
		-6	9.0			a=1.07 d=0.85		PT, 10°, PL, RO, Clay CO, 2 mm
				SANDSTONE: medium grained, pale grey, distinctly cross bedded at 10° -15°				
				SANDSTONE: medium grained, pale grey, massive, with carbonaceous flecks			85%	
		-7	10.0			a=1.45 d=1.63		
		-8	11.0			a=1.58 d=1.49		
		-9	12.0					
				SANDSTONE: medium to coarse grained, pale grey and grey, distinctly cross bedded at 15°-20°				PT, 20°, PL, RO, CN
		-10	13.0			a=1.72 d=1.76	100%	PT, 20°, PL, RO, CN
								PT, 15°, PL, RO, CN
		-11	14.0			a=1.64 d=1.49		PT, 15°, PL, RO, Clay VN
		-12	15.0			a=1.87 d=1.42	97%	PT, 10°, PL, RO, Clay VN
				SANDSTONE: medium to coarse grained, grey and pale grey, distinctly cross bedded at 25° with some fine siltstone gravel clasts				PT, 10°, UN, SO, Coal CO PT, 5°, UN, SO, Coal CO PT, 30°, UN, SO, Coal CO





method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD

- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

roughness

SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

coating

CN	clean
SN	stain
VN	veneer
CO	coating

coffey geotechnics

Engineering Log - Cored Borehole

Borehole ID.	**BH204a**
sheet:	4 of 4
project no.	**GEOTLCOV24303AH**

client:	*Lend Lease Development Pty Ltd*	date started:	*07 Jun 2013*
principal:		date completed:	*07 Jun 2013*
project:	*SICEEP - International Convention Centre (ICC) Hotel*	logged by:	*RC*
location:	*Darling Harbour, Sydney*	checked by:	*DS*

position: E: 333,405.50; N: 6,250,490.90 (Datum Not Specified) surface elevation : 3.00m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 100 mm

drilling information				material substance						rock mass defects	
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 × = axial; ○ = diametral VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular general
NMLC		-13			**SANDSTONE**: medium to coarse grained, grey and pale grey, distinctly cross bedded at 25° with some fine siltstone gravel clasts *(continued)*	FR		a=2.20 d=1.60			
											PT, 30°, PL, RO, CN
											PT, 20°, UN, SO, CN, siltstone clast
					with siltstone clasts, 5mm to 50mm				97%		
					SANDSTONE: coarse grained, pale grey, massive						
		-14	17.0					a=1.80 d=1.83			
	◁				with some laminations at 20°						
					SANDSTONE: fine to medium grained, grey, closely spaced distinct laminations at 10°			a=1.42 d=1.57			PT, 10°, PL, RO, CN
											PT, 15°, PL, RO, CN
					SANDSTONE: medium grained, pale grey, distinctly cross bedded at 15° with some siltstone gravel clasts, 10mm to 40mm diameter						
		-15	18.0								
								a=2.02 d=1.80			
		-16	19.0						100%		
								a=2.78 d=2.11			
		-17	20.0								
											PT, 15°, PL, RO, Clay VN
					Borehole BH204a terminated at 20.40 m						
		-18	21.0								
		-19	22.0								
		-20	23.0								

method & support

DT	diatube
AS	auger screwing
AD	auger drilling
RR	roller/tricone
CB	claw or blade bit
W	washbore
NMLC	NMLC core (51.9 mm)
NQ	wireline core (47.6mm)
HQ	wireline core (63.5mm)
PQ	wireline core (85.0mm)
SPT	standard penetration test

water

- 10/10/12, water level on date shown
- ▶ water inflow
- ◀ complete drilling fluid loss
- ◁ partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery

- core recovered (graphic symbols indicate material)
- ☒ no core recovered

core run & RQD

- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*

RS	residual soil
XW	extremely weathered
HW	highly weathered
DW	distinctly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

*W replaced with A for alteration

strength

VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

defect type

PT	parting
JT	joint
SZ	shear zone
SS	shear surface
CS	crushed seam
SM	seam
DB	drilling break

planarity

PL	planar
CU	curved
UN	undulating
ST	stepped
IR	Irregular

roughness

SL	slickensided
POL	polished
SO	smooth
RO	rough
VR	very rough

coating

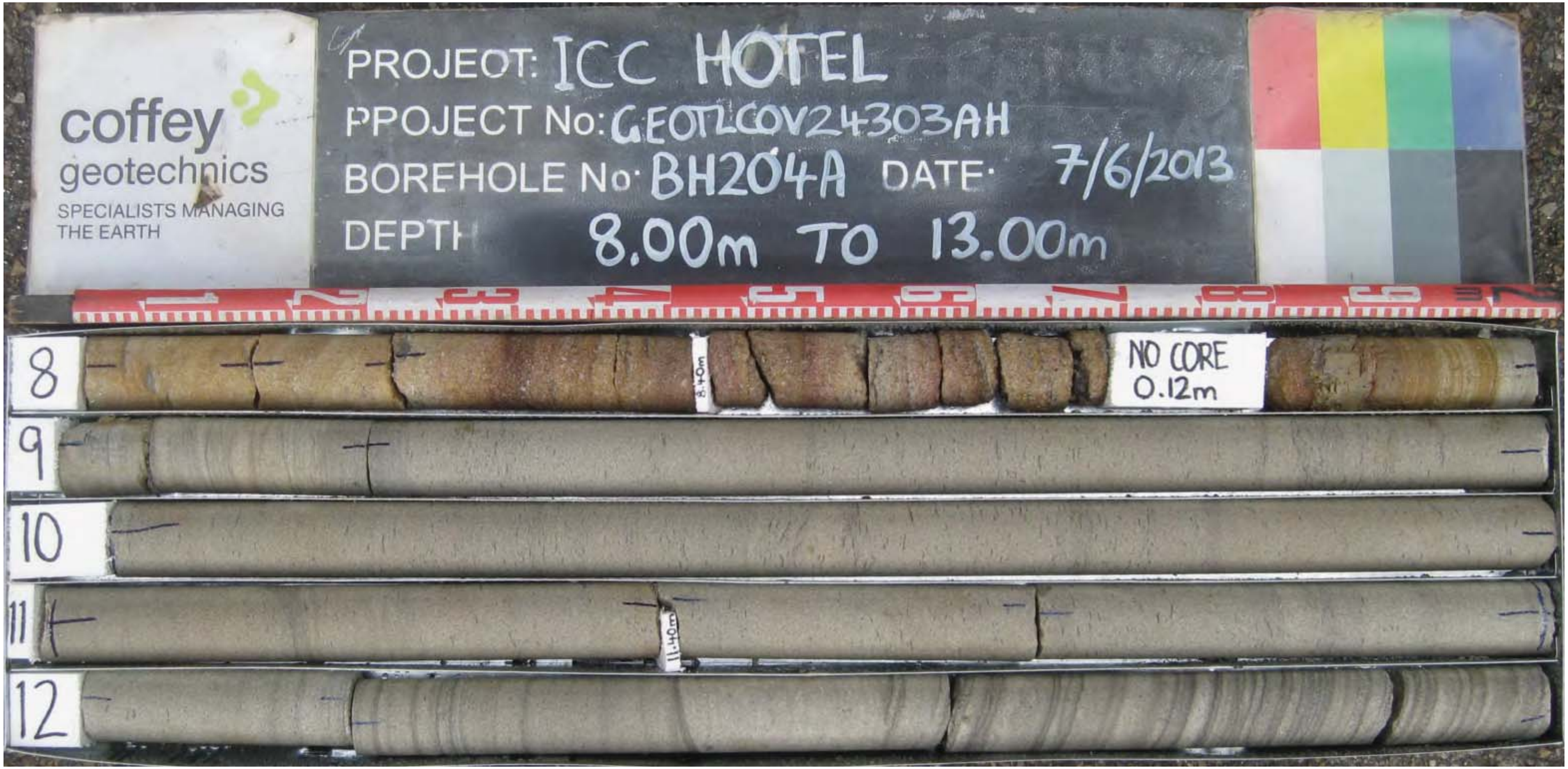
CN	clean
SN	stain
VN	veneer
CO	coating

PointID : BH204a Depth Range: 4.40 - 8.00 m

drawn	RC
approved	
date	11/06/2013
scale	N.T.S.
original size	A4

coffey
geotechnics
SPECIALISTS MANAGING
THE EARTH

client:	Lend Lease Development Pty Ltd				
project:	SICEEP - International Convention Centre (ICC) Hotel Darling Harbour, Sydney				
title:	**CORE PHOTOGRAPH BH204A**				
project no:	GEOTLCOV24303AH	fig no:	**FIGURE 11**	rev:	



PointID : BH204a Depth Range: 8.00 - 13.00 m

drawn	RC	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	Lend Lease Development Pty Ltd
approved			project:	SICEEP - International Convention Centre (ICC) Hotel Darling Harbour, Sydney
date	11/06/2013		title:	**CORE PHOTOGRAPH** **BH204A**
scale	N.T.S.		project no: GEOTLCOV24303AH	fig no: **FIGURE 12** rev:
original size	A4			

PointID : BH204a Depth Range: 13.00 - 18.00 m

drawn	RC	
approved		
date	11/06/2013	
scale	N.T.S.	
original size	A4	

coffey
geotechnics
SPECIALISTS MANAGING
THE EARTH

client:	Lend Lease Development Pty Ltd		
project:	SICEEP - International Convention Centre (ICC) Hotel Darling Harbour, Sydney		
title:	**CORE PHOTOGRAPH BH204A**		
project no: GEOTLCOV24303AH	fig no: **FIGURE 13**	rev:	

PointID : BH204a Depth Range: 18.00 - 20.40 m

drawn	RC	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	Lend Lease Development Pty Ltd
approved			project:	SICEEP - International Convention Centre (ICC) Hotel Darling Harbour, Sydney
date	11/06/2013		title:	**CORE PHOTOGRAPH BH204A**
scale	N.T.S.			
original size	A4		project no: GEOTLCOV24303AH	fig no: **FIGURE 14** rev:

coffey geotechnics

Engineering Log - Borehole

Borehole ID.	**BH205**
sheet:	1 of 4
project no.	*GEOTLCOV24303AH*
client:	*Lend Lease Development Pty Ltd*
principal:	
project:	*SICEEP - International Convention Centre (ICC) Hotel*
location:	*Darling Harbour, Sydney*
date started:	*16 May 2013*
date completed:	*16 May 2013*
logged by:	*CL*
checked by:	*DS*

position: E: 333,392.80; N: 6,250,492.80 (Datum Not Specified) surface elevation : 2.90m (Datum Not Specified) angle from horizontal: 90°

drill model: DP520 mounting: Track hole diameter : 300 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA/V							**ASPHALT**: 0.08m.				**PAVEMENT**
AD/T, CASING			E E	2			**FILL: Gravelly SAND**: fine coarse, angular, Dark grey, Fine to medium gravel.	D			PID = 0ppm at 0.1m, no odour or staining **FILL** PID = 0ppm at 0.5m, no odour or staining
			E SPT 3, 7, 5 N*=12		1.0		**FILL: Silty CLAY**: high plasticity, mottled orange brown- red brown, with atrace of fine grained ironestone gravel and sand.	<Wp			PID = 0ppm at 1.0m, no odour or staining
		►	E SPT 14, 10, 9/80mm N*=R	1	2.0	SM	**Silty SAND**: fine medium, mottled orange brown-grey, with a trace of ironstone gravel.	M	L / MD D		**RESIDUAL SOIL** PID = 0ppm at 2.0m, no odour or staining
				0	3.0		**SANDSTONE**: orange brown mottled, pale grey, HW/MW, estimated low strength. Borehole BH205 continued as cored hole				**BEDROCK**
				-1	4.0						
				-2	5.0						
				-3	6.0						
				-4	7.0						
				-5							

method

AD	auger drilling*
AS	auger screwing*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*	bit shown by suffix
e.g.	AD/T

support

M mud N nil
C casing

penetration

1 2 3 no resistance ranging to refusal

water

▼ 10-Oct-12 water level on date shown
► water inflow
◄ water outflow

samples & field tests

U##	undisturbed sample ##mm diameter
D	disturbed sample
B	bulk disturbed sample
E	environmental sample
HP	hand penetrometer (kPa)
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
VS	vane shear peak/remouded (uncorrected kPa)
R	refusal

classification symbol & soil description
based on Unified Classification System

moisture

D dry
M moist
W wet

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense