

**HAYMARKET PRECINCT, DARLING
HARBOUR, SYDNEY NSW
ACID SULFATE SOIL ASSESSMENT AND
PRELIMINARY MANAGEMENT PLAN**

Prepared for:

Lend Lease Development
30 The Bond
30 Hickson Road
Millers Point NSW 2000

Report Date: 11 March 2013
Project Ref: ENAURHOD04498AA

Written by:



Emma Coleman
Associate Environmental Scientist

Submitted by:



Matthew Locke
Project Manager

Reviewed by:



Laurie Fox
Principal

11 March 2013

Lend Lease Development
30 The Bond
30 Hickson Road
Millers Point NSW 2000

Attention: Warwick Bowyer

Dear Warwick

**RE: Haymarket Precinct, Darling Harbour, Sydney NSW
Acid Sulfate Soils Assessment and Preliminary Management Plan**

Coffey is pleased to submit our Acid Sulfate Soil Assessment and Preliminary Management Plan for the Haymarket Precinct.

This work was carried out in general accordance with our proposal dated 13th February 2013 (ref: ENAURHOD04498AA-P03 Rev.1).

Coffey understands that "The Haymarket" development is to include a mix of land uses including commercial office, residential including student accommodation, retail and public open space. Residential podium and tower forms (up to 40 storeys) are proposed. Generally, car parking is proposed to be above grade within the podium. New infrastructure services (including diversions and augmentations) will be provided to service new developments. In addition, it is likely that additional excavation works associated with remediation and archaeological works will also be required.

Coffey has assessed the Lend Lease proposed development scheme in the context of the potential to encounter acid sulfate soils on the site and have concluded that where such soils are encountered through the undertaking of the proposed development works, that they can be adequately managed utilising industry standard design and construction techniques and practices to prevent unacceptable environmental impacts and render the site suitable for its intended use.

Please contact the undersigned should you have any queries regarding this report

For and on behalf of Coffey Environments Australia Pty Ltd



Emma Coleman
Associate Environmental Scientist

RECORD OF DISTRIBUTION

No. of copies	Report File Name	Report Status	Date	Prepared for:	Initials
1 (word)	ENAU RHOD04498AA-R03a.doc	Draft	26 February 2013	Lend Lease Development Pty Ltd	
1 (pdf)	ENAU RHOD04498AA-R03a	Draft	26 February 2013	Lend Lease Development Pty Ltd	
1 (pdf)	ENAU RHOD04498AA-R03b	Draft	26 February 2013	Coffey Environments Australia Pty Ltd	
1 (pdf)	ENAU RHOD04498AA-R03b	Draft	1 March 2013	Lend Lease Development Pty Ltd	
1 (pdf)	ENAU RHOD04498AA-R03b	Draft	1 March 2013	Coffey Environments Australia Pty Ltd	
1 (pdf)	ENAU RHOD04498AA-R03	Final	11 March 2013	Lend Lease Development Pty Ltd	
1 (pdf)	ENAU RHOD04498AA-R03	Final	11 March 2013	Coffey Environments Australia Pty Ltd	

CONTENTS

1	INTRODUCTION	1
1.1	Background	1
1.2	Brief	2
1.3	Objectives	2
1.4	Previous Reports	3
1.5	Project Description	3
2	PHYSICAL SETTING	4
2.1	Site Description	4
2.2	Soils and Geology	4
2.3	Hydrogeology	4
2.4	General Subsurface Profile	5
2.5	Acid Sulfate Soil Occurrence	6
3	COASTAL ACID SULFATE SOILS	7
3.1	Background	7
3.2	Existing Laboratory Results	7
3.2.1	Action Levels	7
3.2.2	Comparison of Existing ASS Laboratory Results to Action Levels	7
3.3	Summary of ASS Risk	1
3.3.1	Unit 1 Fill Material	1
3.3.2	Unit 2 Alluvium and Estuarine Deposits	2
3.3.3	Unit 3 Residual Soils, Unit 4 Weathered Sandstone and Unit 5 Weathered Dolerite	2
3.3.4	Summary	2
4	MANAGEMENT PLAN AND PROCEDURES FOR ACID SULFATE SOILS	5
4.1	General	5
4.2	Preparation of a Site-Specific ASSMP	6

CONTENTS

4.3	Training, Roles and Responsibilities	6
4.4	Additional Assessment	6
4.5	Visual Classification	7
4.6	Field Test Classification and pH Monitoring	7
4.7	Management of Excavated Soil During Construction	7
4.8	Treatment of ASS	1
4.8.1	Treatment Pad and Liming Methodology	1
4.8.2	Lime Register and pH	1
4.8.3	Validation of Treated ASS	2
4.9	Spoil to be Returned to Below Groundwater Level	2
4.9.1	Temporary Stockpiling	2
4.9.2	Backfilling of Trench	3
4.10	Management of ASS During Directional Drilling/Under-Boring	4
4.11	Dewatering During Construction	4
4.12	Groundwater and Surface Water Monitoring	5
4.13	Monitoring Testing and Reporting	5
4.13.1	Soil Monitoring Programme	5
4.13.2	Water Quality Monitoring Programme	6
5	CONTINGENCY PLAN	7
6	CONCLUSION	8
7	LIMITATIONS	9
8	REFERENCES	10

LIST OF ATTACHMENTS

Important Information about your Coffey Environmental Report

Figures

- Figure 1: Site Locality Plan
- Figure 2: Proposed Development and Previous Borehole Locations
- Figure 3: Section A-A' Occurrence of Acid Sulfate Soils
- Figure 4: Section B-B' Occurrence of Acid Sulfate Soils
- Figure 5: Section C-C' Occurrence of Acid Sulfate Soils

Appendices

- Appendix A: Borehole Logs
- Appendix B: Laboratory Data
- Appendix C: Information from Dear et al (2002)

ABBREVIATIONS

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
AASS	Actual Acid Sulfate Soils
ASS	Acid Sulfate Soils
ASSMAC	Acid Sulfate Soils Management Advisory Committee
ASSMP	Acid Sulfate Soils Management Plan
bgs	below ground surface
BH	Borehole
DLWC	Department of Land and Water Conservation (NSW)
EC	Electrical conductivity
H₂O₂	Hydrogen peroxide
HHERA	Human Health and Environmental Risk Assessment
ha	Hectare
ID	Identification
LLD	Lend Lease Development
NATA	National Association of Testing Authorities
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NSW EPA	Environment Protection Authority of NSW
NSW DECCW	Department of Environment, Climate Change and Water of NSW
NV	Neutralising value
PASS	Potential Acid Sulfate Soils
SCR	Chromium reducible sulfur

ABBREVIATIONS

SEC	Sydney Entertainment Centre
SICEEP	Sydney International Convention, Exhibition and Entertainment Precinct
SWL	Standing Water Level

1 INTRODUCTION

1.1 Background

Darling Harbour Live (formerly known as 'Destination Sydney'- 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 the new Sydney International Convention, Exhibition and Entertainment Precinct (SICEEP).

The SICEEP Site has been divided into three distinct redevelopment areas (from north to south) – Bayside, Darling Central and The Haymarket. The Application Site area relates to The Haymarket as shown in Figure 1.1 below.



Figure 1.1: Overview illustrating the location of The Haymarket relative to other areas within SICEEP

This report supports a State Significant Development Application (SSD 12_5752) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and

Assessment Act 1979 (EP&A Act) for the establishment of building envelopes and design parameters for a new neighbourhood and a community hub within The Haymarket.

Separate development applications will be lodged for other components of the SICEEP Project. Such areas of the SICEEP are beyond the scope of this report.

1.2 Brief

To support the Application, Coffey Environments Australia Pty Ltd (Coffey) was commissioned by LLD to prepare an acid sulfate soil (ASS) assessment and preliminary management plan (ASSMP).

This ASSMP has been prepared using available data from previous investigations by Coffey, which are described in Section 1.4 below.

The ASSMP has been prepared for the planning assessment phase of the proposed development. At this stage, the ASSMP is based on the conceptual drawings provided by LLD. The conceptual drawings show that the proposed development will include:

- Multi-storey buildings founded on bored piles extending to bedrock;
- Car parking, which may extend about 1.5m below ground surface;
- Lift bases, pile caps and stair bases;
- General trenches and excavations for the purpose of infrastructure and services;
- Excavations that may be required as part of remediation and/or archaeological works;
- Excavation and retention systems;
- Extensive dewatering involving the lowering of the water table for extended periods (months) is not anticipated during construction however, dewatering for shorter periods for the localised excavation of lift pits, pile caps, infrastructure services and associated with archaeological works may be required

This ASSMP presents a frame work for the approach and methodology of ASS management at the site during the construction phase to be followed by the contractor and its subcontractors. It provides a basis for specifications for ASS management in the understanding that a site specific ASSMP will be prepared for construction. The ASSMP will be updated and re-submitted with each subsequent Stage 2 DA (where relevant).

It is envisaged that this ASSMP may require review and updating once detailed design has been undertaken.

1.3 Objectives

The objective of the ASSMP is to assess the potential to encounter ASS and reduce the potential environmental impacts associated with the disturbance of ASS within the area of the proposed works. The ASSMP is prepared in general accordance with the Acid Sulfate Soils Assessment Guidelines (Ahern et al, 1998a) and the Acid Sulfate Soils Management Guidelines (Ahern et al, 1998b) in the Acid Sulfate Soil Manual, published by the Acid Sulfate Soils Management Advisory Committee (ASSMAC). Reference has also been made to the Queensland ASS Technical Manual Soil Management Guidelines (Dear et al 2002) and the ASS Laboratory Test Methods (QASSIT 2004).

1.4 Previous Reports

Coffey has prepared several geotechnical and environmental reports for the site. The information contained in these has been collated and summarised in reports:

- Coffey Environments (2013) Site Investigation: Factual Report, Haymarket Precinct, Darling Harbour, Sydney NSW, ref: ENAURHOD04498AA-R01 (Coffey 2013a);
- Coffey Geotechnics (2013) Geotechnical Assessment, SICEEP, Haymarket Precinct – Stage 1, ref: GEOTLCOV24303AG-AB (Coffey 2013b).

The site conditions, geology and hydrogeology information included in Section 2 in this ASSMP has been reproduced from these reports.

The previous ASS sampling and analysis data was only summarised in the Coffey (2013a) report. Therefore ASS data included in Section 3.2 has been obtained from the report Contamination Investigation, Sydney International Convention and Entertainment Centre, ref: GEOTLCOV24303AA-Phase 2 report (Coffey, 2011a).

1.5 Project Description

The conceptual drawings and information provided by LLD show that the proposed development will include:

- Multi-storey buildings (up to 40 levels) founded on bored piles extending to bedrock at depths between 6.7m and 23.5m below ground surface (bgs);
- Car parking, which may extend to about 1.5m bgs;
- Lift bases, pile caps and stair bases;
- General trenches and excavations for the purpose of infrastructure and services;
- Excavations that may be required as part of remediation and/or archaeological works;
- Excavation and retention systems;
- Extensive dewatering involving the lowering of the water table for extended periods (months) is not anticipated during construction.

2 PHYSICAL SETTING

2.1 Site Description

The site is located within Darling Harbour and adjacent to Sydney's Central Business District and comprises the Sydney Entertainment Centre (SEC), associated car park and surrounding public realm. The location of the site and study boundaries is shown in Figure 1.

The site occupies an area of approximately 4ha and is bound by Pier Street to the north, Hay Street to the south, a light rail corridor to the west and Harbour Street to the east. In general, the topography of the site is relatively level. The site layout is provided in Figure 2.

The current location of Cockle Bay, Darling Harbour is about 530m to the north of the site. Based on historical records (Macquarie's Map dated 1822), the site historically would have been within Cockle Bay and its tributaries.

2.2 Soils and Geology

The site is founded over what was originally known as Cockle Bay based on Macquarie's Map of 1822. The former bay and its tributaries extended almost 1km inland from the southern boundary of the current Cockle Bay, Darling Harbour. The present shoreline has been formed progressively by infilling since the 1820's. The fill deposits are underlain by estuarine and alluvial deposits, and slope wash, which are underlain by residual soil and Hawkesbury Sandstone bedrock of the Triassic Geological Age.

After reclamation in the 1820's, several factory buildings and roadways were developed progressively within the site. In the 1930's, most of the site was demolished to allow construction of a council depot. In 1949, the site was redeveloped into City Markets No.4. Subsequently in the 1980's, the City Market structures were demolished and the site was redeveloped with a multi-storey car park and the Sydney Entertainment Centre. Further details on historical land use of the site can be found in the Environmental Desk Study report, ref: GEOTLCOV24303AA-AC dated 13 July 2011.

A paleochannel is orientated in a north to south direction has been identified on the site. The paleochannel has been in-filled with various materials, including slope wash, estuarine deposits, and man-made fill.

An igneous dyke known as "The Great Sydney Dyke" intrudes the Hawkesbury Sandstone in a northwest to southeast direction towards the southern boundary of the site.

Further information on the geotechnical units and subsurface profile is provided in Section 2.4.

2.3 Hydrogeology

Recent ground investigations (Coffey, January 2013) recorded groundwater inflows at depths of 2.4m bgs to 3.0m bgs which coincided predominantly with the fill and upper alluvial deposits. Coffey (August 2011) report that groundwater flows in a northerly direction towards Cockle Bay, Darling Harbour.

Standing groundwater levels were recorded in one monitoring well (MW120), located in the north-eastern portion of the site, using a data logger to assess the influence on tidal fluctuations (Coffey, January 2013). Groundwater levels measured over a five day period ranged between 0.751mAHD

(1.959m bgs) and 0.788m AHD (1.922m bgs), which suggests that tidal fluctuations have negligible influence on groundwater levels within the site.

2.4 General Subsurface Profile

The general subsurface profile comprises fill underlain by alluvial/estuarine sediments, which have been deposited predominantly in a south-north direction consistent with the shape of the bay, with increasing thickness to the north. Beneath these alluvial/estuarine deposits, variable thicknesses of residual soils were encountered, underlain by weathered sandstone bedrock.

Borehole logs, from June 2011 and April to May 2012 drilling programs, reporting observed soil stratigraphy at each borehole location are provided in Appendix A. In general, borehole logs prepared during the investigation broadly correlate with the published geological records.

From the available borehole information, we have broadly inferred the subsurface profiles into geotechnical units for the purpose of this report, as summarised in Table 2.1.

Table 2.1 – Inferred Generalised Geotechnical Units

Unit	Material Description
1	Fill – comprising heterogeneous mixtures of sand, sandy gravel, clay and sandy clay/silt with cobbles and occasional boulder sized rock fragments. Concrete and Asphalt materials were encountered at shallow depths at most of the borehole locations. The density/consistency of the fill is variable, and may range from loose to dense or very soft to stiff. Due to its variability and likely non-uniform placement procedure, it would be classified as “uncontrolled fill”.
2	Alluvium and Estuarine Deposits – comprising clayey sands and clays with occasional shell layers and organic matters. These materials range from very loose to medium dense or very soft to very stiff in consistency. The Estuarine layers would generally be expected to comprise grey to dark grey, very soft to firm clays/silts and very loose to loose dark grey sands and silty sands. Deeper alluvium comprises stiff to very stiff orange brown and grey clays and dense sands and clayey sands.
3	Residual Soil – derived from weathering of the underlying sandstone rock, and generally comprising dense clayey sand or sandy clay having stiff consistency, pale grey to dark grey, orange and red brown. In many places, however, this unit is relatively thin or absent due to the geological erosion process.
4	Bedrock – comprising Hawkesbury Sandstone ranging from extremely weathered to fresh with low to medium strength shale bands (up to 1.2m thick).
5A	Extremely Weathered Dolerite (Clay) – comprising high plasticity clay derived from completely weathered dyke material. This unit is found within the dyke shown to significant depths as recorded in the past investigations.

Unit	Material Description
5B	Highly weathered to fresh Dolerite found within the dyke shown in Figure 2 from observations made during previous investigations.

Three cross sections have been drawn through the site and are presented as Figures 3 to Figure 5.

Table 2.2 presents a summary of the depths of occurrence and thickness of each geotechnical unit observed at the site based on the findings of previous investigations by Coffey.

Table 2.2 – Depth of Occurrence and Thickness of Geotechnical Units

Unit	Material / Origin	Depth to Top of Unit (m)	Thickness of Unit (m)	Elevation at Top of Unit (mAHD)
1	Fill	0	0.4 to 4.5	2.4 to 3.8
2	Alluvium/Estuarine	0.4 to 6.5	1.5 to 14.5 (Where proven)	1.2 to -1.5
3	Residual Soil	4.6 to 9.8	0.4 to 4.2	-1.8 to -11.7
4	Sandstone	6.7 to 23.5	Not Proven	-3.2 to -20.8

2.5 Acid Sulfate Soil Occurrence

The DLWC (1997) 1:25,000 scale ASS risk map shows the site as disturbed terrain, which they describe as *“Disturbed terrain may include filled areas, which often occur during reclamation of low lying swamps for urban development. Other disturbed terrain includes areas which have been mined or dredged, or have undergone heavy ground disturbance through general urban development or construction of dams or levees. Soil investigations are required to assess these areas for acid sulphate soil potential.”*

A review of the acid sulfate soil (ASS) risk map, presented on the Australian Soil Resource Information System (ASRIS) website (http://www.asris.csiro.au/index_ie.html#), indicated a low probability for the presence of ASS beneath the site.

The ASRIS map indicated that there was a high probability of ASS in sediments in Darling Harbour and Sydney Harbour. There is evidence that the site and surrounding area has been reclaimed using harbour sediments, possibly along with other sources of fill material. Therefore it is possible that the some of the fill material at the site could contain ASS.

3 COASTAL ACID SULFATE SOILS

3.1 Background

Coastal ASS are commonly found in low lying coastal floodplains, estuaries, rivers and creeks. They are naturally occurring sediments rich in iron sulfides that form sulfuric acid when exposed to oxygen. Coastal ASS can include **potential** ASS (PASS) and **actual** ASS (AASS).

PASS are soils which contain iron sulfides or sulfidic material. In their undisturbed state, PASS may exhibit a pH of 4 or greater, and may be slightly alkaline. When exposed to air, the sulfides in PASS oxidise and can release significant quantities of acid. Following oxidation, the pH of these soils may fall considerably below pH 3.5.

AASS are highly acidic soils resulting from the oxidation of iron sulfides or sulfidic material present in the soil profile. AASS are formed through the disturbance of PASS, which may be a result of either natural disturbances (i.e. regional fall in groundwater levels which exposes PASS to oxygen) or human disturbances (i.e. excavating PASS, dewatering and/or dredging). AASS are typically characterised by pale yellow mottles, coating of soils with jarosite and pH of 4 or less.

3.2 Existing Laboratory Results

3.2.1 Action Levels

In order to assess the significance of the ASS potential, the laboratory results were compared to action levels in the ASSMAC (1998) Acid Sulfate Soil Manual.

The ASSMAC (1998) action levels are based on oxidisable sulfur concentrations for three differing soil textures. There are separate action levels depending on the amount of soil disturbed as a result of the proposed works. For this project it has been assumed that more than 1,000 tonnes of ASS will be disturbed. The applicable action levels are indicated in Table 3.1.

TABLE 3.1 - ASSMAC (1998) ACTION LEVELS

TEXTURE CATEGORY	APPROXIMATE CLAY CONTENT (%)	ACTION LEVEL Net Acidity (S_{CR}) (%)	ACTION LEVEL Net acidity moles/tonne
Coarse	<5%	0.03	18
Medium	5 to 40%	0.03	18
Fine	>40%	0.03	18

3.2.2 Comparison of Existing ASS Laboratory Results to Action Levels

The existing laboratory results collected by Coffey (2011) are summarised in Table 3.2.

Eighteen (18) soil samples were collected and tested using the ASS Field Screening Procedure. Subsequently, five samples were subjected to testing using the Chromium Reducible sulfur method (S_{CR}).

The testing was performed by SGS Australia Pty Ltd (SGS) a NATA-accredited laboratory in Alexandria, NSW. The results were compared to the ASSMAC (1998) Action Criteria assuming greater than 1000 tonnes of material will be disturbed during construction.

TABLE 3.2 – SUMMARY OF ASS LABORATORY RESULTS

LOCATION	MATERIAL DESCRIPTION	SCREENING TEST RESULT		S _{CR} (%)	NET ACIDITY (mol H ⁺ / tonne)	ANC (% CaCO ₃)	LIMING RATE (kg / tonne)
		pH _F	pH _{FOX}				
BH5 8.5	Alluvium, sandy clay, low to medium plasticity, pale grey, medium sand, some silt, stiff	8.3	2.3	<0.005	<5	NA	NA
BH5 14.5	Estuarine, silty clay, low plasticity, dark brown, black, with some organic material (wood), very light, stiff	6.2	6.9	-	-	-	-
BH6 2.5	Fill, sand, coarse grained, grey-brown, trace silt and rubber	7.6	5.1	-	-	-	-
BH6 6.0	Alluvium, clayey sand, coarse grained, pale grey, medium plasticity clay, loose to medium dense	7.2	5.9	-	-	-	-
BH6 9.5	Slopewash, clay, high plasticity, red-brown, pale grey, grey, trace coarse sand, very stiff to hard	5.8	5.1	<0.005	12	NA	NA
BH10 3.0	Fill, Clay, medium to high plasticity, red, brown, pale grey, orange mottled, with some fine grained gravel	6.8	6.5	-	-	-	-
BH10 8.0	Alluvium, Clay, high plasticity, red-brown-grey, some coarse sand, very stiff	6.7	4.9	-	-	-	-
BH12 3.0	Estuarine, Silty Clay, high plasticity, dark grey, some bands of medium sand, and some shells, soft-firm	6.2	4.2	-	-	-	-
BH12 4.5	Estuarine, Silty Clay, high plasticity, grey, some bands of medium sand, and some shells, soft-firm	7.9	2.7	0.028	16	NA	NA
BH13 2.0	Fill, Gravelly Sand, fine to medium grained, brown, fine to coarse grained gravel	8.1	8.3	-	-	-	-
BH13 4.0	Estuarine, silty clay, high plasticity, dark grey, soft	-	-	0.92	460	0.8	43
BH13 5.5	Slopewash, sandy clay, low plasticity, pale grey mottled	8.3	3.4	-	-	-	-

Acid Sulfate Soil Assessment and Preliminary Management Plan
Haymarket Precinct, Darling Harbour, Sydney NSW

LOCATION	MATERIAL DESCRIPTION	SCREENING TEST RESULT		S _{CR} (%)	NET ACIDITY (mol H ⁺ / tonne)	ANC (% CaCO ₃)	LIMING RATE (kg / tonne)
		pH _F	pH _{FOX}				
	orange-brown, fine to medium sand, with some fine to medium ironstone gravel, stiff to very stiff						
BH14 2.5	Estuarine, silty clay, high plasticity, dark grey to grey, trace of medium sand, very soft	10.7	8.0	0.013	6.7	NA	NA
BH14 5.5	Estuarine, silty clay/clayey sand, clay is high plasticity and dark grey, sand is medium to coarse and dark grey, soft/loose	8.1	6.8	-	-	-	-
BH15 4-4.1	Slopewash, clay, high plasticity, pale grey, trace fine sand, stiff	8.4	6.9	-	-	-	-
BH15 7.5-7.6	Residual, clayey sand, coarse grained, red, trace ironstone gravels, medium dense	7.2	6.9	-	-	-	-
BH17 8-8.1	Alluvium, clay, high plasticity, pale grey mottled red-brown, trace sand, stiff to very stiff	7.5	3.7	-	-	-	-

The results of the field screening tests showed:

- No samples showed soil in water with a pH less than 4. Soil in water showing pH below 4 can be an indication of AASS;
- Three samples showed soil in hydrogen peroxide solution with a pH below 3; R17-BH5 8.5m (alluvium), and R17-BH12 4.5m (estuarine). Soil in hydrogen peroxide solution showing pH below 3 can be an indication of PASS.

The chromium reducible sulfur (S_{CR}) suite tests showed:

- Sample R17-BH13 4.0 (estuarine) recorded 0.92% S_{CR} and a net acidity of 460 mol H⁺/tonne. This indicates PASS is present in this soil;
- Sample R17-BH12 4.5 (estuarine) recorded 0.028% S_{CR} and a net acidity of 16 mol H⁺/tonne. This indicates PASS is present in this soil;
- The remaining three samples tested showed <0.005% S_{CR} , which indicates the soils were not ASS.

The results of the testing carried out to date indicated that the estuarine soils across the site are likely to be ASS. One sample indicated the soil was AASS, and another sample indicated the soil was PASS.

The field screening results indicated that in one location, R17-BH5 8.5m, in the alluvium may be PASS. However, the S_{CR} testing suggests that this was a false positive.

3.3 Summary of ASS Risk

The following summary of ASS risk is based on the current level of knowledge regarding the soil profiles, and the development of a site specific ground model including bored piles to bedrock.

3.3.1 Unit 1 Fill Material

The composition of the fill material is variable across the site. Historical information suggests that some of the fill materials may comprise dredged sediments from the former Cockle Bay. It is unclear when these sediments were placed as fill and there is a risk that these dredged sediments may be ASS. Three samples of fill material were screened using the ASS field screening test, and the results indicated that the fill in those locations were not ASS.

The risk of encountering ASS within the fill is related to the time the sediments were placed and hence the length of time that oxidation could have occurred and the height of groundwater in the fill which would tend to slow down the oxidation process.

It is considered likely that pockets of fill material may be encountered which have some stored acidity and will need to be managed as ASS.

Given the uncertainties associated with the placement and occurrence of dredged sediments the fill material will require check testing during excavation (refer to Sections 4.5 and 4.6), and if the laboratory results indicate that stored acidity is present, then they will require management in accordance with this ASSMP.

3.3.2 Unit 2 Alluvium and Estuarine Deposits

The alluvium and estuarine deposits have been deposited predominantly in a south-north direction consistent with the former shape of the bay and occurrence of paleochannels, with increasing thickness to the north. The estuarine soils generally comprise very soft to firm clays and very loose to loose sand, grey to dark grey in colour. Estuarine soils are often characterised by organic and/or sulfurous odours. The alluvium generally comprises firm to very stiff clay and dense sand, grey and brown, often with red or orange mottling.

Estuarine soils have a high probability of being ASS and the limited laboratory analysis to date generally supports this. The logs indicate that the estuarine deposits are not consistent over the site, and that estuarine soils are not shown on all logs. It would be expected that estuarine soils would exist within former tidal creeks (prior to infilling) and as a thin layer over older alluvium.

3.3.3 Unit 3 Residual Soils, Unit 4 Weathered Sandstone and Unit 5 Weathered Dolerite

Residual soils weathered from Hawkesbury Sandstone, and weathered sandstone and dolerite are not coastal ASS, and therefore do not require management under this ASSMP.

3.3.4 Summary

Based on the review of the available soils and geological information plus the laboratory results, the risk of ASS is considered to be highest in the estuarine soils present in Unit 2. There is a low probability of encountering ASS within Unit 1 fill materials and possibly some Unit 2 alluvium if it has interbedded estuarine deposits.

Therefore, it is considered that Unit 1 and Unit 2 soils will require management in accordance with this ASSMP if excavated or disturbed.

Localised dewatering may be required, and prolonged dewatering has the potential to expose ASS to oxidation and produce acidic water, and procedures will be required to manage these risks.

The probability of ASS being encountered during the various construction activities is outlined in Table 3.3 below.

Table 3.3 – Probability of Encountering ASS

Construction Activity	Probability of Encountering ASS
Boring pile foundations	High probability of encountering ASS. Piles will extend into estuarine soils. There is also a low to moderate probability of encountering pockets of fill which are ASS.
Car park excavation to 1.5m bgs	Across most of the site fill material extends beyond 1.5m bgs. There is a low to moderate probability of encountering pockets of fill which are ASS. Where the car park excavation extends beyond the depth of fill, there is a high probability of encountering ASS.

Construction Activity	Probability of Encountering ASS
Excavation of pile caps, lift bases and stair bases. These are anticipated to be shallow, and extend no deeper than 2m bgs	Across most of the site, fill material extends beyond 2m bgs. There is a low to moderate probability of encountering pockets of fill which are ASS where excavation extends no deeper than 2m bgs. Where the pile cap and lift/stair base excavations extend beyond the depth of fill, there is a high probability of encountering ASS.
Trenches and excavations for infrastructure and services.	Across most of the site, fill material extends beyond 1.5m bgs. There is a low to moderate probability of encountering pockets of fill which are ASS where trenches and excavation extends no deeper than 2m bgs. Where the infrastructure/services excavations extend beyond the depth of fill, there is a high probability of encountering ASS. Should directional drilling/under-boring be proposed for installation of services, these would likely encounter ASS.
Excavations for remediation and/or archaeological purposes.	The depth of proposed remediation/archaeological excavations is not known. There is a low to moderate probability of encountering pockets of fill which are ASS where excavations for remediation and archaeological purposes extend no deeper than 2m bgs. Where the remediation/archaeological excavations extend beyond the depth of fill, there is a high probability of encountering ASS.
Excavation/retention systems.	The depth of proposed excavation/retention systems is not known. There is a low to moderate probability of encountering pockets of fill which are ASS where excavation/retention systems extend no deeper than 2m bgs. Where excavation/retention systems extend beyond the depth of fill, there is a high probability of encountering ASS.

It is anticipated that material which has been excavated, may be managed in the following ways:

- Disposed to landfill - this material will require treatment and management. Guidance on the management and treatment of excavated soils is provided in Sections 4.8 below;
- Re-used on site after long-term stockpiling - this material will require treatment and management. Guidance on the management and treatment of excavated soils is provided in Sections 4.8 below;

- Re-used on site, under the water table, after short to medium term stockpiling – there is a reduced need to treat these soils as they will not be exposed for long time periods, and will be returned to below the water table. Guidance on the management of these soils is provided in Section 4.9 below.

4 MANAGEMENT PLAN AND PROCEDURES FOR ACID SULFATE SOILS

4.1 General

The monitoring and management of ASS will be the responsibility of the Contractor who will prepare a site-specific ASSMP based on the actual construction scenario and using the framework provided by this general ASSMP. The site-specific ASSMP will require review and approval by Department of Planning and Infrastructure as part of the overall project approval and subsequent Development Applications (where relevant).

Sampling undertaken for previous assessment does not conform with the NSW (1998) ASS Manual where it is recommended that samples are collected and field screened at 0.5m intervals (vertically), and selected samples tested in the laboratory for further assessment (S_{CR}). Future sampling and analysis may be carried out by the Contractor to improve confidence on the location of ASS and liming rates. The results, including amended liming rates (if applicable) can be incorporated into the site-specific ASSMP.

The following general management procedures are considered applicable for the following activities:

- Spoil generated from bored piles extending to bedrock at depths between 6.7m and 23.5m below ground surface (bgs);
- Excavations for construction of basement car parks, which may extend about 1.5m bgs;
- Excavations for lift bases, pile caps and stair bases;
- General trenches and excavations for the purpose of infrastructure and services;
- Excavations that may be required as part of remediation and/or archaeological works;
- Excavation and retention systems; and,
- Localised dewatering of the above excavations.

Extensive dewatering involving the lowering of the water table for extended periods (months) is not anticipated during construction, therefore detailed management measures for dewatering has not been provided.

The general management procedures are:

- i. Appointment of an appropriately qualified person to manage the ASS issues during the earthwork activities;
- ii. Undertake regular monitoring (screening) of excavated Unit 1 (fill), and Unit 2 (alluvium and estuarine) soils to assess the potential presence of ASS during excavation activities;
- iii. Undertake regular surface water and groundwater monitoring during localised dewatering to assess if the surface water or groundwater has been impacted by oxidation of ASS;
- iv. Manage the materials that are assessed to potentially be ASS through temporary stockpiling and treatment with lime to neutralise sulphuric acid produced via oxidation.
- v. Assess options for water that requires disposal.

These procedures are further discussed in the following sections.

In the event that extensive dewatering involving the lowering of the water table for extended periods (months) is required, detailed management measures for dewatering will need to be assessed.

4.2 Preparation of a Site-Specific ASSMP

The Contractor will be responsible for preparation of a site-specific ASSMP based on the actual construction scenario.

The site-specific ASSMP will need to use the framework provided in this general ASSMP, including information on:

- The results of the additional sampling and analysis (as per Section 4.4), if carried out;
- Training, roles and responsibilities;
- Management of excavated soils;
- Treatment and monitoring of acid sulfate soils, including liming rates;
- Management of temporary stockpiles;
- Management of dewatering water, including liming rates;
- Options for re-use and/or disposal of soils;
- Options for disposal of water;
- Monitoring and reporting requirements.

4.3 Training, Roles and Responsibilities

The earthworks contractor will appoint an appropriately trained person who is responsible for managing the ASS issues during the earthwork activities.

This person should be familiar with:

- Council and other relevant statutory requirements;
- Recognition of ASS materials;
- ASS testing and treatment procedures;
- Onsite management of ASS materials, including implementing management procedures.

The classification of ASS materials during construction should be carried out by personnel trained in the identification of ASS and be based on visual classification and the field screening test. If required, a suitably qualified Environmental Consultant could be engaged to assist or train the Contractor in the identification of ASS.

4.4 Additional Assessment

The 1998 ASS Manual states that for sites greater than 4 hectares, samples should be collected from a minimum of 2 sampling locations per hectare, with soil samples collected at 0.5m intervals at each

location. Samples should be collected to a depth of 1m below the proposed depth of disturbance. For this site, this would require a minimum of eight locations.

Samples were collected from eight locations, with between one to three samples collected and analysed at each location. Additional sampling and analysis would therefore be required to satisfy these guidelines. The additional sampling and analysis can be undertaken by the Contractor, to improve confidence on the location of ASS and liming rates, with the results and liming rates incorporated into a site-specific ASSMP to be prepared by the Contractor.

4.5 Visual Classification

The preliminary visual checking of potential ASS will be based on material type, colour and consistency. Dark grey and black, very soft to soft, occasionally firm clays and sandy clays and dark grey to grey, very loose to loose clayey sands and sands will be classified as suspected acid sulfate soils.

The site soils comprise fill materials, overlying alluvial and estuarine soils. There is a potential for the fill material to contain pockets of dredged sediments, which may be ASS. The alluvial soils are generally unlikely to be ASS and would comprise stiffer clays and denser sands, and are brown, grey and mottled orange in colour.

4.6 Field Test Classification and pH Monitoring

A field screening test using hydrogen peroxide (H_2O_2) will be performed regularly on the excavated soils. The peroxide screening test will be undertaken based on Appendix I of the ASSMAC (1998) Acid Sulfate Soils Manual (Ahern et al, 1998a). Soils that record a pH of below 4, following oxidation with H_2O_2 , will be managed as ASS.

Based on the results of pH monitoring, visual assessment and field screening, selected soils samples (at a minimum rate of 10% of screened samples) will be sent for laboratory analysis using the chromium reducible suite (Scr) method to confirm the peroxide screening test results to confirm the required liming rate.

4.7 Management of Excavated Soil During Construction

Table 4.1 below summarises the required management/treatment of soils for the various construction activities, and frequency of check testing and validation sampling, and the field and laboratory analysis required. More detailed information on how to carry out the recommended treatment, and the requirements of sampling and analysis are provided in Sections 4.8 and 4.9.

The probability of ASS being encountered during the various construction activities is outlined in Table 3.3 in Section 3.3.4.

It is anticipated that generally material which has been excavated, will not be returned to the excavation. The possible exceptions to this are soils excavated from infrastructure/services trenches, and remediation/archaeological excavations. The material excavated for remediation/archaeological purposes is not expected to be returned to the excavation within a short to medium time frame, and therefore will require treatment similarly to other excavated soils.

The soils excavated from the infrastructure/services trenches may be able to be returned to below the water table within the trench within a short timeframe, reducing the need to treat these soils.

Table 4.1 – Management/Treatment of ASS for Various Construction Activities

Construction Activity	Treatment/Management Method [^]	Check Testing Frequency and Analysis	Validation Sampling and Analysis
Boring pile foundations	It is considered impractical to attempt to separate the soil cuttings that could contain ASS, from the soil cuttings that are non-ASS. It is also considered that the non-ASS cuttings could act as a sufficient buffer to neutralise the ASS present, provided the ratio of ASS to non ASS is greater than 3:1. As a precaution samples of the soil cuttings should be tested to assess if there is a need for additional neutralisation by liming. If liming is required, the procedures in Section 4.8 should be carried out.	One sample per 250m³ to be analysed using the field screening test. If the field screening tests indicate cuttings are ASS, then 10% of samples should be tested using the S_{CR} test to check the liming rate.	If liming is carried out, validation sampling will be required. This would comprise one sample per 250m³ to be analysed using the field screening test.
Car park excavations.	The soils will need to be placed in the treatment area. Check testing is required to assess if the soil is ASS, and confirm liming rates. Depending on the results of check testing, the soil will be treated with lime as per the procedures in Section 4.8.	One sample per 250m³ to be analysed using the field screening test. If the field screening tests indicate cuttings are ASS, then 10% of samples should be tested using the S_{CR} test to check the liming rate.	If liming is carried out, validation sampling will be required. This would comprise one sample per 250m³ to be analysed using the field screening test.
Excavation of pile caps, lift bases and stair bases.	The soils will need to be placed in the treatment area. Check testing is required to assess if the soil is ASS, and confirm liming rates. Depending on the results of check testing, the soil will be treated with lime as per the procedures in Section 4.8.	One sample per 250m³ to be analysed using the field screening test. If the field screening tests indicate cuttings are ASS, then 10% of samples should be tested using the S_{CR} test to check the liming rate.	If liming is carried out, validation sampling will be required. This would comprise one sample per 250m³ to be analysed using the field screening test.
Trenches and excavations for infrastructure and services.	Depending on the method of installation, two management/treatment options are possible. Soils from excavation of trenches: The soils will need to be placed in the treatment area. Check testing is required to assess if the soil is ASS, and confirm liming rates. Depending on the results of check testing, the soil will be treated with lime as per the procedures in Section 4.8. Soils from directional drilling / under-boring: Based on experience with similar under-boring work the drilling technique will most likely include wash boring using a bentonite slurry and casing to keep the hole from collapsing. It is considered impractical to attempt to separate the soil cuttings that could contain ASS, from the bentonite slurry. It is also considered that the bentonite slurry would act as a sufficient buffer to neutralise ASS. As a precaution samples of the slurry should be tested to assess if there is a need for additional neutralisation by liming.	One sample per 250m³ to be analysed using the field screening test. If the field screening tests indicate cuttings are ASS, then 10% of samples should be tested using the S_{CR} test to check the liming rate.	If liming is carried out, validation sampling will be required. This would comprise one sample per 250m³ to be analysed using the field screening test.
Excavations for remediation and/or archaeological purposes.	The soils will need to be placed in the treatment area. Check testing is required to assess if the soil is ASS, and confirm liming rates. Human health precautions may need to be implemented to protect construction workers in accordance with any approved human health and	One sample per 250m³ to be analysed using the field screening test. If the field screening tests indicate cuttings are ASS, then 10% of samples should be tested using the S_{CR}	If liming is carried out, validation sampling will be required. This would comprise one sample per 250m³ to be analysed using the field screening test.

Construction Activity	Treatment/Management Method^	Check Testing Frequency and Analysis	Validation Sampling and Analysis
	environmental risk assessment (HHERA). Depending on the results of check testing, the soil will be treated with lime as per the procedures in Section 4.8.	test to check the liming rate.	
Excavation/retention systems.	The soils will need to be placed in the treatment area. Check testing is required to assess if the soil is ASS, and confirm liming rates. Depending on the results of check testing, the soil will be treated with lime as per the procedures in Section 4.8.	One sample per 250m ³ to be analysed using the field screening test. If the field screening tests indicate cuttings are ASS, then 10% of samples should be tested using the S _{CR} test to check the liming rate.	If liming is carried out, validation sampling will be required. This would comprise one sample per 250m ³ to be analysed using the field screening test.
<i>Notes:</i> <i>^The treatment/management method outlined in this table may be amended if further assessment is carried out. The further assessment may confirm if the soils proposed to be excavated are ASS or non-ASS, and the liming rate. This would reduce the need for check testing.</i>			

4.8 Treatment of ASS

4.8.1 Treatment Pad and Liming Methodology

Excavated soils will be placed in a specially prepared treatment pad for treatment via application of lime to the soil. The type and amount of lime to be applied should be such that a neutralising value (NV) of 100 can be achieved. The NV should be identified prior to mixing. NV relates to the purity of the lime and an NV of 100 is required to ensure that the lime is effective in neutralising the potential acid. Fine powdered agricultural lime (CaCO_3) generally has an NV of 90% to 100% whilst other manufactured forms of lime can have an NV as low as 80%. Where NV is below 100, the factor of safety, hence the amount of lime will have to be adjusted accordingly.

The design of the treatment pad should be in general accordance with Figure 4, page 24, of Dear et al (2002) presented in Appendix C. The following procedures (or other equivalent) should be undertaken for the treatment pad and liming:

- The treatment pad should be located at least 40m from a permanent waterway or creek and, if possible, placed in a topographically high area to avoid inundation following heavy rain. The area should be appropriately bunded and provision made to collect run-off water.
- Spreading of the soil in thin (<200mm) layers on impervious pads within the boundary of the site works. Consideration should be given to providing a suitable foundation for the treatment area that can support the weight of the mixing machinery;
- A guard layer of neutralising agents should be provided at the base of the pad prior to the addition of ASS; and
- Addition of lime by hand or light weight truck followed by mixing, using light weight rotovators or similar tools. The amount of lime to be added has been assessed from the existing laboratory results. The preliminary lime rate, based on the current laboratory data, is 43kg/tonne by dry weight which includes a factor of safety of 1.5 to account for incomplete mixing and NV of 100 (agricultural lime). This preliminary liming rate is based on the laboratory results of five samples at various depths from five locations. Once additional assessment has been carried out, the liming rate can be reviewed;
- The amount of lime to be kept on site for emergencies will be assessed by the Contractor.

4.8.2 Lime Register and pH

In order to demonstrate that appropriate quantities of lime have been used, a lime register shall be maintained by the Contractor. The register shall list the amount of lime delivered to the site, verified by delivery dockets, and where the lime has been used. The lime usage shall quantify areas limed and soil volumes treated, liming rates and quantities of lime used. The amount of lime to be kept on-site for emergencies will be assessed by the Contractor.

Observations of the limed material will be made by an experienced ASS consultant who will also assess the lime register. Monitoring of pH will be carried out at least weekly prior to re-use of the material.

Readings of pH at or above background, in conjunction with the lime register and observations of mixing, can be used as verifiable performance indicators.

4.8.3 Validation of Treated ASS

In order to demonstrate that the treatment of the ASS has been effective sampling and analysis of the soil will be required. The sampling and analysis will comprise:

- Collection of samples at the following frequencies:
 - one sample per 250m³ for volumes up to 5,000m³;
 - one sample per 500m³ for volumes up to 10,000m³;
 - one sample per 1,000m³ for volumes greater than 10,000m³;
- Field screening of the samples as per Appendix I of the ASSMAC (1998) ASS Manual;
- Analysis of at least 10% of samples using the chromium reducible sulfur (S_{CR}) test by a NATA accredited laboratory;

Where the results indicate that the treatment has not been effective, further liming will be required.

Once successfully limed and validated this material could be used on site as general fill provided it is placed above the water table. Alternatively the limed material can be disposed off site to landfill once appropriately classified.

If the material is proposed to be disposed to landfill, sampling and analysis of the soil for contaminants of concern may be required. The soil can then be classified in accordance with the NSW DECCW (2009) Waste Classification Guidelines (or other guidelines that may supersede NSW DECCW (2009) at the time of construction).

If the material is proposed to be re-used on site, sampling and analysis of the soil for contaminants of concern may be required. The results of the testing should be compared to the commercial/industrial land use criteria in NEPM (1999) (or other guidelines that may supersede NEPM (1999) at the time of construction).

It is assumed further information on the re-use and disposal of soil from a contamination perspective will be provided in a remedial action plan or construction environment management plan.

4.9 Spoil to be Returned to Below Groundwater Level

The excavated soil from trenches for infrastructure/services may be able to be returned to at or below the groundwater level within a short to medium timeframe, where such soil also meets the on-site reuse criteria established by any approved HHERA or RAP. Where this is possible, it is not proposed to treat the excavated material but to excavate, temporarily stockpile and monitor this material for pH. The excavated material can then be used to backfill the trench to at or below the groundwater level where practicable and acceptable to the relevant utility provider. The decision to reuse material in such a manner will be to Lend Lease's discretion.

4.9.1 Temporary Stockpiling

The types of material that are likely to be encountered during trenching for services are expected to range from clays (fine textured) to sands (coarse textured). Reference must be made to Table 4 of

Dear et al (2002), presented in Appendix C, for appropriate timeframes for short to medium term stockpiling depending on the actual material types encountered. The site specific ASSMP is to detail how stockpiling will be minimised by preparing a detailed earthworks strategy that documents:

- The timing and volumes of soil to be stockpiled and returned to the trench;
- Temporary stockpile locations;
- Measures to prevent potential impacts relating to the oxidation of ASS on surface water and groundwater.

Medium term stockpiling timeframes should conform to Table 5 of Dear et al (2002) (Appendix C). Where stockpiling exceeds these limits or pH monitoring indicates that oxidation is occurring, these soils will be removed to the specially prepared liming pad and treated as per Section 4.8.

The following management plan should be followed where ASS is placed in a medium term stockpile area:

- Soils will be stockpiled at least 40m from stormwater drains or creeks and if possible placed in a topographically high area to avoid inundation following heavy rain. The soil stockpiles will be bunded, and placed on strong impermeable plastic sheeting, and provision made for collection of surface runoff and appropriate sediment, erosion and dust controls;
- The stockpiles will be kept moist to help slow the oxidation process;
- A supply of fine grained agricultural lime (with a neutralisation factor of at least 97%) will be kept on site during construction work. The amount of lime to be kept on site will be sufficient to provide emergency liming of existing stockpiles on site (see Section 5).
- The stockpiles will also be observed for obvious signs of oxidation, such as jarosite staining;
- Monitoring of the stockpiles and associated run-off water will be carried out for the duration of the work by personnel trained in the identification of ASS. The monitoring will include:
 - **Soil**
 - The stockpiles will be observed for obvious signs of oxidation, such as jarosite staining;
 - Soil samples will be collected from stockpiles at a frequency of one per 250m³ and tested in the field for pH;
 - If the pH results indicate acidification is occurring (i.e. pH is below 4) then the soil will need to be managed and treated as per Section 4.8. The soil can then be re-used on site or disposed to landfill as per Section 4.8.3.
 - **Water**
 - If surface run-off water is collected, then a water sample must be tested in the field for pH;
 - If the pH results indicate the water is acidic (i.e. pH is below 4), then the procedures in Section 4.11 should be implemented.

4.9.2 Backfilling of Trench

Material in the temporary stockpiles will be placed back within the trench within four days of excavation provided there is no evidence of oxidation. This material will be placed below the groundwater level.

4.10 Management of ASS During Directional Drilling/Under-Boring

Directional drilling or under-boring may be used for installation of some underground infrastructure or services. Based on experience with similar underboring work the drilling technique will most likely include wash boring using a bentonite slurry and casing to keep the hole from collapsing.

The slurry material is usually directed to a sump during drilling and recycled as the borehole advances. At the completion of drilling, the slurry waste should be classified and disposed of to a licensed landfill. It is considered impractical to attempt to separate the soil cuttings that could contain ASS, from the bentonite slurry. It is also considered that the bentonite slurry would act as a sufficient buffer should the slurry dry out. As a precaution a sample of the slurry should be tested to assess if there is a need for additional neutralisation.

4.11 Dewatering During Construction

Localised dewatering may be required in excavations for pile caps and lift/stair bases, and possibly in remediation/archaeological excavations. Dewatering has the potential to expose ASS to oxidation. Water levels on the site ranged from about 2.0m to 3.0m bgs.

Localised dewatering during excavations is considered to represent a low risk of ASS oxidation for the following reasons:

- Prolonged drawdown is not expected due to the localised nature of the dewatering (i.e. small excavation areas only). If draw-down is likely, then further consideration of the impacts this will have will be required in the site specific ASSMP;
- Excavations would most likely be carried out progressively in small areas. The length of time for dewatering within each area should be measured in days/weeks and is not considered to be sufficient time for significant oxidation to occur;

It should be noted that actual construction details are not known at this stage and may vary from that assumed above. Dewatering and mitigation strategies will be provided by the Contractor in line with the broad framework outlined in this general ASSMP. Prolonged lowering of the groundwater table (months) would enhance oxidation of the potential ASS in the area and eventually cause harm once the groundwater returned to pre-construction levels. As a precaution groundwater and surface water monitoring is recommended and outlined in the following sections.

Should acidification of water occur, the following general procedures should be followed:

- Water is to be placed in an acid-resistant holding tank or pond, and samples collected to assess the pH, electrical conductivity, chloride sulfate ions, and heavy metals;
- Lime will be added to the water at a rate assessed from the results of the testing;
- Following treatment with lime, the water will be sampled and tested again for pH, electrical conductivity, chloride sulfate ions and heavy metals;
- The results of the water testing must be compared to the results of baseline monitoring of receiving bodies (i.e. Darling Harbour). If the water results are similar to the results of the baseline monitoring of the receiving body, then the water will be considered suitable for disposal to the receiving body, or to stormwater drains that discharge into the receiving body. Permission from the relevant regulatory authority (i.e. NSW Office of Water or Council) must be obtained before disposal;

- If the water is not suitable for disposal in the environment, the water must either be treated to become suitable for disposal to the environment (i.e. use of a pH dosing equipment), or be removed and disposed by a licensed liquid waste contractor;
- It is assumed that the detailed remediation action plan for construction environment management plan would provide information on the management, treatment and disposal of water from a contamination perspective.

4.12 Groundwater and Surface Water Monitoring

A groundwater and surface water monitoring system will be required to confirm that impacts from potential oxidation of ASS are being appropriately managed.

Nearby drains and groundwater monitoring wells should be monitored for pH and electrical conductivity. The frequency of testing should be assessed based on the construction timetable and the length of time each areas of excavation remains open.

Baseline data should be collected from existing drains and groundwater wells prior to the commencement of excavations. Baseline data should include laboratory analysis of samples for pH, electrical conductivity, chloride sulfate ions, and heavy metals.

4.13 Monitoring Testing and Reporting

Monitoring testing and reporting of soil and groundwater will be carried out in accordance with best practice industry standards. Monitoring and testing of surface water will be carried out in accordance with the relevant sections of the National Water Quality Management Strategy. In particular the following guidelines will be referenced and used where appropriate:

- ASS Manual prepared by the ASS Management Advisory Committee (1998);
- National Environment Protection Measure (1999);
- NSW DECCW Waste Classification Guidelines (2009);
- Australian and New Zealand Guidelines for the Protection of Fresh and Marine Waters (2000); and
- Australian Guidelines for Water Quality Monitoring and Protection (2000).

4.13.1 Soil Monitoring Programme

The following soil monitoring programme should be carried out during excavation and pile boring:

- Visual assessment and pH monitoring of stockpiled material (minimum one field test per 250m³);
- Visual assessment and pH monitoring of temporary stockpiles for signs of oxidation of ASS (minimum one field test per 250m³);
- Visual assessment of backfilling operations (if soil is re-used on site) to assess that ASS is placed appropriately within the excavations/trenches;
- Laboratory analysis of selected soil samples for Scr and comparison to ASS Action Criteria;
- Laboratory analysis of soil for contaminants of concern, and comparison to the appropriate landuse criteria in NEPM (1999) and/or the NSW DECCW (2009) Waste Classification Guidelines. Further

information on the re-use and disposal of soil from a contamination perspective will be provided in the remedial action plan or construction environment management plan;

- Reporting of the results of pH monitoring, visual assessment and laboratory results.

4.13.2 Water Quality Monitoring Programme

The following water monitoring programme should be carried out during dewatering activities:

- Baseline sampling of surface water bodies where water will be discharged to, either directly or indirectly (i.e. via stormwater). Samples should be collected in accordance with the guidelines noted above;
- Laboratory analysis of baseline samples for pH, electrical conductivity (EC), chloride sulfate and heavy metals, and other potential contaminants of concern as discussed in the detailed detailed remediation action plan;
- Monitoring of groundwater and surface water during dewatering activities including field parameters EC, temperature, redox and pH;
- Reporting of the baseline results prior to dewatering commencing;
- Reporting of the monitoring of field parameters in groundwater and surface water. A comparison of monitoring results to thresholds and/or baseline data will be made. Should results exceed the threshold and/or baseline data, then the contingency procedures in Section 5 should be implemented. Other factors to be included in reporting are the areas of excavation affected, volume of stockpiled material and length of time dewatering is carried out.

5 CONTINGENCY PLAN

A contingency plan is outlined in Table 5.1, listing potential events relating to ASS that may arise during construction and actions that will be undertaken if unexpected conditions occur.

TABLE 5.1 - CONTINGENCY PLAN

Unexpected Condition	Action
ASS encountered where not expected.	Emergency liming of soil to be carried out. Where emergency liming is required and additional laboratory testing results are not readily available, the liming of ASS may be carried out at a rate of about 20kg lime per tonne of soils. The emergency liming rate is a temporary measure to lower the immediate risk to the environment and may not be sufficient for complete neutralisation.
Severity of ASS encountered is higher than expected (i.e. potential to generate more acid).	Carry out chromium reducible sulphur testing of the soil, using a NATA accredited laboratory, to confirm liming rate. Additional liming of soil is to be carried out (as per Section 4.8.1), and validation testing (as per Section 4.8.3) conducted to check liming has effectively neutralised acid.
Accumulated water from dewatering is observed to be acidified (i.e. pH <4).	Emergency liming of water is to be carried out. Where emergency liming of water is required either from dewatering or run-off from stockpiles, and laboratory testing results are not available, liming of acidic water may be carried out at a rate such that residual lime is present and the pH of the water is not less than 6. The emergency liming rate is a temporary measure to lower the immediate risk to the environment and may not be sufficient for complete neutralisation.
Validation samples fail criteria.	Carry out additional liming of soil.
Identification of unexpected contaminated materials or archaeological finds during excavations.	Refer to construction environment management plan, or remedial action plan (for contamination). An environmental consultant or archaeologist may be required to assess the material and provide management measures.
Other	Other unexpected events which may affect the outcome of the investigation would be notified to the client, and other relevant parties. At that time potential actions to address the unexpected event will be assessed and presented.

6 CONCLUSION

Coffey understands that “The Haymarket” development is to include a mix of land uses including commercial office, residential including student accommodation, retail and public open space. Residential podium and tower forms (up to 40 storeys) are proposed. Generally, car parking is proposed to be above grade within the podium. New infrastructure services (including diversions and augmentations) will be provided to service new developments. In addition, it is likely that additional excavation works associated with remediation and archaeological works will also be required.

Coffey has assessed the Lend Lease proposed development scheme in the context of the potential to encounter acid sulfate soils on the site and have concluded that where such soils are encountered through the undertaking of the proposed development works, that they can be adequately managed utilising industry standard design and construction techniques and practices to prevent unacceptable environmental impacts and render the site suitable for its intended use.

7 LIMITATIONS

This ASSMP is prepared based on the current level of understanding of the site and the proposed development. It should be reviewed and updated progressively as detailed design is known, and work is completed. It is assumed that a site specific ASSMP will be developed by the successful contractor using management procedures of this ASSMP as a framework. This ASSMP will be superceded once a site specific ASSMP has been prepared and approved.

The findings contained in this report are the result of discrete/specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of this site at all points.

This plan has been prepared based on preliminary information regarding acid sulfate soils at the site based on borehole information, and limited laboratory testing. The actual subsurface conditions encountered during the project could differ from that relied on for this report.

This plan does not address geotechnical or contamination issues.

8 REFERENCES

- Ahem CR, Stone Y and Blunden B (1998a) *Acid Sulfate Soils Assessment Guidelines*, Acid Sulphate Soils Management Advisory Committee, Wollongbar, NSW
- Ahem CR, Stone Y and Blunden B (1998b) *Acid Sulfate Soils Management Guidelines*, Acid Sulphate Soils Management Advisory Committee, Wollongbar, NSW
- Dear SE, Moore NG, Dobos SK, Watling KM and Ahern CR (2002) *Queensland Acid Sulfate Soil Technical Manual - Soil management Guidelines Version 3.8*
- Ahearn CR, McElnea AE, Sullivan LA (2004) *Acid Sulfate Soil Laboratory Methods Guidelines in Queensland Acid Sulfate Soils Manual*. Department of Natural Resources Mines and Energy Indooroopilly, Queensland, Australia
- Department of Land & Water Conservation (1997) *Botany Bay Acid Sulfate Soil Risk Map - Edition Two, 1:25,000 scale*
- National Environmental Protection Council (1999) *National Environmental Protection (Assessment of Site Contamination) Measure 1999, Schedule B (1) – Guideline on the Investigation Levels for Soil and Groundwater*
- ANZECC (2000) *Australian Water Quality Guidelines for Fresh and Marine Waters*. Australian and New Zealand Environment & Conservation Council.
- Coffey Geotechnics (August 2011) *Geotechnical Investigation Report: Proposed Sydney International Convention and Entertainment Centre, Darling Harbour* (ref: GEOTLCOV24303AA-AE Rev1).
- Coffey Geotechnics (August 2011b); *Contamination Investigation, Sydney International Convention & Entertainment Centre* (ref: GEOTLCOV24303AA-Phase 2 report)
- Coffey Geotechnics (May 2012); *Geotechnical Investigation Report: Proposed Sydney International Convention Exhibition and Entertainment Precinct (SICEEP), Darling Harbour, Sydney* (ref: GEOTLCOV24303AA-AD Final Rev1)
- Coffey Geotechnics (June 2012a); *Stage 1 – Preliminary Environmental Investigation, Sydney International Conference Exhibition and Entertainment Precinct (SICEEP), Darling Harbour, Sydney* (ref: GEOTLCOV24303AC-AF)
- Coffey Geotechnics (June 2012b); *Stage 2 – Detailed Site Investigation: Sydney International Convention Exhibition and Entertainment Precinct (SICEEP), Darling Harbour, Sydney* (ref: AGEOTLCOV24303AC-AG)
- Coffey Geotechnics (August 2012); *Supplementary Site Investigation: Sydney International Convention Exhibition and Entertainment Precinct (SICEEP), Darling Harbour, Sydney* (ref: GEOTLCOV24303AD-AA)
- Coffey Geotechnics (January 2013); *Supplementary Site Investigation: Factual Report, Sydney International Convention Exhibition and Entertainment Precinct (SICEEP), Darling Harbour* (ref: GEOTLCOV24303AF-R01a)
- Coffey Environments (2013) *Site Investigation: Factual Report, Haymarket Precinct, Darling Harbour, Sydney NSW* (ref: ENAURHOD04498AA-R01) (Coffey 2013a);

Acid Sulfate Soil Assessment and Preliminary Management Plan
Haymarket Precinct, Darling Harbour, Sydney NSW

Coffey Geotechnics (2013) *Geotechnical Assessment, SICEEP, Haymarket Precinct – Stage 1* (ref: GEOTLCOV24303AG-AB) (Coffey 2013b).

Important information about Coffey Environmental Report

Uncertainties as to what lies below the ground on potentially contaminated sites can lead to remediation costs blow outs, reduction in the value of the land and to delays in the redevelopment of land. These uncertainties are an inherent part of dealing with land contamination. The following notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report has been written for a specific purpose

Your report has been developed on the basis of a specific purpose as understood by Coffey and applies only to the site or area investigated. For example, the purpose of your report may be:

- To assess the environmental effects of an on-going operation.
- To provide due diligence on behalf of a property vendor.
- To provide due diligence on behalf of a property purchaser.
- To provide information related to redevelopment of the site due to a proposed change in use, for example, industrial use to a residential use.
- To assess the existing baseline environmental, and sometimes geological and hydrological conditions or constraints of a site prior to an activity which may alter the sites environmental, geological or hydrological condition.

For each purpose, a specific approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible, quantify risks that both recognised and unrecognised contamination pose to the proposed activity. Such risks may be both financial (for example, clean up costs or limitations to the site use) and physical (for example, potential health risks to users of the site or the general public).

Scope of Investigations

The work was conducted, and the report has been prepared, in response to specific instructions from the client to whom this report is addressed, within practical time and budgetary constraints, and in reliance on certain data and information made available to Coffey. The analyses, evaluations, opinions and conclusions presented in this report are based on those instructions, requirements, data or information, and they could change if such instructions etc. are in fact inaccurate or incomplete.

Subsurface conditions can change Interpretation of factual data

Subsurface conditions are created by natural processes and the activity of man and may change with time. For example, groundwater 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 the 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 and/or on the property.

Interpretation of factual data

Environmental site assessments identify actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from indirect field measurements and sometimes other reports on the site are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how well 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, parties involved with land acquisition, management and/or redevelopment should retain the services of Coffey through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other 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 with redevelopment or on-going use of the site. 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. In particular, a due diligence report for a property vendor may not be suitable for satisfying the needs of a purchaser. Your report should not be applied for any purpose other than that originally specified at the time the report was issued.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other professionals who are affected by the report. Have Coffey explain the report implications to professionals affected by them and then review plans and specifications produced to see how they have incorporated 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, laboratory data, 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), field testing and laboratory evaluation of field samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Contact Coffey for additional assistance

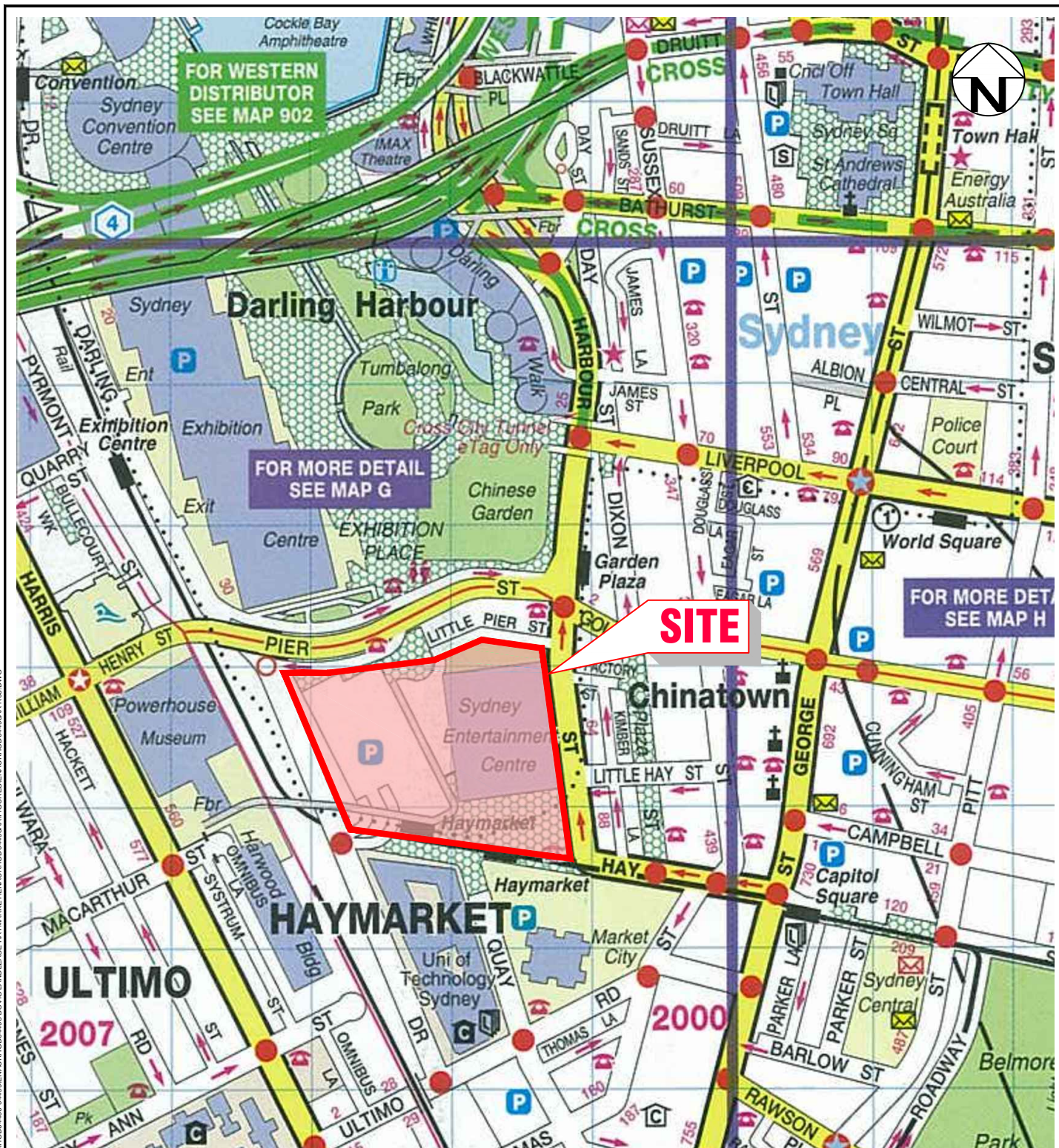
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to land development and land use. It is common that not all approaches will be necessarily dealt with in your environmental site assessment report due to concepts proposed at that time.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

Responsibility

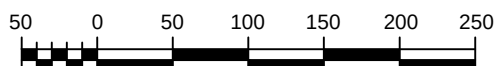
Environmental reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help 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.

Figures

**Acid Sulfate Soil Assessment and Preliminary Management Plan
Haymarket Precinct, Darling Harbour, Sydney NSW**

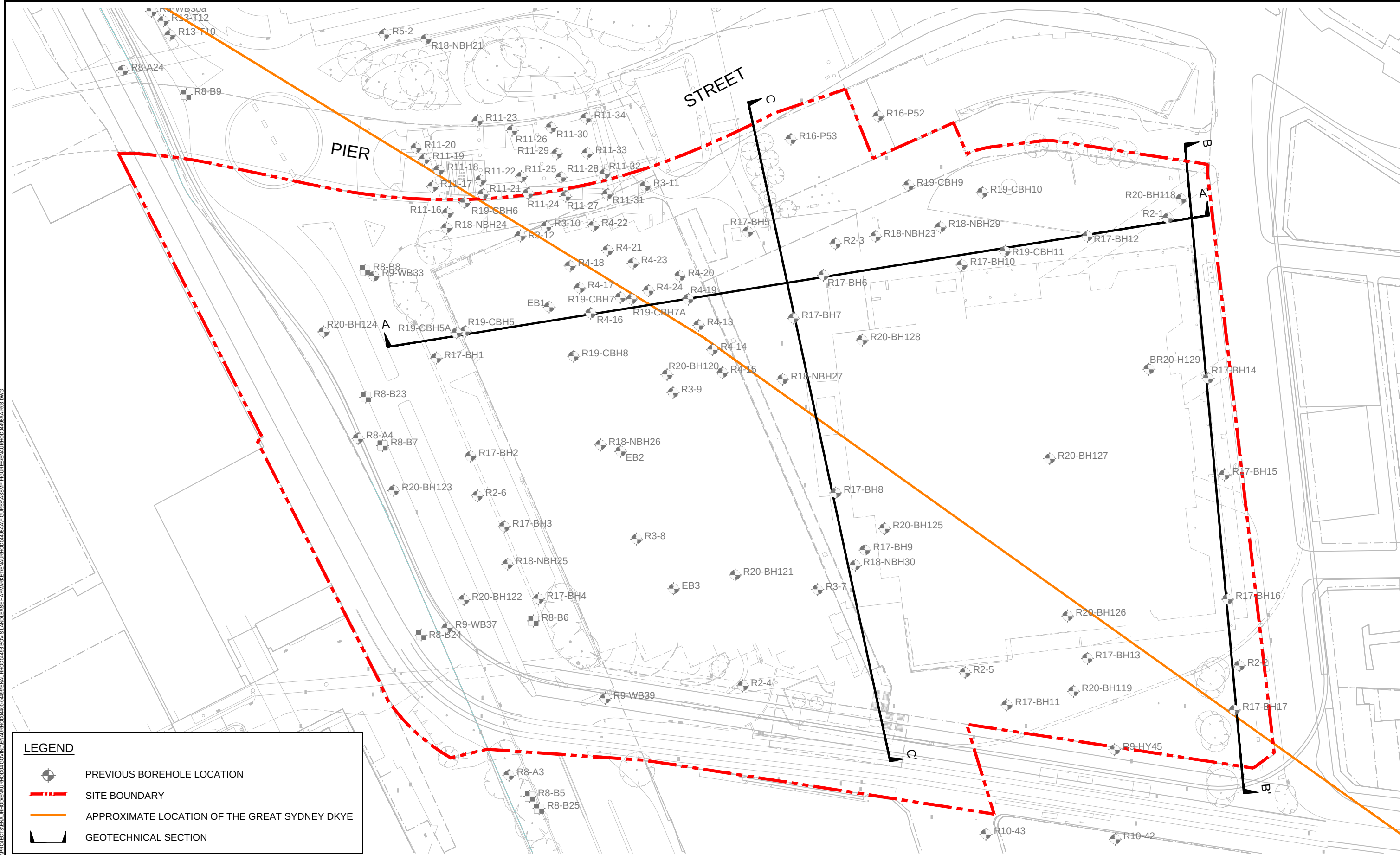


SOURCE: UBD STREET DIRECTORY GREGORYS
SYDNEY, NEW SOUTH WALES
47TH EDITION, 2012, MAP 20



Scale (metres) 1:5000

drawn	EC / AW	 coffey environments SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE	client:	LEND LEASE DEVELOPMENTS PTY LTD	
approved	-		project:	ACID SULFATE SOIL MANAGEMENT PLAN HAYMARKET PRECINCT, DARLING HARBOUR, NSW	
date	22 / 02 / 13		title:	SITE LOCALITY PLAN	
scale	AS SHOWN		project no:	ENAU RHOD04498AA-R03	figure no: FIGURE 1
original size	A4				



LEGEND

PREVIOUS BOREHOLE LOCATION

SITE BOUNDARY

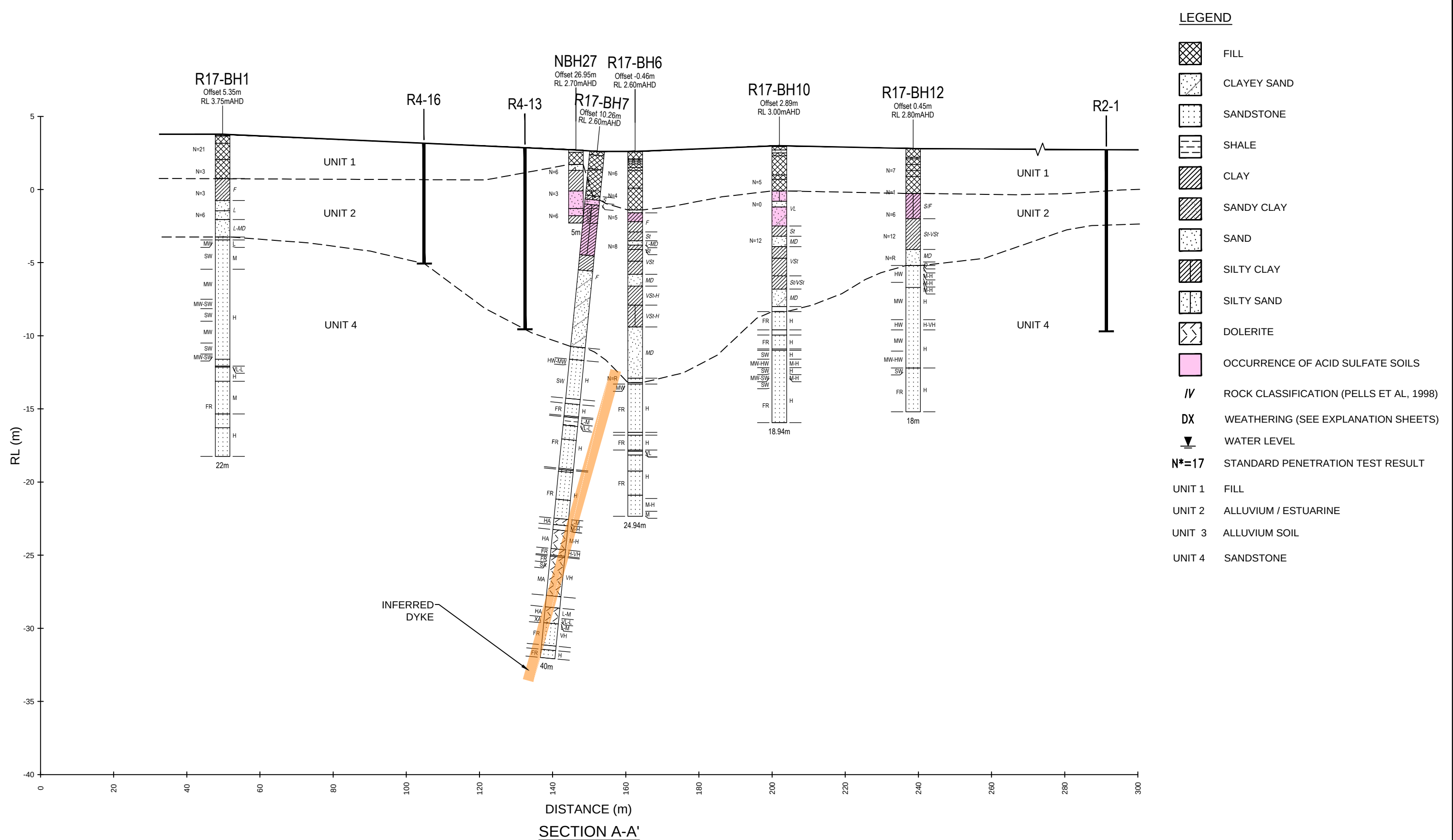
APPROXIMATE LOCATION OF THE GREAT SYDNEY DKE

GEOTECHNICAL SECTION

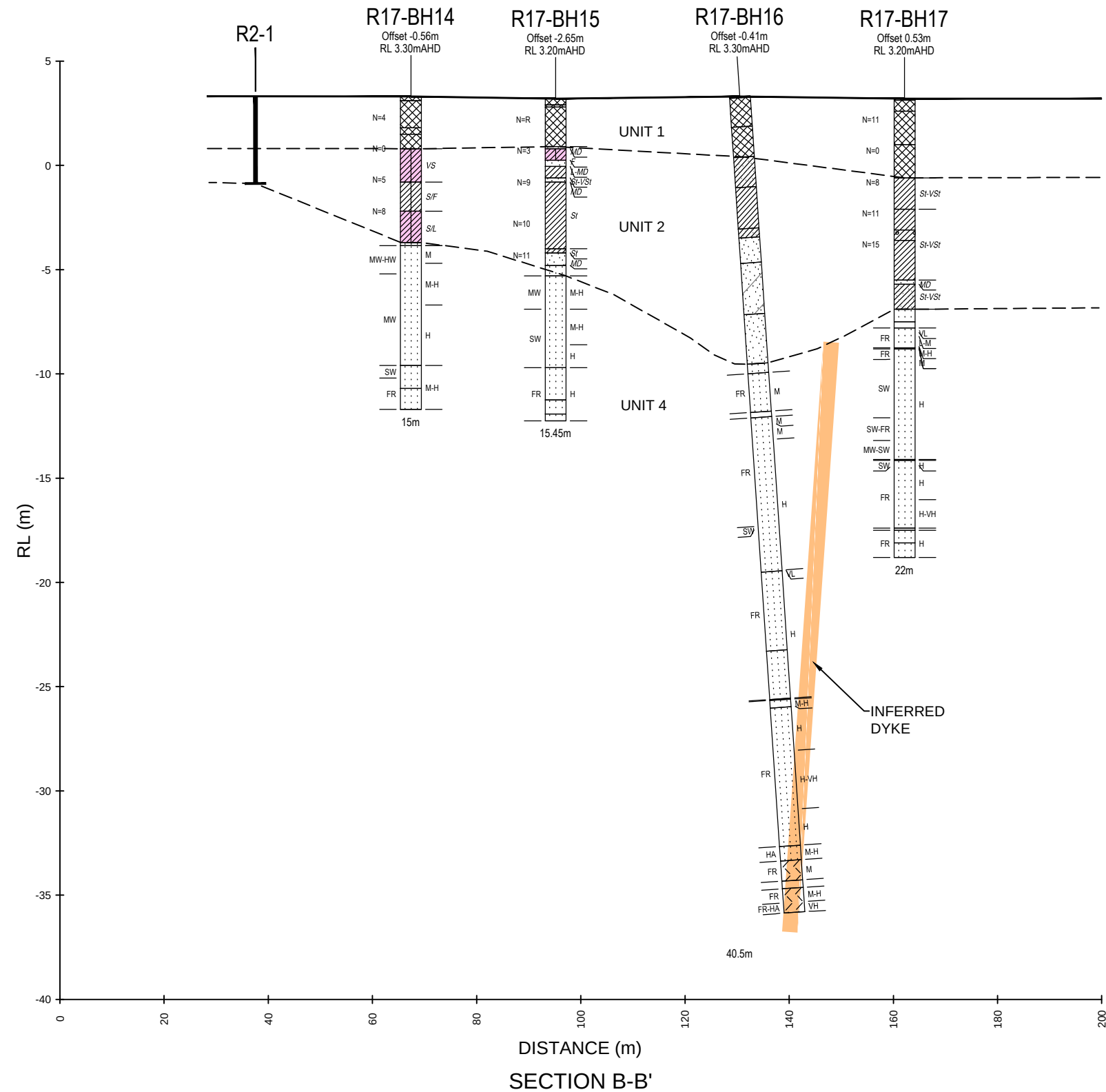
revision	description	drawn	approved	date	N 10 0 10 30 50 Scale (metres) 1:1000	drawn	EC / AW	coffey environments SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE	client: LEND LEASE DEVELOPMENTS PTY LTD	
						approved	-		project: ACID SULFATE SOIL MANAGEMENT PLAN HAYMARKET PRECINCT, DARLING HARBOUR, NSW	
						date	26 / 02 / 13		title: PROPOSED DEVELOPMENT LAYOUT AND PREVIOUS BOREHOLE LOCATIONS	
						scale	AS SHOWN			
						original size	A3			project no: ENAU RHOD04498AA-R03

PLOT DATE: 26/02/2013 4:38:24 PM DWG FILE: F:\ENV\PROJECTS\ENAU RHOD04498AA\ENAU RHOD04498AA\FIGURE2.DWG

PLOT DATE: 22/02/2013 8:23:31 AM DWG FILE: F:\ENV\PROJECT\SENAURHOD\04498AA\FIGURES\AS\MP FIGURES\ENR\HOD\04498AA-R03.DWG



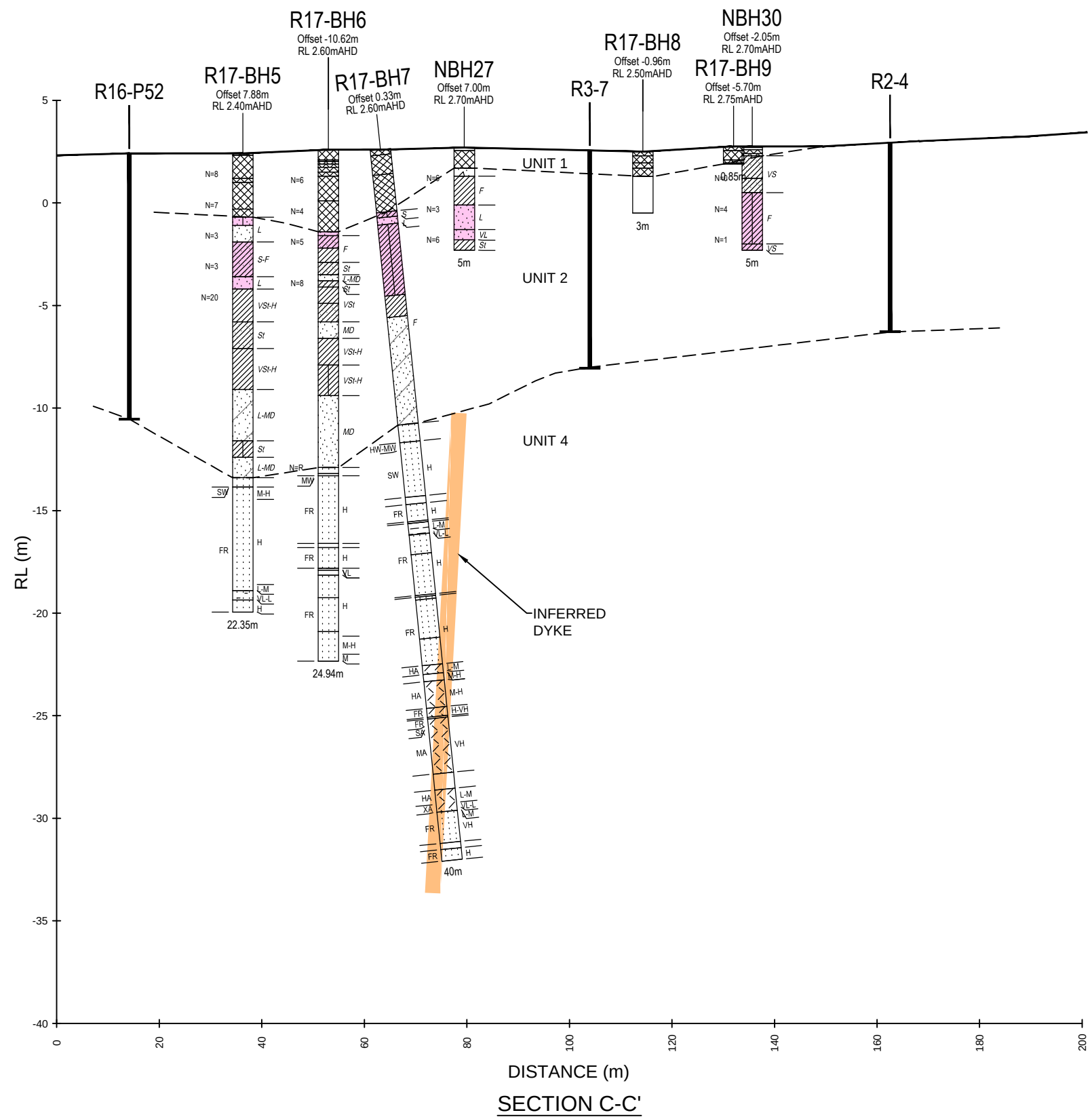
revision	description	drawn	approved	date		drawn	EC / AW	 SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE	client: LEND LEASE DEVELOPMENTS PTY LTD	
						approved	-		project: ACID SULFATE SOIL MANAGEMENT PLAN HAYMARKET PRECINCT, DARLING HARBOUR, NSW	
						date	22 / 02 / 13		title: SECTION A-A' OCCURRENCE OF ACID SULFATE INFERRED SOILS	
						scale	AS SHOWN		project no: ENAURHOD04498AA-R03	figure no: FIGURE 3
						original size	A3			



- LEGEND**
- FILL
 - CLAYEY SAND
 - SANDSTONE
 - SHALE
 - CLAY
 - SANDY CLAY
 - SAND
 - SILTY CLAY
 - SILTY SAND
 - DOLERITE
 - OCCURRENCE OF ACID SULFATE SOILS
 - IV ROCK CLASSIFICATION (PELLS ET AL, 1998)
 - DX WEATHERING (SEE EXPLANATION SHEETS)
 - WATER LEVEL
 - N*=17 STANDARD PENETRATION TEST RESULT
 - UNIT 1 FILL
 - UNIT 2 ALLUVIUM / ESTUARINE
 - UNIT 3 ALLUVIUM SOIL
 - UNIT 4 SANDSTONE

revision	description				drawn	approved	date	  Scale (metres) 1:1000	drawn	EC / AW	 SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE	client:	LEND LEASE DEVELOPMENTS PTY LTD	
					approved							project:	ACID SULFATE SOIL MANAGEMENT PLAN HAYMARKET PRECINCT, DARLING HARBOUR, NSW	
					date		22 / 02 / 13					title:	SECTION B-B' OCCURRENCE OF ACID SULFATE INFERRED SOILS	
					scale		AS SHOWN					project no:	ENAU RHOD04498AA-R03	figure no: FIGURE 4
					original size		A3							

PLOT DATE: 22/02/2013 9:31:31 AM DWG FILE: P:\ENV\PROJECT\SENAURHOD\ENAU RHOD04498AA\FIGURES\AS\MP FIGURES\ENAU RHOD04498AA-R03.DWG



LEGEND

- FILL
- CLAYEY SAND
- SANDSTONE
- SHALE
- CLAY
- SANDY CLAY
- SAND
- SILTY CLAY
- SILTY SAND
- DOLERITE
- OCCURRENCE OF ACID SULFATE SOILS
- IV ROCK CLASSIFICATION (PELLS ET AL, 1998)
- DX WEATHERING (SEE EXPLANATION SHEETS)
- WATER LEVEL
- N*=17 STANDARD PENETRATION TEST RESULT
- UNIT 1 FILL
- UNIT 2 ALLUVIUM / ESTUARINE
- UNIT 3 ALLUVIUM SOIL
- UNIT 4 SANDSTONE

PLOT DATE: 22/02/2013 9:30:57 AM DWG FILE: E:\ENV\PROJECT\SENAURHOD\ENNAURHOD04498AA\FIGURES\AS\MP FIGURES\ENNAURHOD04498AA-R03.DWG

revision	description	drawn	approved	date	 Scale (metres) 1:1000	drawn	EC / AW	 coffey environments SPECIALISTS IN ENVIRONMENTAL, SOCIAL AND SAFETY PERFORMANCE	client: LEND LEASE DEVELOPMENTS PTY LTD	
						approved	-		project: ACID SULFATE SOIL MANAGEMENT PLAN HAYMARKET PRECINCT, DARLING HARBOUR, NSW	
						date	22 / 02 / 13		title: SECTION C-C' OCCURRENCE OF ACID SULFATE INFERRED SOILS	
						scale	AS SHOWN		project no: ENAURHOD04498AA-R03	figure no: FIGURE 5
						original size	A3			

Appendix A

Borehole Logs

**Acid Sulfate Soil Assessment and Preliminary Management Plan
Haymarket Precinct, Darling Harbour, Sydney NSW**

Borehole No. **NBH1**

Engineering Log - Borehole

Sheet 1 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **19.4.2012**

Principal:

Date completed: **19.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XP60 Ute Easting: 333372 slope: -90° R.L. Surface: 2.85
hole diameter: 100 mm Northing 6250503 bearing: N/A datum: AHD

drilling information					material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations	
NDD	1 2 3	C		E		1			FILL: Red Brick (0.08m) FILL: Clayey SAND: Fine to medium grained, pale brown, trace fine gravel	M			PAVEMENT FILL No Odour, PID = 14.8ppm No Odour, PID = 16.1ppm	
TC				SPT 5,9,6/30 N*=R		2		SC	Clayey SAND: Fine to medium grained, pale brown, mottled red-brown and pale grey		VD		RESIDUAL SOIL No Odour, Dup 3, PID = 3.9ppm	
RR			None Observed			3			SANDSTONE: Medium to coarse grained, yellow brown, with some quartz grains, highly weathered, low to medium strength.				BEDROCK	
						4			Borehole NBH1 continued as cored hole					
						5								
						6								
						7								
						8								

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT	M mud C casing penetration 1 2 3 4  water  10/1/98 water level on date shown  water inflow  water outflow	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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

Borehole No. **NBH10**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **See Figure 1**

Sheet 1 of 5

Project No: **GEOTLCOV24303AC**Date started: **30.4.2012**Date completed: **1.5.2012**

Logged by: **JW**

Checked by: **DS**

drill model and mounting:						XC Drill Track		Easting:		slope: -90°		R.L. Surface:		5.8	
hole diameter:						100 mm		Northing		bearing: N/A		datum:		AHD	
drilling information							material substance								
method	penetration			support water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa		structure and additional observations
	1	2	3												
ADDT				C						CONCRETE: (0.11m) with 10mm reinforcement FILL: GRAVEL: Medium to coarse grained, subangular, dark grey, with some fine to medium grained sand	M				CONCRETE SLAB FILL No Odour, PID = 0.4ppm
					E	5	1			FILL: Gravelly SAND: Fine to medium grained, pale grey, mottled pale yellow, pale brown, medium to coarse grained, subangular sandstone gravel, with some cobbles and boulders 1.5m - With some low plasticity clay					No Odour, PID = 1.1ppm
					E	4	2								No odour, PID = 0.6ppm
					E	3	3			FILL: Gravelly Sandy CLAY: Low plasticity, dark brown, mottled dark grey, fine to medium grained, subangular sandstone gravel, trace of boulders	<Wp				No odour, PID = 0.7ppm
						2	4								
					E	1	5			FILL: Gravelly CLAY: Low plasticity, pale grey, fine to medium grained, subangular gravel					
						0	6			FILL: Sandy CLAY: Low plasticity, pale brown, mottled orange-brown, fine grained sand					
RR						-1	7								
						-2	8								
method		auger screwing*			support		M mud N nil		notes, samples, tests		classification symbols and soil description based on unified classification system			consistency/density index	
AS		auger drilling*			C casing				U ₅₀ undisturbed sample 50mm diameter		VS very soft				
AD									U ₆₃ undisturbed sample 63mm diameter		S soft				
RR		roller/tricone							D disturbed sample		F firm				
W		washbore							N standard penetration test (SPT)		St stiff				
CT		cable tool							N* SPT - sample recovered		VSt very stiff				
HA		hand auger							Nc SPT with solid cone		H hard				
DT		diatube							V vane shear (kPa)		Fb friable				
B		blank bit							P pressuremeter		VL very loose				
V		V bit							Bs bulk sample		L loose				
T		TC bit							E environmental sample		MD medium dense				
*bit shown by suffix e.g. ADT									R refusal		D dense				
											VD very dense				

Borehole No. **NBH10**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **See Figure 1**

Sheet 2 of 5

Project No: **GEOTLCOV24303AC**

Date started: **30.4.2012**Date completed: **1.5.2012**

Logged by: **JW**

Checked by: **DS**

drill model and mounting:		XC Drill Track		Easting:		slope: XC Track -90°		R.L. Surface:		5.8						
hole diameter:		100 mm		Northing		bearing: N/A		datum:		AHD						
drilling information							material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations	
	1	2	3													
CB	RR			C							Clayey SAND: Medium to coarse grained, pale grey, mottled dark grey, trace fine grained, subangular sandstone gravel	>Wp				ALLUVIUM
								-3				W	L-MD			No Odour, PID = 0.5ppm
								-4								
								-5								
								-6								
								-7								
								-8								
								-9			SANDSTONE: Medium to coarse grained, pale grey, off-white, moderately weathered grading to slightly weathered, low to medium strength.	>Wp				BEDROCK
								-10								
								-11								
								-12								
								-13								
								-14								
								-15								
								-16								
method		support		notes, samples, tests		classification symbols and soil description		consistency/density index								
AS auger screwing* AD auger drilling* 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. ADT		M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		U ₉₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit		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								

Borehole No. **NBH10**

Engineering Log - Borehole

Sheet 3 of 5
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **30.4.2012**

Principal:

Date completed: **1.5.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XC Drill Track		Easting:		slope: -90°		R.L. Surface: 5.8	
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD	
drilling information				material substance			
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.
CB							SANDSTONE: Medium to coarse grained, pale grey, off-white, moderately weathered grading to slightly weathered, low to medium strength. (continued)
				-11			
				17			
				-12			
				18			
				-13			
				19			
				-14			
				20			
				-15			
				21			
				-16			
				22			
				-17			
				23			
				-18			
				24			
method		support		notes, samples, tests		classification symbols and soil description	
AS auger screwing*		M mud N nil		U ₅₀ undisturbed sample 50mm diameter		based on unified classification system	
AD auger drilling*		C casing		U ₆₃ undisturbed sample 63mm diameter			
RR roller/tricone		penetration		D disturbed sample			
W washbore		1 2 3 4		N standard penetration test (SPT)			
CT cable tool		no resistance ranging to refusal		N* SPT - sample recovered			
HA hand auger		water		Nc SPT with solid cone			
DT diatube		10/1/98 water level on date shown		V vane shear (kPa)			
B blank bit		water inflow		P pressuremeter			
V V bit		water outflow		Bs bulk sample			
T TC bit				E environmental sample			
*bit shown by suffix e.g. ADT				R refusal			
						moisture	
						D dry	
						M moist	
						W wet	
						Wp plastic limit	
						WL liquid limit	
						consistency/density index	
						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	

Borehole No. **NBH10**

Engineering Log - Borehole

Sheet 4 of 5
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **30.4.2012**

Principal:

Date completed: **1.5.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XC Drill Track		Easting:		slope: -90°		R.L. Surface: 5.8								
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD								
drilling information				material substance										
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations			
CB				-19 25			SANDSTONE: Medium to coarse grained, pale grey, off-white, moderately weathered grading to slightly weathered, low to medium strength. (continued)	>Wp						
				-20 26										
				-21 27										
				-22 28										
				-23 29										
				-24 30			SANDSTONE: Fine to medium grained, pale grey, fresh, medium to high strength.							
				-25 31			Borehole NBH10 continued as cored hole							
				-26 32										
method AS auger screwing* AD auger drilling* 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. ADT			support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow			notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal			classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit			consistency/density index 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		

Borehole No. **NBH11**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **See Figure 1**

Sheet 1 of 1

Project No: **GEOTLCOV24303AC**Date started: **23.4.2012**Date completed: **23.4.2012**

Logged by: **ACM**

Checked by: **DS**

drill model and mounting:		XC Drill Track		Easting:		slope: -90°		R.L. Surface:		5.8																	
hole diameter:		100 mm		Northing		bearing: N/A		datum:		AHD																	
drilling information				material substance																							
method		penetration		support		water		notes samples, tests, etc		RL		depth metres		graphic log		classification symbol		material		moisture condition		consistency/ density index		pocket penetro- meter kPa		structure and additional observations	
1 2 3		1 2 3 4		1 2 3 4														soil type: plasticity or particle characteristics, colour, secondary and minor components.						100 200 300 400			
ADTDT		N		None Observed								1		2		3		FILL: CONCRETE (0.15m) with 10mm reinforcement		D						CONCRETE SLAB	
								E		5		1		2		3		FILL: Sandy GRAVEL: Medium to coarse grained, subangular, pale grey, mottled orange-brown, fine to medium grained sand		M						FILL	
								E		4		2		3		4		FILL: Clayey GRAVEL: Fine to coarse grained, subangular sandstone, pale brown, low plasticity clay, trace fine to medium grained sand								No Odour, Dup 6 + Dup 6a, PID = 1.6ppm	
												3		4		5		SANDSTONE: Fine to medium grained, orange-brown to pale grey, highly weathered, low to medium strength								No Odour, PID = 1.6ppm	
												4		5		6										BEDROCK	
												5		6		7		Borehole NBH11 terminated at 3.2m									
												6		7		8											
												7		8													
												8															
method		support		notes, samples, tests		classification symbols and soil description		consistency/density index																			
AS AD RR W CT HA DT B V T		M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		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																			

Borehole No. **NBH12**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **23.4.2012**

Principal:

Date completed: **23.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: Ausrock 3000 Truck Easting: 333563 slope: -90° R.L. Surface: 5.4
hole diameter: 100 mm Northing 6250232 bearing: N/A datum: AHD

drilling information							material substance															
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter				structure and additional observations				
	1	2	3											100 kPa	200 kPa	300 kPa	400 kPa					
HA				N		E					FILL: Red Brick (0.08m)	M						PAVEMENT				
						E	5				FILL: Sandy GRAVEL: Dark grey, fine to medium grained, subangular, fine to medium grained sand							FILL				
						E					FILL: Gravelly SAND: Fine to medium grained, yellow-brown, mottled pale grey, fine to medium grained, subangular sandstone gravel							No Odour, PID = 1.8ppm				
ADT							1															
							4				FILL: Gravelly Sandy CLAY: High plasticity, pale grey, mottled pale brown, fine to medium grained sand, fine to medium grained sandstone gravel							No Odour, PID = 0.6ppm				
						SPT 7,3,14 N*=17	2															
						None Observed	3															
						E					FILL: Sandy CLAY: High plasticity, dark brown, mottled orange-brown, medium grained sand							No Odour, PID = 1.5ppm				
							2															
							4															
							1															
						SPT 3,3,2 N*=5	5											No Odour, PID = 0.4ppm				
							0				Borehole NBH12 terminated at 4.95m											
							6															
							-1															
							7															
							-2															
							8															
method AS auger screwing* AD auger drilling* 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. ADT							support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow			notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal					classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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			

Borehole No. **NBH13**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **1.5.2012**

Principal:

Date completed: **1.5.2012**

Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XP60 Ute		Easting:		slope: -90°		R.L. Surface: 5.4					
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD					
drilling information				material substance							
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.				
1 2 3				RL							
ND/BA			E	5			FILL: Red Brick (0.08m)				
			E				FILL: SAND: Medium to coarse grained, pale brown				
			E	1			Gravelly SAND: Fine to medium, dark brown, fine to coarse grained, subangular sandstone gravel, with some silt				
				4			0.7m - With some sandstone cobbles/boulders				
ADT			E	2							
				3			FILL: Clayey SAND: Fine to medium, pale grey, mottled pale brown, with some fine to coarse grained, subangular sandstone gravel				
			SPT 1,0,2 N*=2	3							
				4			FILL: Sandy GRAVEL: Medium to coarse grained, subangular, pale grey, fine to coarse grained sand				
			SPT 8,9,10 N*=19	5							
				6			Borehole NBH13 terminated at 5m				
				7							
				8							
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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	

Borehole No. **NBH14**

Engineering Log - Borehole

Sheet 1 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **26.4.2012**

Principal:

Date completed: **26.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Ausrock 3000 Truck		Easting:	333583	slope:	-90°	R.L. Surface:	5.4
hole diameter:		100 mm		Northing	6250177	bearing:	N/A	datum:	AHD

drilling information				material substance								
method	penetration	support	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
1	2	3						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HA		C		5				FILL: Red Brick (0.08m)	D			PAVEMENT
								FILL: Gravelly SAND: Medium grained, dark grey, fine to medium grained, subangular sandstone gravel, trace clay	M			FILL
ADT				1				0.8m - With some sandstone cobbles/boulders, becoming fine grained, pale grey, mottled yellow, pale brown				
			SPT 10,12,12 N*=24	4								
				2				FILL: Clayey SAND: Fine to medium grained, dark grey, with some medium to coarse grained, subangular gravel				No Odour
				3								
			SPT 4,4,2 N*=6	2								No Odour
				3								
				4				CONCRETE: (0.4m)	D			CONCRETE SLAB
				5								
			SPT 8,7,5 N*=12	1				FILL: Gravelly SAND: Fine to medium grained, dark grey, medium to coarse grained, subangular gravel, trace clay	M			FILL
				2				4.5m - Becoming dark grey, mottled pale grey, brown, with a trace of red brick fragments				No Odour
				3								
				4								
			SPT 4,1,4 N*=5	0				FILL: Gravelly CLAY: Low plasticity, pale grey, mottled dark grey, medium to coarse grained, subangular sandstone gravel	>Wp			No Odour
				1								
				2								
			SPT 6,13,10 N*=23	7				FILL: Clayey Sandy GRAVEL: Fine to coarse grained, subangular sandstone and shale, pale grey, fine grained sand	W			No Odour
				8								

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index 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
--	--	--	---	---

Borehole No. **NBH14**

Engineering Log - Borehole

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **26.4.2012**

Principal:

Date completed: **26.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: Ausrock 3000 Truck		Easting: 333583		slope: -90°		R.L. Surface: 5.4	
hole diameter: 100 mm		Northing: 6250177		bearing: N/A		datum: AHD	
drilling information				material substance			
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.
ADT	1 2 3	C					
				-3			FILL: Clayey Sandy GRAVEL: Fine to coarse grained, subangular sandstone and shale, pale grey, fine grained sand (<i>continued</i>)
			SPT 11,5,7 N*=12	-4			FILL: Clayey SAND: Fine to medium grained, pale grey, mottled dark grey, with some fine to medium grained sandstone gravel
				-5			
			SPT 6,9,6 N*=15	-6			
				-7			FILL: GRAVEL: Fine to medium grained, subangular, pale grey, mottled pale brown, mainly sandstone with shale
				-8			13.3m - With mixture of concrete, brick and sandstone gravel
				-9			FILL: Clayey GRAVEL: Dark grey, medium to coarse grained, subangular
RR			SPT 3,8,12 N*=20	-10		CH	CLAY: High plasticity, drak grey-black, trace fine grained sand Clayey SAND: Fine grained, dark grey
				-11			
				-12			
				-13			
				-14			
				-15			
				-16			
method				support		notes, samples, tests	
AS auger screwing*				M mud		U ₅₀ undisturbed sample 50mm diameter	
AD auger drilling*				C casing		U ₆₃ undisturbed sample 63mm diameter	
RR roller/tricone				penetration		D disturbed sample	
W washbore				1 2 3 4		N standard penetration test (SPT)	
CT cable tool						N* SPT - sample recovered	
HA hand auger						Nc SPT with solid cone	
DT diatube						V vane shear (kPa)	
B blank bit						P pressuremeter	
V V bit						Bs bulk sample	
T TC bit						E environmental sample	
*bit shown by suffix e.g. ADT						R refusal	
				water		classification symbols and soil description based on unified classification system	
				10/1/98 water level on date shown		moisture	
				no resistance ranging to refusal		D dry	
				water inflow		M moist	
				water outflow		W wet	
						Wp plastic limit	
						WL liquid limit	
						consistency/density index	
						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	

Borehole No. **NBH14**

Engineering Log - Borehole

Sheet 3 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **26.4.2012**

Principal:

Date completed: **26.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Ausrock 3000 Truck		Easting:	333583	slope:	-90°	R.L. Surface:	5.4
hole diameter:		100 mm		Northing	6250177	bearing:	N/A	datum:	AHD

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
1	2	3	4						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
RR					-11				Clayey SAND: Fine grained, dark grey (<i>continued</i>)	W	MD		
					-12				SANDSTONE: Fine to medium grained, yellow-brown, highly weathered, low to medium strength				BEDROCK SPT hammer bouncing
				SPT 29,10/120,1 N*=R	-13								
					-14				Borehole NBH14 continued as cored hole				
					-15								
					-16								
					-17								
					-18								
					-19								
					-20								
					-21								
					-22								
					-23								
					-24								

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	--	--	--	---

Borehole No. **NBH15**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **See Figure 1**

Sheet 1 of 1

Project No: **GEOTLCOV24303AC**

Date started: **27.4.2012**Date completed: **27.4.2012**

Logged by: **ACM**

Checked by: **DS**

drill model and mounting:		XP60 Ute		Easting:		slope:		-90°		R.L. Surface:		3.4											
hole diameter:		100 mm		Northing		bearing:		N/A		datum:		AHD											
drilling information							material substance																
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations								
	1	2	3																				
HA						E					FILL: Red Brick (0.08m)	D			PAVEMENT								
SS						E	3				FILL: SAND: Medium to coarse grained, pale brown	W			FILL								
						E		1			FILL: Clayey GRAVEL: Medium to coarse grained, subangular sandstone, pale brown with some fine to medium grained sand	>Wp			No Odour, Dup 15 + Dup 15a, PID = 11.6ppm								
							2				FILL: Gravelly CLAY: Medium plasticity, pale brown, fine to medium grained, subangular sandstone/gravel												
						E		2			FILL: Silty CLAY: Medium plasticity, red-brown, with some fragments of concrete towards base				No Odour, PID = 2.0ppm								
								2							Concrete Obstruction Encountered at 2.1m - Suspected Service								
							1				Borehole NBH15 terminated at 2.1m												
							3																
							0																
							4																
							-1																
							5																
							-2																
							6																
							-3																
							7																
							-4																
							8																
method		auger screwing*		support		M mud N nil		penetration		1 2 3 4		no resistance ranging to refusal		water		10/1/98 water level on date shown		notes, samples, tests		classification symbols and soil description based on unified classification system		consistency/density index	
AS		auger drilling*		C casing														U ₉₀ undisturbed sample 50mm diameter		VS very soft			
AD																		U ₆₃ undisturbed sample 63mm diameter		S soft			
RR		roller/tricone																D disturbed sample		F firm			
W		washbore																N standard penetration test (SPT)		St stiff			
CT		cable tool																N* SPT - sample recovered		VSt very stiff			
HA		hand auger																Nc SPT with solid cone		H hard			
DT		diatube																V vane shear (kPa)		Fb friable			
B		blank bit																P pressuremeter		VL very loose			
V		V bit																Bs bulk sample		L loose			
T		TC bit																E environmental sample		MD medium dense			
*bit shown by suffix e.g. ADT																		R refusal		D dense			
																				VD very dense			

Borehole No. **NBH16**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **See Figure 1**

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Date started: **23.4.2012**Date completed: **23.4.2012**

Logged by: **ACM**

Checked by: **DS**

[illegible]

Borehole Location: **See Figure 1**

Form GEO 5.3 Issue 3 Rev.2

Borehole No. **NBH17**

Engineering Log - Borehole

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Ausrock 3000 Truck		Easting:	333635	slope:	-90°	R.L. Surface:	2.4
hole diameter:		100 mm		Northing	6250073	bearing:	N/A	datum:	AHD

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1 2 3												
RR					-6			CH	CLAY: High plasticity, pale grey, mottled dark grey, with some shell fragments	M-W	St		
				SPT 8,11,12 N*=23		9		CH	CLAY: High plasticity, pale grey, mottled orange-brown, trace of ironstone gravel and staining		VSt		RESIDUAL SOIL
					-7								
					-8								
					-9								
				SPT 6,7,9 N*=16		12			11.5m - Becoming dark grey, mottled yellow-brown		St		
					-10								
					-11								
					-12								
				SPT 13,7,15 N*=22		15			SANDSTONE: Medium to coarse grained, pale grey, extremely weathered, very low strength				BEDROCK
					-13								
					-14								
					-15								
					-16				Borehole NBH17 continued as cored hole				

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	---	--	---	---

Borehole No. **NBH18**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **24.4.2012**

Principal:

Date completed: **24.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: Ausrock 3000 Truck Easting: 333676 slope: -90° R.L. Surface: 2.9
hole diameter: 100 mm Northing 6250079 bearing: N/A datum: AHD

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
HA	1 2 3								FILL: Red Brick (0.08m)	D			PAVEMENT
ADT				E		1			FILL: Sandy GRAVEL: Fine to medium grained, subangular, dark grey, medium to coarse grained sand	M			FILL
				SPT 3,2,2 N*=4		2			FILL: Gravelly SAND: Medium grained, pale grey, mottled yellow-brown, fine to medium grained, subangular sandstone gravel, trace clay				No Odour, PID = 140ppm
						3			FILL: CLAY: High plasticity, dark grey, mottled off-white, orange-brown, with some fine to coarse grained gravel	<Wp			No Odour, PID = 186ppm
				SPT 1,1,3 N*=4		4		CH	Sandy CLAY: High plasticity, dark grey, mottled yellow-brown, fine grained sand, trace of fine grained gravel	St	X	X	No Odour, PID = 0ppm
						5		SP	Clayey SAND: Fine grained, dark grey/black	W	L		ALLUVIUM
				E		6			Borehole NBH18 terminated at 4.5m				No odour, PID = 70.3ppm
						7							
						8							

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT	M mud C casing penetration 1 2 3 4 water 10/1/98 water level on date shown water inflow water outflow	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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

Borehole No. **NBH19**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **24.4.2012**

Principal:

Date completed: **24.4.2012**

Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		XC Drill Track		Easting:		slope: -90°		R.L. Surface: 5.79					
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD					
drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
ADT	1 2 3	Observed	None	E	5	1			CONCRETE: (0.15m) with 10mm reinforcement FILL: GRAVEL: Medium to coarse grained, subangular, pale brown, mottled pale grey FILL: Silty SAND: fine to coarse grained, pale brown, with some fine to medium grained, subangular sandstone gravel	M	S		CONCRETE SLAB FILL No Odour, Dup 10 + Dup 10a, PID = 9.1ppm
				E					SANDSTONE: Fine to medium grained, pale brown, highly weathered, low strength Borehole NBH19 terminated at 1.4m				BEDROCK No Odour, PID = 9.6ppm
					4	2							
						3							
					2	4							
					1	5							
					0	6							
					-1	7							
					-2	8							
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal			classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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		

Borehole No. **NBH2**

Sheet 1 of 3

Project No: **GEOTLCOV24303AC**

Date started: **1.5.2012**

Date completed: **1.5.2012**

Logged by: **DB**

Checked by: **DS**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **See Figure 1**

drill model and mounting: XP60 6x6 Ute Easting: slope: -90° R.L. Surface: 2.82

hole diameter: 100 mm Northing bearing: N/A datum: AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
ADT				C							FILL: Asphaltic Concrete (0.4m)	D			PAVEMENT
						E	2				FILL: Gravelly SAND: Medium to coarse grained, pale brown, mottled pale grey, fine to coarse, subangular gravel.	M			ROADBASE
HA							1			SP	FILL: Sandy GRAVEL: Fine to coarse grained, subangular, pale grey, mottled orange-brown sandstone and shale, fine to medium grained sand with some sandstone cobbles <100mm.		L		No Odour, Dup 20 + Dup 20a, PID = 3.0ppm
						E	1				FILL: Gravelly SAND: Fine to medium grained, yellow-brown, mottled red-brown and pale grey.				Geofabric Layer at 0.95m
						D	2				SAND: Fine to medium grained, orange-brown, trace of shell fragments.				ALLUVIUM
							3								No Odour, PID = 1.8ppm
							0					W			
						E	3								No Odour, PID = 1.8ppm
ADT						D	4								
							5								
							6								
							7								
							8								
						SPT R ₁₀₀ N*=R	-2				SANDSTONE: Fine to medium grained, orange brown, highly weathered, medium strength. Borehole NBH2 continued as cored hole				BEDROCK No Odour, PID = 2.7ppm SPT rods bouncing at 4.50m
							-3								
							-4								
							-5								

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT	M mud C casing penetration 1 2 3 4  water 10/1/98 water level on date shown water inflow water outflow	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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

Borehole No. **NBH20**

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Date started: **24.4.2012**

Principal:

Date completed: **24.4.2012**Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

[illegible]

Borehole No. **NBH21**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Ausrock 3000 Truck		Easting:	333580	slope:	-90°	R.L. Surface:	4.2
hole diameter:		100 mm		Northing	6249998	bearing:	N/A	datum:	AHD

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
1	2	3											
ADT		N			4				CONCRETE: (0.4m)				CONCRETE SLAB
				E					FILL: Gravelly SAND: Fine to medium grained, yellow-brown	M			FILL No Odour, PID = 48.3ppm
					3				1m - With some medium plasticity clay, trace of brick fragments and fine to coarse grained, subangular gravel				
				SPT 3,4,5 N*=9					FILL: CLAY: High plasticity, dark grey, mottled dark brown, trace medium grained, subangular sandstone gravel				No Odour, PID = 12.5ppm
					2								
					2								
					3			CH	CLAY: High plasticity, dark grey	>Wp	VS-S		ALLUVIUM
				SPT 0,1,1 N*=2	1							XXX	No Odour, PID = 7.0ppm
									Borehole NBH21 terminated at 3.45m				
					4								
					0								
					5								
					-1								
					6								
					-2								
					7								
					-3								
					8								

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	---	--	--	---

Borehole No. **NBH22**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **24.4.2012**

Principal:

Date completed: **24.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: Ausrock 3000 Truck Easting: 333636 slope: -90° R.L. Surface: 2.4
hole diameter: 100 mm Northing 6250067 bearing: N/A datum: AHD

drilling information						material substance										
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations	
	1	2	3													
HA											ASPHALT: (0.1m) CONCRETE: (0.3m)	D			PAVEMENT CONCRETE SLAB	
						E	2				FILL: SAND: Fine to medium grained, yellow-brown, mottled pale brown	M			FILL No Odour, PID = 29ppm	
ADT						E	1				1.3m - With some dark grey high plasticity clay, and a trace of organic material	<Wp			No Odour, PID = 60.2ppm	
						SPT 2,4,4 N*=8		2			FILL: CLAY: High plasticity, dark grey, mottled dark brown, trace fine grained sand				No Odour, PID = 6.5ppm	
							0									
						SPT 4,2,1 N*=3		3				>Wp				
							-1			CH	CLAY: High plasticity, dark grey, mottled black		VS-S		ALLUVIUM Organic Odour, PID = 4.9ppm	
						E	-2								No Odour, PID = 7.1ppm	
								5			Borehole NBH22 terminated at 4.5m					
							-3									
							6									
							-4									
							7									
							-5									
							8									
method						support		notes, samples, tests				classification symbols and soil description			consistency/density index	
AS auger screwing* AD auger drilling* 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. ADT						M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit			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	

Borehole No. **NBH23**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **17.4.2012**

Principal:

Date completed: **24.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XP60 Ute		Easting: 333727		slope: -90°		R.L. Surface: 2.7					
hole diameter: 100 mm		Northing: 6249937		bearing: N/A		datum: AHD					
drilling information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
DT		N					FILL: Red Brick (0.08m)	D			PAVEMENT
HA			E	2			FILL: SAND: Coarse grained, pale brown, mottled yellow-brown, with some shell fragments	M			FILL
				1			FILL: Concrete: (0.25m)	D			CONCRETE SLAB
							FILL: Sandy GRAVEL: Fine grained, subangular, dark grey, fine to medium grained sand	M			FILL
							FILL: Clayey SAND: Fine grained, pale brown, mottled red-brown				No Odour, PID = 0.4ppm
ADT			SPT 3,2,4 N*=6	1			FILL: CLAY: High plasticity, dark grey, mottled orange-brown, pale grey, trace fine grained sand, and medium grained, subangular sandstone gravel	<Wp			No Odour, PID = 0.8ppm
				2							
				0		CL	Sandy CLAY: Low plasticity, drak grey, mottled black, fine grained sand	>Wp	VS	X	ALLUVIUM
			SPT 1,0,1 N*=1	3						X	No Odour, PID = 0.3ppm
				-1			Borehole NBH23 terminated at 3.45m				
				4							
				-2							
				5							
				-3							
				6							
				-4							
				7							
				-5							
				8							
method AS auger screwing* AD auger drilling* 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. ADT			support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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		

Borehole No. **NBH24**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **24.4.2012**

Principal:

Date completed: **24.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Ausrock 3000 Truck		Easting: 333604		slope: -90°		R.L. Surface: 3.9					
hole diameter:		100 mm		Northing 6249930		bearing: N/A		datum: AHD					
drilling information				material substance									
method	penetration 1 2 3	support water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations	
HA		N	E					FILL: Red Brick (0.08m)	D			PAVEMENT	
			E					FILL: SAND: Fine to medium grained, pale brown, trace fine to medium grained, subangular sandstone gravel	M			FILL	
								FILL: Gravelly Sandy CLAY: Low plasticity, dark grey, mottled dark brown, fine to medium grained sand and fine to medium grained, subangular gravel	<Wp			No Odour, PID = 1.9ppm	
ADT					3	1		FILL: CLAY: High plasticity, pale grey, mottled orange-brown, dark grey, trace fine grained sand	>Wp				
			SPT 5/20, N*=R		2	2		FILL: Gravelly CLAY: Low plasticity, dark grey, mottled red-brown, medium to coarse grained, subangular gravel	W			No Odour, PID = 6.9ppm	
							CL	FILL: Clayey GRAVEL: Fine to medium grained, subangular, dark grey, mottled black, low plasticity clay, with some medium to coarse grained sandstone gravel					
					1	3		CLAY: Low plasticity, dark grey, mottled black, trace of organics	>Wp	VS		ALLUVIUM	
			SPT 0,0,1 N*=1				CL	Sandy CLAY: Low plasticity, dark grey, mottled black, fine grained sand, with some shell fragments			XXX	Organic Odour, PID = 18.2ppm	
Borehole NBH24 terminated at 3.45m													
				0	4								
				-1	5								
				-2	6								
				-3	7								
				-4	8								
method			support			notes, samples, tests			classification symbols and soil description			consistency/density index	
AS auger screwing* AD auger drilling* 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. ADT			M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow			U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal			based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit			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	

Borehole No. **NBH25**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **18.4.2012**

Principal:

Date completed: **18.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XP60 Ute		Easting: 323628		slope: -90°		R.L. Surface: 3.3	
hole diameter: 100 mm		Northing: 6249852		bearing: N/A		datum: AHD	

drilling information				material substance			
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material
1	2	3					soil type: plasticity or particle characteristics, colour, secondary and minor components.
DT				3			CONCRETE: (0.4m) with 10mm reinforcement
HA			E E				
ADT				1			FILL: Sandy CLAY: Low plasticity, pale brown, fine grained sand, trace fine to medium grained, subangular gravel
			SPT 12/120, N*=R	2			FILL: Clayey SAND: Fine grained, dark grey, with some fine to medium grained, subangular sandstone gravel
				2			2m - Becoming dark grey, mottled red-brown
				3			
			SPT 4,2,10/80 N*=R	0			FILL: Gravelly Sandy CLAY: High plasticity, dark grey, fine to medium grained, angular gravel, fine to medium grained sand
				4			
			SPT 11,13,7 N*=20	-1			
				5			
				-2		CH	Sandy CLAY: High plasticity, dark grey/grey, fine grained sand
				6			
			SPT 2,2,3 N*=5	-3			
				7			
				-4			
			SPT 4,7,11 N*=18	8			7.5m - Becoming dark grey/grey, mottled yellow-brown

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	Borehole NBH25 terminated at 7.95m U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	--	---	---	---

Borehole No. **NBH26**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **24.4.2012**

Principal:

Date completed: **24.4.2012**

Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XC Drill Track Easting: slope: -90° R.L. Surface: 3.3
hole diameter: 100 mm Northing bearing: N/A datum: AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
ADT	1	2	3	N	None Observed						ASPHALT: (0.3m)			100 200 300 400	PAVEMENT
						E	3			M	FILL				
											No Odour, PID = 2.7ppm				
											BEDROCK				
							1				SANDSTONE: Fine to medium grained, pale grey to orange-brown, highly weathered, low to medium strength Borehole NBH26 terminated at 0.8m				
							2								
							2								
							1								
							3								
							0								
							4								
							-1								
							5								
							-2								
							6								
							-3								
							7								
							-4								
							8								

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS auger screwing*	M mud N nil	U ₅₀ undisturbed sample 50mm diameter	based on unified classification system	VS very soft
AD auger drilling*	C casing	U ₆₃ undisturbed sample 63mm diameter		S soft
RR roller/tricone	penetration 1 2 3 4	D disturbed sample	moisture	F firm
W washbore	no resistance ranging to refusal	N standard penetration test (SPT)		St stiff
CT cable tool	water 10/1/98 water level on date shown	N* SPT - sample recovered	moisture	VSt very stiff
HA hand auger		Nc SPT with solid cone		H hard
DT diatube		V vane shear (kPa)	moisture	Fb friable
B blank bit		P pressuremeter		VL very loose
V V bit		Bs bulk sample	moisture	L loose
T TC bit		E environmental sample		MD medium dense
*bit shown by suffix e.g. ADT		R refusal	moisture	D dense
				VD very dense

Engineering Log - Borehole

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**

Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:	XP60 Truck	Easting:	slope: -90°	R.L. Surface:	2.65
hole diameter:	100 mm	Northing	bearing: N/A	datum:	AHD

drilling information						material substance											
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations		
	1	2	3														
ADT											ASPHALT: (0.15m)	D			PAVEMENT		
				E											FILL		
																No Odour	
				E												CONCRETE	
																ALLUVIUM	
																No Odour, PID = 2.1ppm	

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT	M mud C casing penetration 1 2 3 4  water 10/1/98 water level on date shown water inflow water outflow	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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 - Borehole

Client: **Infrastructure NSW**

Date started: **20.4.2012**

Principal:

Date completed: **23.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:				Ausrock 3000 Truck		Easting: 333703		slope: -90°		R.L. Surface: 2.3					
hole diameter:				100 mm		Northing 6250005		bearing: N/A		datum: AHD					
drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
HA				C		E	-2				FILL: Red Brick (0.08m)	D			PAVEMENT
						E					FILL: SAND: Medium grained, pale brown	M			FILL
											FILL: Clayey Gravelly SAND: Fine to medium grained, dark grey, fine to medium grained, subangular gravel				No Odour, PID = 0.9ppm
ADT							1			SP	FILL: Clayey SAND: Fine to medium grained, pale brown, with some sandstone cobbles (<100mm)				No Odour, PID = 0.5ppm
											SAND: Fine to medium grained, pale brown, trace clay				ALLUVIUM
						SPT 4,3,4 N*=7	2			CH	CLAY: High plasticity, dark grey, mottle pale grey, orange-brown	<Wp	F-St		No Odour, PID = 0.8ppm
RR						SPT 2,3,3 N*=6	-1			CH	CLAY: High plasticity, black, trace fine grained sand	>Wp	S-F		No Odour, PID = 0.8ppm
										CH	Sandy CLAY: High plasticity, dark grey, mottled dark brown, fine grained sand				
						SPT 1,2,1 N*=3	-2			SP	Clayey SAND: Fine grained, dark grey, trace medium grained, subangular sandstone gravel	M-W	VL		No Odour, PID = 0.9ppm
											5.5m - With some shell fragments				
						SPT 0,1,1 N*=2	-4			CL	CLAY: Low plasticity, dark grey, with some shell fragments	<Wp	VS		5.8m - SPT Rod sunk under weight of hammer (250mm) No Odour, PID = 0.7ppm
						SPT 0,12,15 N*=27	-5			CH	Silty CLAY: High plasticity, pale grey, mottled red-orange, yellow-brown	>Wp	St-VSt		RESIDUAL SOIL
															No Odour, PID = 1.8ppm
method						support		notes, samples, tests		classification symbols and soil description				consistency/density index	
AS auger screwing*						M mud		U ₅₀ undisturbed sample 50mm diameter		based on unified classification system				VS very soft	
AD auger drilling*						C casing		U ₆₃ undisturbed sample 63mm diameter						S soft	
RR roller/tricone								D disturbed sample						F firm	
W washbore								N standard penetration test (SPT)						St stiff	
CT cable tool								N* SPT - sample recovered						VSt very stiff	
HA hand auger								Nc SPT with solid cone						H hard	
DT diatube								V vane shear (kPa)						Fb friable	
B blank bit								P pressuremeter						VL very loose	
V V bit								Bs bulk sample						L loose	
T TC bit								E environmental sample						MD medium dense	
*bit shown by suffix e.g. ADT								R refusal						D dense	
														VD very dense	

Borehole No. **NBH28**

Engineering Log - Borehole

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **20.4.2012**

Principal:

Date completed: **23.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Ausrock 3000 Truck		Easting: 333703		slope: -90°		R.L. Surface: 2.3							
hole diameter:		100 mm		Northing 6250005		bearing: N/A		datum: AHD							
drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
RR				C			-6			CH	Silty CLAY: High plasticity, pale grey, mottled red-orange, yellow-brown (<i>continued</i>)	>Wp	St-VSt		
						SPT 7,10,15 N*=25	-9						VSt	X X	No Odour, PID = 1.4ppm
							-7								
							-10								
						SPT 12,19,22 N*=41	-8			CH	CLAY: High plasticity, dark grey, trace shell fragments			X X	No Odour, PID = 1.2ppm
							-11								
							-9								
							-12								
							-10								
							-13								
							-11			SC	Clayey SAND: Fine to medium grained, dark grey, mottled orange-brown, high plasticity clay	M-W	MD		
							-14								
						SPT 5,8,12 N*=20	-12								
							-15								
							-13								
											SANDSTONE: Medium grained, yellow-brown, red-brown, moderately weathered, low to medium strength				BEDROCK
											Borehole NBH28 continued as cored hole				
							-16								
method		support		notes, samples, tests		classification symbols and soil description		consistency/density index							
AS	auger screwing*	M	mud	N	nil	U ₅₀	undisturbed sample 50mm diameter	based on unified classification system	VS very soft						
AD	auger drilling*	C	casing			U ₆₃	undisturbed sample 63mm diameter			S soft					
RR	roller/tricone	penetration		D		D	disturbed sample		F firm						
W	washbore	1	2	3	4	N	standard penetration test (SPT)		St stiff						
CT	cable tool	no resistance ranging to refusal		N*		N*	SPT - sample recovered		VSt very stiff						
HA	hand auger	water		Nc		Nc	SPT with solid cone	moisture	H hard						
DT	diatube	10/1/98 water level on date shown		V		V	vane shear (kPa)		Fb friable						
B	blank bit	water inflow		P		P	pressuremeter	W	VL very loose						
V	V bit	water outflow		Bs		Bs	bulk sample	Wp	L loose						
T	TC bit			E		E	environmental sample	W _L	MD medium dense						
*bit shown by suffix e.g. ADT				R		R	refusal		D dense						
									VD very dense						

BOREHOLE GINTGEOTLCOV24303AC_COMBINED WITH AA GINT.GPJ COFFEY.GDT 5.15.12

Borehole No. **NBH29**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **See Figure 1**

Sheet 1 of 1

Project No: **GEOTLCOV24303AC**

Date started: **17.4.2012**Date completed: **17.4.2012**

Logged by: **JW**

Checked by: **DS**

[illegible]

Borehole No. **NBH3**

Engineering Log - Borehole

Sheet 1 of 5
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **4.5.2012**

Principal:

Date completed: **4.5.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Mobile Drill B80 Truck		Easting:	333487	slope:	-90°	R.L. Surface:	3.5
hole diameter:		100 mm		Northing	6250411	bearing:	N/A	datum:	AHD

drilling information				material substance								
method	penetration	support	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
1	2	3						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
ADV		C	E					FILL: Red Brick (0.08m)	M			PAVEMENT
			E, Dup 2	3				FILL: SAND: Fine to medium grained, brown/dark brown, trace of fine to medium, sub angular gravel				FILL
ADT					1			0.5m - With trace of clay.				
					2			FILL: Gravelly Clayey SAND: Fine to medium grained, pale grey, mottled pale brown, dark brown, fine to medium grained, subangular sandstone gravel	W			
			SPT 14,6,4 N*=10		2							
					1			FILL: Clayey GRAVEL: Fine to coarse grained, grey, mottled orange-brown, dark brown, trace fine grained sand				
					3							
			SPT 3,3,3 N*=6		0							
					4			4m - With some fine grained sand				
					-1							
			SPT 7,13,6 N*=19		5			FILL: Gravelly CLAY: Low plasticity, grey to dark grey, fine to medium grained, subangular gravel				
					-2							
					6			6m - With some medium grained sand				
			SPT 4,7,4 N*=11		-3							
					7							
					-4							
			SPT 4,5,7 N*=12		8							

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	--	--	---	---

Borehole No. **NBH3**

Engineering Log - Borehole

Sheet 2 of 5
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **4.5.2012**

Principal:

Date completed: **4.5.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Mobile Drill B80 Truck		Easting:	333487	slope:	-90°	R.L. Surface:	3.5
hole diameter:		100 mm		Northing	6250411	bearing:	N/A	datum:	AHD

drilling information				material substance								
method	penetration	support	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
1	2	3										
ADT		C			-5			FILL: Gravelly CLAY: Low plasticity, grey to dark grey, fine to medium grained, subangular gravel (continued)	W			
					9		CH	CLAY: High plasticity, brown, mottled pale grey, orange-brown, trace fine gravel and medium sand	>Wp	F		ALLUVIUM
			Bs		10							
			SPT 4,9,6 N*=15		11					F-St		
					12							
					13		CH	CLAY: High plasticity, red brown, mottled orange-brown and grey	>Wp	St-VSt		
			SPT 7,12,16 N*=28		14							
					15		CH	Sandy CLAY: High plasticity, dark grey, fine grained sand	<Wp	St		
					16							

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	---	--	---	---

Borehole No. **NBH3**

Engineering Log - Borehole

Sheet 3 of 5
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **4.5.2012**

Principal:

Date completed: **4.5.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:		Mobile Drill B80 Truck		Easting:	333487	slope:	-90°	R.L. Surface:	3.5
hole diameter:		100 mm		Northing	6250411	bearing:	N/A	datum:	AHD

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
1	2	3											
ADT								CH	Sandy CLAY: High plasticity, dark grey, fine grained sand (<i>continued</i>)	<Wp	St		
RR				SPT 2,4,6 N*=10	-13	17					F-St	xxx	
					-14								
					-15								
					-16								
				SPT 3,6,12 N*=18	-16	20		SC	Clayey SAND: Fine to medium grained, dark grey, mottled black	M	MD	xxx	
					-17								
					-18								
					-18				SANDSTONE: Fine grained, orange brown - pale grey, highly weathered, low to medium strength				BEDROCK
					-19				Borehole NBH3 continued as cored hole				
					-20								
					-21								
					-22								
					-23								
					-24								

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	--	--	---	---

Borehole No. **NBH30**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**

Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XP60 Truck		Easting:		slope: -90°		R.L. Surface: 2.75	
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD	
drilling information				material substance			
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.
ADT		N	E	2		CL	ASPHALTIC CONCRETE: (0.1m) FILL: Clayey GRAVEL: Medium to coarse grained, subangular to angular sandstone, pale brown, medium plasticity clay fines FILL: SAND: Fine to medium grained, pale grey, mottled pale brown, cement stabilized Sandy CLAY: Medium to low plasticity, pale brown, mottled orange-brown, fine to medium grained sand
ADT			SPT 1,0,0 N*=0	1		CH	Sandy CLAY: Medium to high plasticity, pale brown, mottled red-brown, medium to coarse grained sand
				2		CH	Silty CLAY: Medium plasticity, dark grey, mottled black
			SPT 1,3,1 N*=4	3			
				4			
			SPT 0,0,1 N*=1	5		CH	CLAY: Medium plasticity, pale grey
Borehole NBH30 terminated at 5m							
				6			
				7			
				8			
method		support		notes, samples, tests		classification symbols and soil description	
AS auger screwing* AD auger drilling* 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. ADT		M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	
						consistency/density index 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	

Borehole No. **NBH4**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **30.4.2012**

Principal:

Date completed: **30.4.2012**

Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XP60 Truck		Easting:		slope: -90°		R.L. Surface: 2.97			
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD			
drilling information				material substance					
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.		
ADT	1 2 3	N							
			E				FILL: Red Brick (0.08m)		
			E				FILL: SAND: Fine to medium grained, pale brown		
				2	1		FILL: Sandy GRAVEL: Medium to coarse grained, subangular, pale brown, fine to medium grained sand, with some sandstone cobbles <100mm, trace clay		
			SPT 3,3,12 N*=15	1	2				
				0	3				
			SPT 2,3,3 N*=6			SC	Sandy CLAY: Low plasticity, pale brown, mottled red-brown, fine to medium grained sand, with some black organic stained layers and plant fibres		
				-1	4				
			SPT 2,2,1 N*=3	-2	5				
				-3	6	SC	Sandy CLAY: Low plasticity, dark grey, mottled pale brown, medium grained sand, with some shell fragments		
			SPT 1,1,2 N*=3						
				-4	7				
			SPT 1,3,3 N*=6	-5	8	CH	CLAY: Medium to high plasticity, pale grey, mottled red-brown.		
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		Borehole NBH4 tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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

Borehole No. **NBH5**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **1.5.2012**

Principal:

Date completed: **1.5.2012**

Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XP60 Truck		Easting:		slope: -90°		R.L. Surface: 3.0					
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD					
drilling information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
ND		N	E	2			CONCRETE: (0.05m)	D			CONCRETE SLAB
			E	1			FILL: Gravelly SAND: Fine to medium grained, dark grey, fine to medium grained, subangular sandstone gravel.	M			FILL No Odour, PID = 0.3ppm
				1			FILL: Sandy GRAVEL: Medium to coarse grained, subangular, orange-brown, mottled red-brown, fine to coarse grained sand, with some clay.				No Odour, PID = 0.4ppm
				1			FILL: CLAY: Low to medium plasticity, red-brown.	<Wp			
			SPT 5,6,7 N*=13	2			FILL: Sandy GRAVEL: Medium to coarse grained, subangular sandstone, pale brown, fine to coarse grained sand, trace of clay.	M			No Odour, PID = 0.3ppm
				3		SC	Clayey SAND: Medium to coarse grained, dark grey, low plasticity clay fines, with some shell fragments.	MD			ALLUVIUM
			SPT 3,4,7 N*=11	4				W			No Odour, PID = 0.1ppm
				5				VD			No Odour, PID = 1.3ppm
			SPT R... N*=R	5			Borehole NBH5 terminated at 5m				
				6							
				7							
				8							
method AS auger screwing* AD auger drilling* 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. ADT				support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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	

Borehole No. **NBH6**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **30.4.2012**

Principal:

Date completed: **30.4.2012**

Project: **SICEEP**

Logged by: **ACM**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XP60 Truck		Easting:		slope: -90°		R.L. Surface: 5.4	
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD	
drilling information				material substance			
method	penetration 1 2 3	support water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol
ADT HA		N	E	5			
			E		1		
			SPT 7,17,9 N*=26		4		
					2		
			SPT 9,7,3 N*=10		3		
					2		
			SPT 3,0,1 N*=1		1		
					5		
					0		
					6		
Borehole NBH6 terminated at 6m							
					-1		
					7		
					-2		
					8		
method		support		notes, samples, tests		classification symbols and soil description	
AS auger screwing*		M mud N nil		U ₅₀ undisturbed sample 50mm diameter		based on unified classification system	
AD auger drilling*		C casing		U ₆₃ undisturbed sample 63mm diameter		moisture	
RR roller/tricone		penetration		D disturbed sample		D dry	
W washbore		1 2 3 4		N standard penetration test (SPT)		M moist	
CT cable tool		no resistance ranging to refusal		N* SPT - sample recovered		W wet	
HA hand auger		water		Nc SPT with solid cone		Wp plastic limit	
DT diatube		10/1/98 water level on date shown		V vane shear (kPa)		WL liquid limit	
B blank bit		water inflow		P pressuremeter			
V V bit		water outflow		Bs bulk sample			
T TC bit				E environmental sample			
*bit shown by suffix e.g. ADT				R refusal			
						consistency/density index	
						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	

Borehole No. **NBH7**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **23.4.2012**

Principal:

Date completed: **23.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: Ausrock 3000 Truck Easting: 333529 slope: -90° R.L. Surface: 5.4
hole diameter: 100 mm Northing 6250304 bearing: N/A datum: AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
HA	1	2	3	N		E					FILL: Red Brick (0.08m)	D			PAVEMENT
						E	5				FILL: SAND: Fine to medium grained, pale brown	M			FILL
ADT								1			FILL: Gravelly SAND: Fine to medium grained, yellow-brown, mottled pale grey, with some fine to medium grained, subangular sandstone gravel, trace of clay				No Odour, PID = 0.7ppm
							4				FILL: Sandy GRAVEL: Fine to medium grained, subangular sandstone, dark grey, coarse grained sand	<Wp			
						SPT 4,4,2 N*=6		2			FILL: Sandy CLAY: Low plasticity, dark grey, fine to medium grained sand, with some fine to medium grained, subangular gravel				No Odour, PID = 2.3ppm
							3								No Odour, PID = 1.9ppm
						E		3			FILL: CLAY: High plasticity, dark brown, mottled dark grey, trace fine grained, subangular sandstone gravel and fine grained sand				
							2				FILL: CONCRETE	D			Suspected Service Encountered
								4			Borehole NBH7 terminated at 3.6m				
							1								
							5								
							0								
							6								
							-1								
							7								
							-2								
							8								
method						support		notes, samples, tests			classification symbols and soil description			consistency/density index	
AS auger screwing*						M mud N nil		U ₅₀ undisturbed sample 50mm diameter			based on unified classification system			VS very soft	
AD auger drilling*						C casing		U ₆₃ undisturbed sample 63mm diameter						S soft	
RR roller/tricone						penetration		D disturbed sample						F firm	
W washbore						1 2 3 4		N standard penetration test (SPT)						St stiff	
CT cable tool								N* SPT - sample recovered						VSt very stiff	
HA hand auger						no resistance ranging to refusal		Nc SPT with solid cone						H hard	
DT diatube						water		V vane shear (kPa)			moisture			Fb friable	
B blank bit						10/1/98 water level on date shown		P pressuremeter			D dry			VL very loose	
V V bit								Bs bulk sample			M moist			L loose	
T TC bit								E environmental sample			W wet			MD medium dense	
*bit shown by suffix e.g. ADT								R refusal			Wp plastic limit			D dense	
											WL liquid limit			VD very dense	

Engineering Log - Borehole

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**

Project: **SICEEP**

Logged by: **DB**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting:	Mobile Drill Truck	Easting:	slope: -90°	R.L. Surface:	3.4
hole diameter:	100 mm	Northing	bearing: N/A	datum:	AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3											100 200 300 400	
ADT				C	E	3	1				FILL: Red Brick (0.08m)	D			PAVEMENT
					E						FILL: Gravelly SAND: Fine to coarse grained, dark brown, mottled red-brown, dark grey, fine to medium grained, angular gravel.	M			
ADT				▶	SPT 3,4,5 N*=9	2	2				FILL: Sandy Gravelly CLAY: Low plasticity, dark brown, mottled pale grey, orange-brown, fine to medium grained sand, fine to coarse grained, subangular to angular gravel.	<Wp			Slight Odour, PID = 31.5ppm
					SPT 2,1,5 N*=6	3					FILL: Silty Clayey SAND: Fine to medium grained, dark brown, with some fine to coarse grained, angular to subangular gravel and slag.	M W			No Odour, PID =16.1ppm
					SPT 3,2,12 N*=14	4	5				FILL: Sandy Gravelly CLAY: Low plasticity, dark brown, mottled pale grey, red-brown, orange-brown, fine to medium grained sand, fine to coarse grained, subangular sandstone/blue metal gravel, with some cobbles (<100mm).	>Wp	No Odour, PID =6.8ppm		
					SPT 3,1,2 N*=3	6					FILL: Gravelly SAND: Fine to medium grained, pale grey, mottled orange-brown, dark brown, fine to coarse grained, subangular sandstone and blue metal slag gravel, trace clay.	W	No Odour, PID =5.3ppm		
					SPT 1,1,0 N*=1	8		SP					W	VL	ALLUVIUM

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	--	--	---	---

Borehole No. **NBH8**

Engineering Log - Borehole

Sheet 2 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**

Project: **SICEEP**

Logged by: **DB**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: Mobile Drill Truck		Easting:		slope: -90°		R.L. Surface: 3.4					
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD					
drilling information				material substance							
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.				
ADT	1 2 3	C		5		SP	SAND: Medium, dark brown to dark grey, abundant shell fragments. <i>(continued)</i>				
				9		SC	Sandy CLAY: Low to medium plasticity, orange-brown, mottled red-brown, fine to medium grained sand, trace of fine to medium grained, subrounded to subangular ironstone/sandstone gravel.				
			SPT 1,1,0 N*=1	6							
				10			SANDSTONE: Fine to medium grained, orange-brown, highly weathered, low to medium strength.				
				11			Borehole NBH8 continued as cored hole				
				12							
				13							
				14							
				15							
				16							
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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	

Borehole No. **NBH9**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **30.4.2012**

Principal:

Date completed: **30.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model and mounting: XC Drill Track		Easting:		slope: -90°		R.L. Surface: 5.8		
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD		
drilling information				material substance				
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	
ADT	1 2 3	N		5			CONCRETE: (0.21m) with 10mm reinforcement FILL: GRAVEL: Medium to coarse grained, subangular, dark grey, with some fine to medium grained sand, trace of clay SANDSTONE: Fine to medium grained, pale grey, pale yellow brown, moderately weathered, low to medium strength. Borehole NBH9 terminated at 0.33m	
				1				
				4				
				2				
				3				
				3				
				2				
				4				
				1				
				5				
				0				
				6				
				-1				
				7				
				-2				
				8				
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit
				consistency/density index 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				

Borehole No. **R17-BH1**

Engineering Log - Borehole

Sheet 1 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **7.6.2011**

Principal:

Date completed: **7.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Hydrapower Scout Truck		Easting:		slope: -90°		R.L. Surface: 3.75							
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD							
drilling information				material substance											
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations		
ADT	1 2 3	C							FILL: BRICK PAVERS: 0.08m. FILL: SAND: Medium grained, brown, with some roots, 0.02m. FILL: CONCRETE: Grey, 0.50m.	D			PAVEMENT		
				SPT 7,11,10 N*=21	3	1			FILL: SAND: Coarse grained, red, brown, grey, trace of clay and fine to medium sandstone and brick gravel.	D			FILL		
					2	2			FILL: Clayey SAND: Coarse grained, brown, low plasticity clay, with some medium grained sand, trace of shells, fibers and fine grained rounded sandstone and brick gravel.						
ADV				SPT 1,1,2 N*=3	1	3									
					0	4		CL	Sandy CLAY: Low to medium plasticity clay, dark brown, coarse grained sand, with some shells.	M	F		POSSIBLY FILL?		
				SPT 3,2,1 N*=3					4.00m Band of red partially cemented sand and ironstone gravel.	W					
					-1	5		SC	Clayey SAND: Medium to coarse grained, brown, red, orange mottled, low to medium plasticity clay, with some shells.		L		ESTUARINE/ALLUVIUM		
				SPT 1,2,4 N*=6	-2	6		SW	SAND: Medium to coarse grained, brown, grey, red, with some clay and shells.						
					-3	7		SP	SAND: Coarse grained, pale grey to grey, trace of clay.		L-MD		RESIDUAL SOIL		
				SPT 8/70mm N*=R	-4	8			SANDSTONE: Extremely weathered, coarse grained, grey, red, brown, estimated to be low strength, remoulds to a sand.				WEATHERED BEDROCK		
Borehole R17-BH1 continued as cored hole															
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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	

Borehole No. **R17-BH10**

Sheet 1 of 4

Project No. **GEOTLCOV24303AC**

Date started: **1.6.2011**

Date completed: **10.6.2011**

Logged by: **LJG**

Checked by: **SS**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Little Pier Street, Haymarket, NSW**

drilling information				material substance							
method	penetration	support	notes	depth	graphic log	classification	material	moisture	consistency/density index	pocket penetrometer	structure and additional observations
1	2	3	samples, tests, etc	metres		symbol	soil type: plasticity or particle characteristics, colour, secondary and minor components.	condition		100 200 300 400 kPa	
ADT		C					BRICK PAVERS:	D			PAVEMENT
							FILL: Gravelly SAND: Medium to coarse grained, brown, fine to medium grained, angular gravel.				
							CONCRETE: Grey, 200mm	D			FILL
							FILL: Clayey SAND: Coarse grained, brown				
			SPT 8/90mm N*=R	1			FILL: Sandy CLAY: Medium plasticity, red-brown/pale grey.				1.09m - Strong odour
				2			1.09m - with some asphalt gravel.	M			
				3			FILL: Silty CLAY: Low to medium plasticity, grey, brown, trace of sand.	D			
			SPT 3,2,3 N*=5	4			FILL: CLAY: Medium to high plasticity, red, brown, pale grey, orange mottled, with some fine grained gravel				
				5		SM	Silty SAND: Medium to coarse grained, black, with some shells, trace of fine grained gravel.	W	VL		ALLUVIUM
				6		SC	Clayey SAND: Coarse grained, brown, medium to high plasticity clay.				
			SPT 1,0,0 N*=0	7		SC	Clayey SAND: Coarse grained, black, low plasticity clay, with some shells, trace of silt.				
				8		CH	CLAY: High plasticity, red brown, grey with some sand.	St			
				9		SC	Clayey SAND: Fine grained, pale grey, low plasticity clay.	MD			
			SPT 4,5,7 N*=12	10		CL-CH	Sandy CLAY: Medium to high plasticity, pale grey, yellow brown.	VSt		X	
				11		CH	CLAY: High plasticity, red brown, grey, with some coarse sand.			X	

BOREHOLE GINTGEOTLCOV24303AC_COMBINED WITH AA GINT.GPJ COFFEY.GDT 5.15.12

Borehole No. **R17-BH10**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

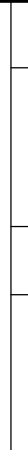
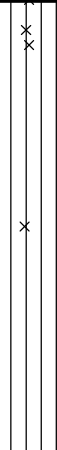
Borehole Location: ***Little Pier Street, Haymarket, NSW***

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Date started: **1.6.2011**Date completed: **10.6.2011**

Logged by: **LJG**

Checked by: **SS**

drill model and mounting:		Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 3													
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD													
drilling information							material substance														
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter	structure and additional observations						
	1	2	3																		
WB						SPT 6,7,9 N*=16				CH	CLAY: High plasticity, red brown, grey, with some coarse sand. (continued)	W	VSt								
														-6	9	CH	CLAY: High plasticity, red, brown, dark grey, orange mottled, trace of ironstone gravel and fine sand.		St/VSt		
													SPT 5,5,7 N*=12				SC	Clayey SAND: Coarse grained, grey, low to medium clay.		MD	
							-7	10													
							-8	11													
							-9	12			Borehole R17-BH10 continued as cored hole										
							-10	13													
							-11	14													
							-12	15													
							-13	16													
method AS auger screwing* AD auger drilling* 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. ADT						support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		notes, samples, tests U ₉₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit		consistency/density index 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							

Borehole No. **R17-BH11**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

Sheet 1 of 3
Project No: **GEOTLCOV24303AC**

Date started: **1.6.2011**Date completed: **1.6.2011**

Logged by: ***RH***

Checked by: **SS**

drill model and mounting:						Ausrock 2000 Truck		Easting:		slope: -90°		R.L. Surface: 2.9				
hole diameter:						100 mm		Northing		bearing: N/A		datum: AHD				
drilling information						material substance										
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations	
	1	2	3													
ADV				C		D					FILL: SAND: Medium to coarse grained, pale brown, with some quartz and shell fragments.	M			FILL	
						D	2	1			FILL: SAND: Fine to coarse grained, dark brown, black, with some fine to medium lithic gravels and sandstone.				0.70m distinct bitumen odour	
						SPT 13,5,3 N*=8	-1	2			FILL: SANDSTONE BOULDER: Pale yellow and white				0.80m SPT1 moved from 1.0m to 1.50m due to sandstone boulder.	
										CL	Silty CLAY: Low plasticity, pale grey mottled red.	W	F		ALLUVIUM	
							0	3		SC	Clayey SAND: Fine to medium grained, dark grey, clay rich and sand rich layers throughout		MD		3.00m distinct organic odour	
						U ₅₀	-1	4		CH	CLAY: High plasticity, dark grey, brown.		S-F			
						SPT 3,4,10 N*=14	-2	5		CL	Silty CLAY: Low plasticity, pale grey mottled red and orange iron stained, with some red clay pockets throughout.		VSt	X X X	RESIDUAL SOIL	
							-3	6			5.70m increased iron staining			X X X		
						SPT 7,8,9 N*=17	-4	7								
						SPT 3,5,30/120mm N*=R	-5	8			SANDSTONE: Extremely weathered, medium grained, pale grey, white, estimated to be very low strength.				WEATHERED BEDROCK	
method						support		notes, samples, tests				classification symbols and soil description			consistency/density index	
AS auger screwing*						M mud N nil		U ₅₀ undisturbed sample 50mm diameter				based on unified classification system			VS very soft	
AD auger drilling*						C casing		U ₆₃ undisturbed sample 63mm diameter							S soft	
RR roller/tricone								D disturbed sample							F firm	
W washbore								N standard penetration test (SPT)							St stiff	
CT cable tool								N* SPT - sample recovered							VSt very stiff	
HA hand auger								Nc SPT with solid cone							H hard	
DT diatube								V vane shear (kPa)							Fb friable	
B blank bit								P pressuremeter							VL very loose	
V V bit								Bs bulk sample							L loose	
T TC bit								E environmental sample							MD medium dense	
*bit shown by suffix e.g. ADT								R refusal							D dense	
															VD very dense	

Borehole No. **R17-BH11**

Engineering Log - Borehole

Sheet 2 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **1.6.2011**

Principal:

Date completed: **1.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

Checked by: **SS**

drill model and mounting: Ausroc 4000 Truck Easting: slope: -90° R.L. Surface: 2.9
hole diameter: 100 mm Northing bearing: N/A datum: AHD

drilling information						material substance												
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa				structure and additional observations
	1	2	3											100	200	300	400	
											Borehole R17-BH11 continued as cored hole							
								-6	9									
								-7	10									
								-8	11									
								-9	12									
								-10	13									
								-11	14									
								-12	15									
								-13	16									

method AS auger screwing* AD auger drilling* 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. ADT	support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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
--	--	--	--	---

Borehole No. **R17-BH12**

Sheet 1 of 3

Project No. **GEOTLCOV24303AC**

Date started: **10.6.2011**

Date completed: **10.6.2011**

Logged by: **RC**

Checked by: **SS**

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

drill model and mounting:				Hydrapower Scout Truck				Easting:				slope: -90°				R.L. Surface: 2.8							
hole diameter:				100 mm				Northing				bearing: N/A				datum: AHD							
drilling information								material substance															
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa				structure and additional observations					
	1	2	3											100	200	300	400						
ADT				C							FILL: Clayey SAND: Fine to medium grained, brown, trace of gravel and rootlets.	D						TOPSOIL/FILL					
							2				FILL: CONCRETE: Pale grey, 100mm							FILL (Pavement?)					
							1				FILL: Sandy GRAVEL: Medium to coarse, grey to dark grey.												
											FILL: Silty SAND: Fine to medium grained, dark grey to black, with some clay and fine rounded gravel.	M						FILL slight odour					
						SPT 4,4,3 N*=7	1				FILL: Very low strength shale remoulding as brown silty clay.	<Wp											
							2				FILL: Silty CLAY: High plasticity, red-brown mottled orange-brown, with some sand.												
												>Wp											
							0				2.7m - With some fine to medium subangular ironstone gravel.												
ADV							3			CH	3.4m - Band with some sand and shells (50mm). Silty CLAY: High plasticity, dark grey, with some bands of medium grained sand and some shells. 3.4m - Band with some sand and shells.		S/F					3.0m - SPT rods sunk 400mm under hammer weight ALLUVIUM					
						U ₅₀	-1				3.95m - With some fibres. 4.2m - Becoming grey.												
											4.7m - Becoming mottled red.												
						SPT 2,2,4 N*=6	-2			CH	Sandy CLAY: High plasticity, pale grey mottled red and orange-brown, medium grained sand, trace of silt.		St-VSt										
							-3																
							6																
						SPT 2,4,8 N*=12																	
							-4																
							7			SP	SAND: Medium grained, pale grey mottled brown, trace of clay.	W	MD					RESIDUAL SOIL					
						SPT 3,11,30/60mm N*=R	-5				7.75m - Becoming yellow and red.		D					WEATHERED BEDROCK					
							8																
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow water outflow				Borehole R17-BH12 continued as cored hole U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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							

Borehole No. **R17-BH13**

Engineering Log - Borehole

Sheet 1 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **9.6.2011**

Principal:

Date completed: **9.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Hydrapower Scout Truck		Easting:		slope: -90°		R.L. Surface: 3.15											
hole diameter:		100 mm		Northing:		bearing: N/A		datum: AHD											
drilling information				material substance															
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations						
ADT	1 2 3				3				FILL: Rectangular, red-brown concrete pavers (50mm) overlying medium grained pale brown sand (50mm)	D			PAVEMENT						
ADV					1				FILL: Sandy GRAVEL: Medium to coarse grained, grey, fine to medium grained gravel.	M			FILL						
				SPT 10,8,2 N*=10	2				FILL: Gravelly SAND: Fine to medium grained, brown, fine to coarse angular to subrounded gravel.	W									
					2				FILL: SAND: Medium grained, pale brown.										
					1				1.8m - With some brown gravel.										
					0			CH	Silty CLAY: High plasticity, dark grey.	>Wp	S		ALLUVIUM						
				SPT 1,1,1 N*=2	3								3m - With sulfuric odour						
				U ₅₀	0														
					4														
				SPT 3,6,6 N*=12	-1						F/St								
					5														
					-2			CL	Sandy CLAY: Low plasticity, pale grey mottled, orange-brown, fine to medium grained sand with some fine to medium grained subangular ironstone gravel.		St-VSt								
				SPT 5,4,4 N*=8	6														
					-3														
					7														
				SPT 6,6,7 N*=13	-4														
					8														
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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			

BOREHOLE GINTGEOTLCOV24303AC_COMBINED WITH AA GINT.GPJ COFFEY.GDT 5.15.12

Borehole No. **R17-BH13**

Engineering Log - Borehole

Sheet 2 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **9.6.2011**

Principal:

Date completed: **9.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

Checked by: **SS**

drill model and mounting: Hydrapower Scout Truck		Easting:		slope: -90°		R.L. Surface: 3.15					
hole diameter: 100 mm		Northing		bearing: N/A		datum: AHD					
drilling information				material substance							
method	penetration	support	water	notes samples, tests, etc	depth metres	graphic log	classification symbol				
ADV	1 2 3				-5		CL				
				SPT 4.5,3 N*=8	9		SP				
					-6						
					-7						
NMLC				SPT R,30/140,R N*=R							
Borehole R17-BH13 continued as cored hole											
					-8						
					-9						
					-10						
					-11						
					-12						
					-13						
					-14						
					-15						
					-16						
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal		classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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	

Borehole No. **R17-BH14**

Engineering Log - Borehole

Sheet 1 of 2
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **17.6.2011**

Principal:

Date completed: **17.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Hydrapower Scout Truck		Easting:		slope: -90°		R.L. Surface: 3.3											
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD											
drilling information				material substance															
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations						
ADT	1 2 3	C			3				FILL: ASPHALT: Dark grey, medium to coarse grained gravel, overlying medium to coarse grained, pale brown. Sandy GRAVEL.	D			PAVEMENT						
					1				Gravelly SAND: Fine to medium grained, brown, dark brown, fine to coarse gravel, with some dioritic cobbles (70mm), trace of silt.				FILL						
				SPT 3,2,2 N*=4	2														
					2				FILL: CONCRETE: Pale grey										
					2				FILL: Gravelly SAND:	M									
					1														
				SPT 1,0,0 N*=0	3			CH	Silty CLAY: High plasticity, dark grey, grey, trace of medium grained sand.	>Wp	VS	X	ALLUVIUM						
					0				3.5m - With some bands of sand.										
					4			CH	Silty CLAY: High plasticity, red mottled pale grey.		S/F	X							
				SPT 2,3,2 N*=5	-1							X							
					5							X							
					-2			CH/SC	BANDS OF Silty CLAY/Clayey SAND: Dark grey and high plasticity clay. Sand is medium to coarse grained, dark grey sand.	>Wp/W	S/L								
				SPT 3,3,5 N*=8	6														
					-3														
					7				SANDSTONE: Medium to coarse grained, pale grey to white, remoulds to a sand.				WEATHERED BEDROCK						
				SPT R,20/90 N*=R	-4				Borehole R17-BH14 continued as cored hole										
					8														
method AS auger screwing* AD auger drilling* 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. ADT				support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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			

Borehole No. ***R17-BH15***

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Harbour Street, Haymarket, NSW**

Sheet 1 of 3

Project No: **GEOTLCOV24303AC**Date started: **21.6.2011**Date completed: **21.6.2011**

Logged by: **LJG**

Checked by: **SS**

drill model and mounting:		Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 3.2							
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD							
drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
ADT				C			3				FILL: BITUMEN: Dark grey, 300mm				FILL
								1			FILL: CONCRETE: Grey, 100.m FILL: Gravelly SAND: Medium to coarse grained, dark grey, brown, fine grained brick, sandstone and aggregate gravel, trace of clay. 0.5m - Fine to medium grained gravel, with some clay.	D M			1m - SPT refused on gravel
						SPT 8/160mm N*=R	2				1.50m - With some clay and coarse sandstone gravel, trace of cobbles.				
								2							
							1								
						SPT 3,1,2 N*=3				SC CL	Clayey SAND: Medium to coarse grained, black, dark grey, high plasticity clay, trace of organic material. Silty CLAY: Low plasticity, dark brown, dark grey, with some organic material and some shells.	W M-W	MD F		ALLUVIUM
							3								
							0			SC CH	Clayey SAND: Coarse grained, dark grey, brown, trace of shells. CLAY: High plasticity, pale grey mottled red brown, trace of sand. 3.5m - With some interbedded sand layers.	W	L-MD St-VSt		
						SPT 3,4,5 N*=9	-1			SC CH	Clayey SAND: Coarse grained, dark grey, dark brown, low plasticity clay, trace of shells. CLAY: High plasticity, pale grey, trace of fine sand.		MD St		
								5			5.20m - Pale grey, pale brown mottled.	M			
						SPT 2,4,6 N*=10	-3				5.80m - Pale grey, red, brown mottled, trace of fine to coarse sand and fine ironstone.				
								6							
								7							
						SPT 7,5,6 N*=11	-4			CL SC	Sandy CLAY: Low to medium plasticity, pale brown mottled red, coarse sand. Clayey SAND: Coarse grained, red, trace of fine ironstone gravel and burrows.	M	St MD		RESIDUAL SOIL
											7.8m - Pale brown, mottled black and red, trace of				
								8							
method				support		notes, samples, tests				classification symbols and soil description based on unified classification system				consistency/density index	
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT				M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		N nil U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				moisture D dry M moist W wet Wp plastic limit W _L liquid limit				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	

Borehole No. ***R17-BH15***

Engineering Log - Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Harbour Street, Haymarket, NSW**

Sheet 2 of 3

Project No: **GEOTLCOV24303AC**

Date started: **21.6.2011**

Date completed: **21.6.2011**

Logged by: **LJG**

Checked by: **SS**

drill model and mounting:							Ausrock 2000 Truck						Easting:			slope: -90°				R.L. Surface: 3.2							
hole diameter:							100 mm						Northing			bearing: N/A				datum: AHD							
drilling information								material substance																			
method		penetration 1 2 3			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type; plasticity or particle characteristics, colour, secondary and minor components.				moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations								
ADT					C			-5				burrows. _____ SANDSTONE: Extremely weathered, coarse grained, pale brown, pale grey, estimated to be very low strength, remoulds to a sand.									WEATHERED BEDROCK						
												Borehole R17-BH15 continued as cored hole									TC Bit refusal at 8.50m						
									9																		
									-6																		
									10																		
									-7																		
									11																		
									-8																		
									12																		
									-9																		
									13																		
									-10																		
									14																		
									-11																		
									15																		
									-12																		
									16																		
method AS auger screwing* AD auger drilling* 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. ADT								support M mud N nil C casing penetration 1 2 3 4 water 10/1/98 water level on date shown water inflow water outflow				notes, samples, tests U ₉₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal								classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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			

Borehole No. **R17-BH16**

Engineering Log - Borehole

Sheet 1 of 6
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **20.6.2011**

Principal:

Date completed: **21.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Hydrapower Scout Truck		Easting:		slope: -75°		R.L. Surface: 3.30									
hole diameter:		100 mm		Northing		bearing: 177.5°		datum: AHD									
drilling information				material substance													
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations				
PH	1 2 3	C			3	1			BRICK PAVERS: 0.06m FILL: Gravelly SAND: Fine to coarse, brown, dark brown, fine to rounded gravel with some clay and trace of medium to coarse gravel, roots, glass, metal piping, concrete, bricks.	D			FILL				
AD					2	2			FILL: SAND: Medium to coarse grained, brown, with some clay and fine gravel.	M							
WB					1	3				W							
					0	4		CL/SC	Sandy CLAY/Clayey SAND: Low plasticity clay, medium to coarse grained sand, grey, brown, with some organic material.				ALLUVIUM				
					-1	5		CH	CLAY: High plasticity, red, brown, grey, trace of sand.								
				U ₅₀	-2	6											
					-3	7		CH	Sandy CLAY: High plasticity, grey, coarse sand.								
					-4	8		SP	SAND: Coarse grained, grey, brown, trace of clay.								
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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	

Borehole No. **R17-BH16**

Engineering Log - Borehole

Sheet 2 of 6
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **20.6.2011**

Principal:

Date completed: **21.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Hydrapower Scout Truck		Easting:		slope: -75°		R.L. Surface: 3.30							
hole diameter:		100 mm		Northing:		bearing: 177.5°		datum: AHD							
drilling information				material substance											
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations		
WB	1 2 3	C						SP	SAND: Coarse grained, grey, brown, trace of clay. (continued)	W					
					-5	9		SC	Clayey SAND: Medium to coarse sand, pale grey, red, brown, high plasticity clay.						
					-6	10									
					-7	11		SP	SAND: Coarse grained, grey, pale grey, trace of clay.				RESIDUAL SOIL		
					-8	12									
					-9	13									
					-10	14			SANDSTONE: Extremely weathered, coarse grained, pale grey to red brown, estimated to be low strength. Remoulds to a sand. 13.45m - Highly weathered.				WEATHERED BEDROCK		
									Borehole R17-BH16 continued as cored hole						
					-11	15									
					-12	16									
method AS auger screwing* AD auger drilling* 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. ADT				support M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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	

BOREHOLE GINTGEOTLCOV24303AC_COMBINED WITH AA GINT.GPJ COFFEY.GDT 5.15.12

Engineering Log - Borehole

Client: **Infrastructure NSW**

Date started: **16.6.2011**

Principal:

Date completed: **16.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:	Edson 3000 Truck	Easting:	slope: -90°	R.L. Surface:	3.2
hole diameter:	100 mm	Northing	bearing: N/A	datum:	AHD

drilling information							material substance								
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
ADT				C			-3				FILL: BRICK PAVERS: Brown, 0.08m FILL: Clayey Gravelly SAND: Medium to coarse grained, brown, grey, fine gravel, medium plasticity clay.	D		100 200 300 400	FILL
						SPT 6,7,4 N*=11	-2	1			FILL: SAND: Coarse grained, grey, brown, yellow, red mottled, with some fine sandstone gravel, trace of clay.				
							-2	2							
							-1				FILL: Silty CLAY: Low plasticity, black, with some organic material, trace of sand and fine gravel.	W			
						SPT 2,0,0 N*=0	-3	3			3.10m - With some sand.				
							0								
						SPT 2,3,5 N*=8	-1	4		CH	CLAY: High plasticity, red, brown, grey, trace of fine grained ironstone gravel.	M	St-VSt	x x	ALLUVIUM
							-2	5							
						SPT 2,5,6 N*=11	-3	6		CH	CLAY: High plasticity, grey, red, brown, yellow, with some coarse sand, trace of fine to medium grained sandstone and ironstone gravel.		St-VSt	x x	
							-4	7		CL	Gravelly CLAY: Low plasticity, brown, grey, red, fine angular sandstone and ironstone gravel.	W			
						SPT 4,7,8 N*=15	-4			CH	CLAY: High plasticity, pale grey, red brown mottled, trace of sand.			x x	
								8							

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T	M mud C casing penetration 1 2 3 4  water 10/1/98 water level on date shown water inflow water outflow	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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

Borehole No. **R17-BH17**

Engineering Log - Borehole

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **16.6.2011**

Principal:

Date completed: **16.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Edson 3000 Truck		Easting:		slope: -90°		R.L. Surface: 3.2											
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD											
drilling information				material substance															
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations						
ADT	1 2 3	C			-5			CH	CLAY: High plasticity, pale grey, red brown mottled, trace of sand. <i>(continued)</i> 8.10m - With some coarse sand.	W	St-VSt		RESIDUAL SOIL						
				SPT 4,12,10 N*=22	9		SC	Clayey SAND: Coarse grained, pale grey, grey.		MD									
					-6		CH	Sandy CLAY: High plasticity clay, grey, pale grey, coarse sand.		St-VSt									
					-7				SANDSTONE: Extremely weathered, coarse grained, pale grey, remoulds to a sandy clay. 10.30m - Highly weathered.				WEATHERED BEDROCK						
					-8	11			Borehole R17-BH17 continued as cored hole										
					-9	12													
					-10	13													
					-11	14													
					-12	15													
					-13	16													
method AS auger screwing* AD auger drilling* 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. ADT				support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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			

Borehole No. **R17-BH2**

Engineering Log - Borehole

Sheet 1 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **3.6.2011**

Principal:

Date completed: **3.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model and mounting: Ausroc 4000 Truck Easting: slope: -90° R.L. Surface: 3.5
hole diameter: 100 mm Northing bearing: N/A datum: AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
DT	1	2	3	C							ASPHALT CONCRETE	D		100 200 300 400	PAVEMENT
ADT							-3				FILL: Sandy SILT : Low plasticity, pale brown, fine to medium grained sand with some clay. FILL: Clayey SAND : Fine to coarse grained, dark brown and black with red brown mottles, some pale brown sand pockets, fine to coarse grained sandstone and fine grained ironstone gravels throughout, trace of glass and wire refuse.	M			FILL
						SPT 8,5,4 N*=9		1							
							-2								
								2							
											2.5m - Increasing clay content.				
						SPT 4,3,3 N*=6		1							
								3							
							0								
								4		SW	SAND : Fine to coarse grained, grey, trace of silt.		VL		ALLUVIUM
						SPT 1,1,0 N*=1		-1							
								5		SC	Clayey SAND : Fine to medium to coarse grained, dark brown, low to medium plasticity clay.		L-MD		
										SC	Clayey SAND : Fine to coarse grained, pale grey, clay with some pockets of shells throughout.	W			
						SPT 1,2,3 N*=5		-2							5.7m - Distinct organic odour
								6							
								7			SANDSTONE : Extremely weathered, medium to coarse grained, pale yellow and brown, estimated to be very low strength, remoulds to a sand.				WEATHERED BEDROCK
								8							
NMLC															

method	support	penetration	water	classification symbols and soil description	consistency/density index
AS auger screwing* AD auger drilling* 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. ADT	M mud C casing no resistance ranging to refusal 10/1/98 water level on date shown water inflow water outflow	1 2 3 4	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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 - Borehole

Client: **Infrastructure NSW**

Date started: **2.6.2011**

Principal:

Date completed: **2.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:	Ausroc 4000 Truck	Easting:	slope: -90°	R.L. Surface:	3.5
hole diameter:	100 mm	Northing	bearing: N/A	datum:	AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
DT				C							ASPHALT: 0.05m CONCRETE: 0.45m				PAVEMENT
ADV							3				FILL: Sandy SILT : Low plasticity, pale brown, fine grained sand, with some clay. FILL: Clayey SAND : Fine to medium grained, dark brown, trace of pale brown sand pockets, fine to coarse grained sandstone and fine grained ironstone gravel.	M			FILL
						SPT 9,6,8 N*=14	2								
							2								
							1								
						SPT 4,5,10 N*=15	3								
							0								
							4		SW		SAND : Fine to coarse grained, with some low plasticity fines.	L			ALLUVIUM
						SPT 4,3,2 N*=5	-1								
							5		SC		Clayey SAND : Fine grained, dark brown	W			
							-2		SW		SAND : Medium to coarse grained, pale grey, trace of fines.	L-MD			
						SPT 5,4,3 N*=7	6								
							-3								
							7		SC		Clayey SAND : Fine to coarse grained, pale grey, pale orange brown, with some silt.	M			RESIDUAL SOIL
						SPT 3,2,5 N*=7	-4								
							8								

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT	M mud C casing penetration 1 2 3 4 water 10/1/98 water level on date shown water inflow water outflow	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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

Borehole No. **R17-BH3**

Engineering Log - Borehole

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **2.6.2011**

Principal:

Date completed: **2.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface:		3.5									
hole diameter:		100 mm		Northing		bearing: N/A		datum:		AHD									
drilling information				material substance															
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations						
ADV	1 2 3	C			-5			SC	SANDSTONE: Extremely to highly weathered, fine to coarse grained, pale orange brown, estimated to be very low to low strength. Borehole R17-BH3 continued as cored hole	M	L-MD		WEATHERED BEDROCK						
					-6	9													
					-7	10													
					-8	11													
					-9	12													
					-10	13													
					-11	14													
					-12	15													
					-13	16													
method AS auger screwing* AD auger drilling* 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. ADT				support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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			

Borehole No. **R17-BH4**

Engineering Log - Borehole

Sheet 1 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **6.6.2011**

Principal:

Date completed: **6.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 3.3					
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD					
drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
DT	1 2 3	C			3				ASPHALT: Dark grey, 0.04m. CONCRETE: Grey, 0.35m.	D			PAVEMENT
ADV						1			FILL: SAND: Fine to medium grained, pale brown with some low plasticity fines. FILL: Clayey SAND: Fine to medium grained, dark grey/dark brown, low plasticity fines, trace of light brown sand pockets and fine to medium grained sandstone and ironstone gravel.	M			FILL
				SPT 4,5,6 N*=11	2								
						2							
					1								
				SPT 2,2,4 N*=6	3								
					0								2.3m - Slight hydrocarbon odour.
						4			4m - Band of red, partially cemented sand.	W			
				SPT 8,8,5 N*=13	-1								
						5		SC	Clayey SAND: Fine to medium grained, grey.		L		ALLUVIUM
						6			Clayey SAND: Fine to coarse grained, pale grey, with some silt. Trace of bivalves and shell fragments in bands throughout layer.				5.7m - organic odour
				SPT 5,3,2 N*=5	-2								
						7			Clayey SAND: Fine to coarse grained, pale grey with red/orange brown mottles, with some silt and fine to medium grained sandstone gravel.		D		RESIDUAL SOIL
						8							
				SPT 8,14,11 N*=25	-3								
						7							
						8							
method				support		notes, samples, tests				classification symbols and soil description		consistency/density index	
AS auger screwing* AD auger drilling* 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. ADT				M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow		U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		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	

Borehole No. **R17-BH4**

Engineering Log - Borehole

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **6.6.2011**

Principal:

Date completed: **6.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface:		3.3									
hole diameter:		100 mm		Northing		bearing: N/A		datum:		AHD									
drilling information				material substance															
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations						
ADV	1 2 3	C			-5			SM	Clayey SAND: Fine to coarse grained, pale grey with red/orange brown mottles, with some silt and fine to medium grained sandstone gravel.	W	D		RESIDUAL SOIL						
NMLC									Silty SAND: Medium to coarse grained, pale grey with orange brown mottles.	M			WEATHERED BEDROCK						
Borehole R17-BH4 continued as cored hole																			
					9														
					-6														
					10														
					-7														
					11														
					-8														
					12														
					-9														
					13														
					-10														
					14														
					-11														
					15														
					-12														
					16														
method AS auger screwing* AD auger drilling* 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. ADT				support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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 - Borehole

Client: **Infrastructure NSW**

Date started: **14.6.2011**

Principal:

Date completed: **15.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Lackey Street, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:	Ausroc 4000 Truck	Easting:	slope: -90°	R.L. Surface:	2.4
hole diameter:	100 mm	Northing	bearing: N/A	datum:	AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
ADT				C							FILL: BRICK PAVERS: FILL: SAND: Coarse sand, brown, trace of roots. 0.3m - Medium to coarse sand with some clay, trace of gravel. 0.5m - Brown, yellow.	D			FILL
						SPT 8,4,4 N*=8	-2	1			FILL: Clayey SAND: Medium to coarse, brown mottled yellow, medium to high plasticity clay, with some fine gravel. FILL: CLAY: Medium to high plasticity, pale grey, red brown, trace of fine rounded ironstone gravel and sand. (shale fill) 2.0m - Red brown mottled pale grey, grey.				
						SPT 1,2,5 N*=7	-1	2			2.50m - With some fine shale gravel.	M			
							-1	3		SM	Silty SAND: Coarse grained, black with some shells.	W	L		ALLUVIUM
							-2	4		SC	Clayey SAND: Coarse grained, brown, medium plasticity clay, trace of shells and fine gravel.				
WB						SPT 2,1,2 N*=3	-3	5		CL-CH	Sandy CLAY: Low to medium plasticity, dark brown to dark grey, fine to medium sand, with some organic fibrous materials.	>Wp	S-F		
							-4	6		SC	Clayey SAND: Coarse grained, dark brown to black, low plasticity clay, trace of fine gravel.		L		
						SPT 2,1,2 N*=3	-5	7		CH	CLAY: High plasticity, red brown, pale grey, trace of ironstone and sand. 7.20m - Yellow, brown mottled. 7.40m - Pale grey with some fine sand.	>Wp	VSt-H		5.6m - Organic material in SPT sulphur odour
						SPT 7,8,12 N*=20	-6	8							

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT	M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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

Borehole No. **R17-BH5**

Engineering Log - Borehole

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **14.6.2011**

Principal:

Date completed: **15.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Lackey Street, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:				Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 2.4					
hole diameter:				100 mm		Northing		bearing: N/A		datum: AHD					
drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
WB				C								>Wp	VSt-H		
							-6			CS	Sandy CLAY: Low to medium plasticity, pale grey, medium sand, with some silt.		St		
						SPT 4,6,6 N*=12		9						x	
							-7							x	
							-8			CH	CLAY: High plasticity, dark grey, trace of silt.		VSt-H		
						SPT 7,9,13 N*=22		10						x	
							-9							x	
							-10			SC	Clayey SAND: Medium to coarse, brown, grey, trace of gravel.	W	L-MD		11.50m - No sample recovered
						SPT 4,3,2 N*=5		12						x	
							-11							x	
							-12			CL	Silty CLAY: Low plasticity, dark brown, black, with some organic material (wood), very light.	>Wp	St		
						SPT 3,5,9 N*=14		15						x	
							-13			SC	Clayey SAND: Coarse grained, pale grey, dark grey, low plasticity clay, trace of silt.	W	L-MD		
							-14							x	
							-15							x	
							-16							x	
							-17							x	
							-18							x	
							-19							x	
							-20							x	
							-21							x	
							-22							x	
							-23							x	
							-24							x	
							-25							x	
							-26							x	
							-27							x	
							-28							x	
							-29							x	
							-30							x	
							-31							x	
							-32							x	
							-33							x	
							-34							x	
							-35							x	
							-36							x	
							-37							x	
							-38							x	
							-39							x	
							-40							x	
							-41							x	
							-42							x	
							-43							x	
							-44							x	
							-45							x	
							-46							x	
							-47							x	
							-48							x	
							-49							x	
							-50							x	
							-51							x	
							-52							x	
							-53							x	
							-54							x	
							-55							x	
							-56							x	
							-57							x	
							-58							x	
							-59							x	
							-60							x	
							-61							x	
							-62							x	
							-63							x	
							-64							x	
							-65							x	
							-66							x	
							-67							x	
							-68							x	
							-69							x	
							-70							x	
							-71							x	
							-72							x	
							-73							x	
							-74							x	
							-75							x	
							-76							x	
							-77							x	
							-78							x	
							-79							x	
							-80							x	
							-81							x	
							-82							x	
							-83							x	
							-84							x	
							-85							x	
							-86							x	
							-87							x	
							-88							x	
							-89							x	
							-90							x	
							-91							x	
							-92							x	
							-93							x	
							-94							x	
							-95							x	
							-96							x	
							-97							x	
							-98							x	
							-99							x	
							-100							x	
							-101							x	
							-102							x	
							-103							x	
							-104							x	
							-105							x	
							-106							x	
							-107							x	
							-108							x	
							-109							x	
							-110							x	
							-111							x	
							-112							x	
							-113							x	
							-114							x	
							-115							x	
							-116							x	
							-117							x	
							-118							x	
							-119							x	
							-120							x	
							-121							x	
							-122							x	
							-123							x	
							-124							x	
							-125							x	
							-126							x	
							-127							x	
							-128							x	
							-129							x	
							-130							x	
							-131							x	
							-132							x	
							-133							x	
							-134							x	
							-135							x	
							-136							x	
							-137							x	
							-138					</			

Borehole No. **R17-BH5**

Engineering Log - Borehole

Sheet 3 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **14.6.2011**

Principal:

Date completed: **15.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Lackey Street, Haymarket, NSW**

Checked by: **SS**

drill model and mounting:		Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 2.4											
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD											
drilling information				material substance															
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations						
WB	1 2 3								SANDSTONE: Extremely weathered, pale grey, brown, coarse grained, estimated to be very low strength, remoulds to SAND. (continued) Borehole R17-BH5 continued as cored hole										
					-14														
						17													
					-15														
						18													
					-16														
						19													
					-17														
						20													
					-18														
						21													
					-19														
						22													
					-20														
						23													
					-21														
						24													
method AS auger screwing* AD auger drilling* 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. ADT				support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow				notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit				consistency/density index 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 - Borehole

Client: **Infrastructure NSW**

Date started: **9.6.2011**

Principal:

Date completed: **9.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model and mounting:	Ausroc 4000 Truck	Easting:	slope: -90°	R.L. Surface:	2.6
hole diameter:	100 mm	Northing	bearing: N/A	datum:	AHD

drilling information					material substance										
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3											100 200 300 400	
ADT				C							FILL: ASPHALT: Dark grey, 0.02m	D			PAVEMENT
							2				FILL: GRAVEL: Medium to coarse, subangular to subrounded, black, grey, trace of sand and clay.				
DT											FILL: CONCRETE: Grey, 0.08m	D			
							1				FILL: GRAVEL: Medium to coarse grained, angular to subangular, grey-brown, trace of fine gravel and sand.	D			FILL
											FILL: CONCRETE: Grey, 0.16m				
ADT						SPT 2,3,3 N*=6	1				FILL: GRAVEL: Medium to coarse grained, angular to subrounded, trace of fine gravel and cobbles.	<Wp			
							2				FILL: SANDSTONE BOULDER: Coarse grained, yellow/orange, rounded.				
											FILL: CLAY: High plasticity, mottled, red-brown, pale-grey, and grey, trace of fine gravel, ironstone and shale. (shale fill) 1.80m - Grey, with some fine shale angular gravel.	M			
							0				FILL: SAND: Coarse grained, grey-brown, trace of silt and rubber.	W			
						SPT 5,2,2 N*=4	3								
							-1								
							4								
									SC		Clayey SAND: Coarse grained, brown-grey, low plasticity clay.				ALLUVIUM
									CL		Sandy CLAY: Low plasticity, brown-black, coarse sand, trace of silt.		F		
W						SPT 0,2,3 N*=5	-2								
							5			CL	CLAY: Low to medium plasticity, red-brown, with some fine sand.				
							-3			CH	Sandy CLAY: High plasticity, red, brown, pale grey, medium to coarse sand.		St		
							6								
									SC		Clayey SAND: Coarse grained, pale grey, red-brown, medium plasticity clay.		L-MD		
						SPT 5,3,5 N*=8	-4			CL	Sandy CLAY: Low to medium plasticity, pale grey.		St	x	
							7			CH	CLAY: High plasticity, red-brown, pale grey, micaceous.		VSt	x	
							-5								
							8			CL-CH	Sandy CLAY: Medium to high plasticity, grey, pale grey, coarse grained sand.				

method	support	notes, samples, tests	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T *bit shown by suffix e.g. ADT	M mud C casing penetration 1 2 3 4  water 10/1/98 water level on date shown water inflow water outflow	U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	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

Borehole No. **R17-BH6**

Engineering Log - Borehole

Sheet 2 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **9.6.2011**

Principal:

Date completed: **9.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model and mounting: Ausroc 4000 Truck Easting: slope: -90° R.L. Surface: 2.6
hole diameter: 100 mm Northing bearing: N/A datum: AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
W				C		U ₅₀				CL-CH	Sandy CLAY: Medium to high plasticity, grey, pale grey, coarse grained sand. <i>(continued)</i>	W	VSt		
						SPT 0,4,5 N*=9	-6	9		SC	Clayey SAND: Medium to coarse grained, grey, pale grey.		MD		
						SPT 5,6,9 N*=15	-7	10		CH	CLAY: High plasticity, red-brown, pale grey, grey, trace of coarse sand and fine grained.		VSt-H	x x x	
							-8								
						SPT 5,6,7 N*=13		11		CH	Silty CLAY: High plasticity, dark grey, brown, black, micaceous.		VSt-H		
							-9							x x x	
								12							
						SPT 5,8,10 N*=18	-10			SP	SAND: Coarse grained, grey, dark grey, with some clay.		MD		
								13							
							-11								
						SPT 0,5,7 N*=12		14			14m - Dark grey, black, trace of organics.				
							-12								
								15			15m - With some silt and organic material.				RESIDUAL SOIL?
						SPT 9,R N*=R	-13								
								16			SANDSTONE: Extremely weathered, coarse grained, black, dark grey, estimated low strength, with some organic matter.				WEATHERED BEDROCK

method	support	penetration	water	classification symbols and soil description	consistency/density index
AS AD RR W CT HA DT B V T	M mud C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow			moisture D dry M moist W wet Wp plastic limit WL liquid limit	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

Borehole Location: **Back of House of Sydney Entertainment Centre**

Form GEO 5.3 Issue 3 Rev.2

Borehole No. **R17-BH7**

Engineering Log - Borehole

Sheet 2 of 6
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **15.6.2011**

Principal:

Date completed: **17.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model and mounting: Hydrapower Scout Truck Easting: slope: -60° R.L. Surface: 2.6
hole diameter: 100 mm Northing bearing: 213.5° datum: AHD

drilling information						material substance									
method	penetration			support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
	1	2	3												
WRR				C						CH		>Wp	F		
								-5		CH	CLAY: High plasticity, red brown, orange brown, pale grey, with some fine grained sand.				
								-6		SC	CLAYey SAND: Medium to coarse grained, grey, with bands of clay.				
								-7							
								-8							
								-9							
								-10							
								-11			SANDSTONE: Medium to coarse grained, pale grey to white, extremely weathered to highly weathered.				WEATHERED BEDROCK
								-12							
								-13							
								-14							
								-15							
								-16							

method		support	notes, samples, tests		classification symbols and soil description		consistency/density index	
AS	auger screwing*	M mud	N	nil	U ₅₀	undisturbed sample 50mm diameter	VS	very soft
AD	auger drilling*	C casing			U ₆₃	undisturbed sample 63mm diameter	S	soft
RR	roller/tricone				D	disturbed sample	F	firm
W	washbore				N	standard penetration test (SPT)	St	stiff
CT	cable tool				N*	SPT - sample recovered	VSt	very stiff
HA	hand auger				Nc	SPT with solid cone	H	hard
DT	diatube				V	vane shear (kPa)	Fb	friable
B	blank bit				P	pressuremeter	VL	very loose
V	V bit				Bs	bulk sample	L	loose
T	TC bit				E	environmental sample	MD	medium dense
*bit shown by suffix e.g. ADT					R	refusal	D	dense
							VD	very dense

support		penetration		water	
M	mud	1	2	3	4
C	casing				
		no resistance ranging to refusal			
		water			
		10/1/98 water level on date shown			
		water inflow			
		water outflow			

Borehole No. **R17-BH7**

Engineering Log - Borehole

Sheet 3 of 6
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **15.6.2011**

Principal:

Date completed: **17.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model and mounting:		Hydrapower Scout Truck		Easting:		slope: -60°		R.L. Surface: 2.6					
hole diameter:		100 mm		Northing		bearing: 213.5°		datum: AHD					
drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
WRR	1 2 3	C							SANDSTONE: Medium to coarse grained, pale grey to white, extremely weathered to highly weathered. (continued)				
					-12	17			Borehole R17-BH7 continued as cored hole				
					-13	18							
					-14	19							
					-15	20							
					-16	21							
					-17	22							
					-18	23							
						24							
method AS auger screwing* AD auger drilling* 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. ADT				support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal				classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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	

Borehole No. **R17-BH8**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **14.6.2011**

Principal:

Date completed: **14.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model and mounting:		Hydrapower Scout Truck		Easting:		slope: -90°		R.L. Surface: 2.5					
hole diameter:		100 mm		Northing		bearing: N/A		datum: AHD					
drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
ADT	1 2 3	C			2				FILL: ASPHALT: Dark grey, 70mm thickness sandy gravel: medium grained, grey sand, fine grained, grey gravel	D			PAVEMENT
									FILL: SAND: Fine to medium grained, dark brown, with some clay and fine gravel.	M			
NMLC			▲		1				FILL: ASPHALT: Dark grey, 250mm. FILL: CONCRETE: Pale grey, 410mm. 1m - With some dark grey gravel aggregate and steel.	D			1m - TC Bit Refusal
			▲		1				VOID:				
					2								
					3								
					0								
					3				Borehole R17-BH8 terminated at 3m				BH8 was terminated at 3m, due to obstructions.
					-1								
					4								
					-2								
					5								
					-3								
					6								
					-4								
					7								
					-5								
					8								
method AS auger screwing* AD auger drilling* 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. ADT				support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow		notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal			classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit		consistency/density index 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		

Borehole No. **R17-BH9**

Engineering Log - Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **15.6.2011**

Principal:

Date completed: **15.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model and mounting:		Hydrapower Scout Truck		Easting:		slope: -90°		R.L. Surface: 2.75					
hole diameter:		100 mm		Northing:		bearing: N/A		datum: AHD					
drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa	structure and additional observations
ADT	1 2 3		Not Observed		2	1			FILL: ASPHALT: Dark grey 70mm, overlying sandy gravel, medium grained, brown sand, dark grey gravel. FILL: SAND: Medium to coarse grained, yellow, with some fine to coarse sandstone gravel. 0.60m - Becoming brown, with some coarse dolerite gravel. FILL: ASPHALT: Grey, 150mm FILL: CONCRETE: Pale grey, 50mm. Borehole R17-BH9 terminated at 0.85m	D		100 200 300 400	PAVEMENT SUB BASE FILL PREVIOUS PAVEMENT BH9 was terminated at shallow depth due to obstructions after many attempts.
						1							
						1							
						2							
						0							
						3							
						-1							
						4							
						-2							
						5							
						-3							
						6							
						-4							
						7							
						-5							
						8							

method AS auger screwing* AD auger drilling* 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. ADT	support M mud C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit WL liquid limit	consistency/density index 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

Client: **Infrastructure NSW**

Date started: **7.6.2011**

Principal:

Date completed: **7.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Hydrapower Scout Truck				Easting:				slope: -90°				R.L. Surface: 3.75									
hole diameter: 100 mm				Drilling fluid:				Northing:				bearing: N/A				datum: AHD					
drilling information				material substance								rock mass defects									
method	core-lift	water	RL	depth metres	graphic log core recovery	material	weathering alteration	estimated strength				IS ₅₀ MPa	D- diam- A- axial	RQD %	defect spacing mm	defect description					
						rock type; grain characteristics, colour, structure, minor components		VL	L	M	H	EH			30	100	300	1000	3000	particular	general
NMLC						Continued from non-cored borehole	MW														
			-4	8		SANDSTONE: Coarse grained, pale grey, mottled orange, yellow and red, distinctly bedded at 15°, with some fine rounded gravel inclusions, trace of black carbonaceous flecks, ironstained and micaceous.	SW								0.03 0.17					PT, 0°, PL, RO, CN	
			-5	9											0.34 0.38					PT, 0°, PL, RO, CN	
			-6	10		9.20m Heavily iron stained.	MW													PT/JT x2, 15°, PL, RO, CN, 20mm	
			-7	11																PT x2, 15°, PL, RO, CN, 40mm	
			-8	12		11.25m Moderately iron stained.	MW/SW								1.45					PT, 0°, PL, RO, CN	
			-9	13		12.76m Heavily iron stained.	SW								1.72					PT, 10°, PL, RO, CO, Clay	
			-10	14																CS, 5°, PL, RO, CN	
			-11	15		14.25m Moderately iron stained.	MW								1.02 1.83					CS, 5°, PL, RO, CN	
							SW								1.27 1.61					JT, 10°-20°, IR, RO, SN	
							MW/SW													PT/JT, 10°-20°, PL-IR, RO, CN	
																				JT, 20°, IR, RO, CN	
																				JT, 25°, IR, RO, CN	
																				SM, 0°, PL, Clay filled, 10mm, 200pp	
																				PT, 20°, PL, RO, CN, 20mm	
																				PT, 10°, PL, RO, CN/JT, 85°, PL, RO, CN, 260mm	
																				JT, 90°, PL, RO, FeSN, 300mm	
																				PT, 15°, PL, Closed	
																				PT, 10°, PL, Closed	
																				PT x2	

All defects are: PT, 5°-15°, PL, RO, CN unless noted otherwise.

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **7.6.2011**

Principal:

Date completed: **7.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drilling information				material substance				rock mass defects			
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₅₀ MPa	D- diam- A- axial	defect spacing mm	defect description
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH			30 100 300 1000 3000	particular
NMLC			-12	16	15.25m with some black carbonaceous (coal) layers 10mm thick. SANDSTONE: Medium to coarse grained, grey, massive, with some black carbonaceous flecks. SHALE: Grey, thinly laminated at 0°. SANDSTONE: Medium grained, grey, massive, with some black laminations, distinctly crossbedded at 15°.	FR					JT, 45°, PL, RO, CN PT, 0°, PL, SO, Clay VN
			-13	17	SANDSTONE: Fine to medium grained, grey, massive, with some black carbonaceous flecks. 17.06m Indistinctly bedded at 10°.						SM, 0°, PL, Clay filled, 10mm, 280pp
			-14	18	17.5m Fine grained. 17.73m Medium grained.						
			-15	19	18.7m with some black carbonaceous laminations. SANDSTONE: Medium to coarse grained, grey, massive, with some black carbonaceous flecks.						
			-16	20	SANDSTONE: Medium to coarse grained, pale grey to grey, distinctly bedded at 10°-15°. 20.14m Coarse grained. 20.25m Indistinctly crossbedded at 10°, micaceous and black flecks.						PT, 0°, PL, SO-RO, Clay, UN PT, 10°, PL, RO, Fe SN PT, 10°, PL, RO, Fe SN PT, 10°-15°, PL-IR, RO, Fe SN PT, 10°-15°, PL-IR, RO, Fe SN PT, 10°-15°, PL-IR, RO, Fe SN
			-17	21							
			-18	22							
			-19	23	A water standpipe was installed. R17-BH1 terminated at 22m						

All defects are: PT, 5°-15°, PL, RO, CN unless noted otherwise.

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--

Borehole No. **R17-BH10**

Sheet 3 of 4

Project No: **GEOTLCOV24303AC**

Date started: **1.6.2011**

Date completed: **10.6.2011**

Logged by: **LJG**

Checked by: **SS**

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Little Pier Street, Haymarket, NSW**

drill model & mounting: Ausroc 4000 Truck Easting: slope: -90° R.L. Surface: 3

hole diameter: 100 mm Drilling fluid: Northing: bearing: N/A datum: AHD

drilling information					material substance					rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₅₀ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description		
								VL L M H VH EH			30 100 300 1000 3000	particular	general	
			-6	9										
			-7	10										
			-8	11		Continued from non-cored borehole								
NMLC						NO CORE: 0.35m								
			-9	12		SANDSTONE: Coarse grained, pale grey massive	FR					HFZ, 70mm JT, 80°, PL, RO, CN, 350mm		
						12.04m - indistinctly bedded at 10°-20°			D A 1.39 1.98					
			-10	13		NO CORE: 0.35m						JT, 48°, PL, RO, CN HFZ, JT & PT & SM, 80mm		
						SANDSTONE: Coarse grained, pale grey, massive, with some shale inclusions and black carbon flecks.	FR		D A 1.24 1.49			SM, Clay and sand filled 20mm Wedge		
			-11	14		13.60m - indistinctly bedded at 25°						Multiple PT, 5°-15°, PL, RO, CN CS, 20°, PL, sand filled, 10mm		
						13.86m - Bedding at 10°	SW					SM, sand filled		
			-12	15		NO CORE: 0.1m			D A 1.6 0.79			CS, gravel filled, 30mm PT, 25°, IR, VN, SN HFZ, of multiple PT, 0°-15°, PL, VR, SN PT x 2		
						SANDSTONE: Medium to coarse grained, grey mottled, red, orange, yellow, brown, indistinctly bedded at 10°-20°, with some fine gravel inclusions and black carbon flecks.	MW-HW							
			-13	16		14.60m - Heavily iron stained.								
						15.10m - Distinctly bedded at 20°-30°	SW							
						15.18m - Moderately iron stained.								
						15.60m - Moderately to heavily iron stained.	MW-SW							
method					core-lift					water				
DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core					casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered					10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown				
										FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high				
										defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating				

All defects are: PT, 10°-20°, PL, RO, CN unless noted

Borehole No. **R17-BH10**

Engineering Log - Cored Borehole

Sheet 4 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **1.6.2011**

Principal:

Date completed: **10.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Little Pier Street, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 3	
hole diameter: 100 mm		Drilling fluid:		bearing: N/A		datum: AHD	
drilling information		material substance				rock mass defects	
method	core-lift	water	RL	depth metres	graphic log	material	weathering alteration
						rock type; grain characteristics, colour, structure, minor components	estimated strength
							VL L M H VH EH
							IS ₍₅₀₎ MPa
							D- diam- A- axial
							RQD %
							defect spacing mm
							defect description
							type, inclination, planarity, roughness, coating, thickness
							particular
							general
NMLC			-14	17		15.90m - Moderately iron stained. SANDSTONE: Medium to coarse grained, grey mottled, red, orange, yellow, brown, indistinctly bedded at 10°-20°, with some fine gravel inclusions and black carbon flecks. (continued) 16m - Becoming pale grey with grey laminations.	SW
			-15	18		17.50m - Distinctly bedded at 10°	FR
			-16	19		18.03m - Indistinctly bedded at 20°-30°	
			-17	20		R17-BH10 terminated at 18.94m	
			-18	21			
			-19	22			
			-20	23			
			-21	24			
method		core-lift		water		weathering	
DT diatube		casing used		10/1/98 water level on date shown		FR fresh	
AS auger screwing		barrel withdrawn		water inflow		SW slightly weathered	
AD auger drilling				partial drill fluid loss		MW moderately weathered	
RR roller/tricone				complete drill fluid loss		HW highly weathered	
CB claw or blade bit						XW extremely weathered	
NMLC NMLC core						DW distinctly weathered	
NQ, HQ, PQ wireline core						(covers MW and HW)	
		graphic log/core recovery				strength	
		core recovered		water pressure test result (lugeons) for depth interval shown		VL very low	
		- graphic symbols indicate material				L low	
		no core recovered				M medium	
						H high	
						VH very high	
						EH extremely high	
						defect type	
						JT joint	
						PT parting	
						SM seam	
						SZ sheared zone	
						SS sheared surface	
						CS crushed seam	
						planarity	
						PL planar	
						CU curved	
						UN undulating	
						ST stepped	
						IR irregular	
						roughness	
						VR very rough	
						RO rough	
						SO smooth	
						SL slickensided	
						coating	
						CN clean	
						SN stained	
						VN veneer	
						CO coating	

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **1.6.2011**

Principal:

Date completed: **1.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 2.9								
hole diameter: 100 mm		Drilling fluid:		bearing: N/A		datum: AHD								
drilling information			material substance				rock mass defects							
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	Is ₍₅₀₎ MPa D- diam- etral A- axial	RQD % 30 100 300 1000 3000	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness		
Continued from non-cored borehole														
NMLC						NO CORE: 0.30m				25				
			-6	9		SANDSTONE: Medium to coarse grained, red brown, indistinct laminations at 5°-15°. 8.7m colour change to orange brown	MW		D 0.39 A 0.37			JT, 80°, PL, RO, CN		
			-7	10		9.8m colour change to pale grey and orange	SW			97				
			-8	11		SHALE: Pale grey, with distinct dark grey laminations at 10°-15°	FR		D 0.03 A 0			SM, 0°-10°, clay filled, 70mm		
			-9	12		SANDSTONE: Coarse grained, pale grey and orange, indistinct laminations at 5°-15°.	SW		D 0.16 A 0.33			PT, 5°, CU, RO, CN PT, 5°-10°, PL, RO, Clay CO (1mm) JT, 85°, PL, RO, CN		
			-10	13		NO CORE: 0.14m SANDSTONE: Coarse grained, pale grey and orange, indistinct laminations at 5°-15°. 12.7m becoming fine grained	SW		D 0.47			SM, 5°-15°, clay filled, 80mm		
			-11	14		13.3m becoming massively bedded	FR		D 0.43			SM, 10°-20°, clay filled, 30mm SM, 10°, clay filled, 70mm JT, 25°, PL, RO, CN		
			-12	15		14.6m sandstone becoming indistinctly laminated with some iron staining	MW/SW		D 2.15 A 1.14			SM, 0°-5°, clay filled, 30mm		
			-13	16		15.45m laminations becoming increasingly distinct	SW/FR		D 0.56 A 0.92 A 1.46			JT, 85°, PL, RO, FeSN PT, 5°, PL, RO, FeSN PT, 5°, PL, RO, FeSN		
				16		R17-BH11 terminated at 15.9m						PT, 5°-10°, PL, RO, CN PT, 5°-10°, PL, RO, CN		
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core			core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered			water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown			weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high			defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating		

All defects are: JT, 0°-15°, PL, RO, CN, unless noted otherwise

Borehole No. **R17-BH12**

Sheet 2 of 3

Project No. **GEOTLCOV24303AC**

Date started: **10.6.2011**

Date completed: **10.6.2011**

Logged by: **RC**

Checked by: **SS**

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

drill model & mounting: Hydrapower Scout Truck Easting: slope: -90° R.L. Surface: 2.8

hole diameter: 100 mm Drilling fluid: Northing: bearing: N/A datum: AHD

drilling information					material substance					rock mass defects											
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components Continued from non-cored borehole	weathering alteration	estimated strength				Is ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness						
								VL	L	M	H	VH	EH		30	100	300	1000	3000	particular	general
NMLC				-6	9	SANDSTONE: Medium to coarse grained, orange-brown mottled, dark red and pale grey, indistinctly cross bedded at 15°-20°.	HW							D 1.02 A 0.41						PT, 15°, PL, RO, CO, clayey sand, 3mm	Unless noted, defects are: PT, 5°-25°, PL, RO, SN
				-7	10		MW								D 1.25 A 1.26	87				SM, 10°, PL, RO, clayey sand, 45mm	
				-8	11	11.7m - 12.4m - Dark orange-brown iron indurated zone around defects (700mm)															
				-9	12		HW								D 2.66 A 3.16					JT, 35°, PL, RO, VN, black material	
				-10	13		MW								D 0.79 A 1.22	85				PT, 25°, UN, RO, CO, Clay, 1mm PT, 10°, PL, VR, CO, Clay, 1mm	
				-11	14		MW-HW													PT, 20°, PL, RO, CO, XW, 2mm PT, 5°, PL, RO, CO, XW, 3mm JT, 60°, PL, RO, SN, discontinuous	
				-12	15										D 2.43 A 2.87	88				14.53m - 14.64m - closely spaced partings 11mm JT, 30°, PL, RO, SN, discontinuous	
				-13	16	SANDSTONE: Medium to coarse grained, pale grey, distinctly bedded at 5°-25°.	SW FR														

Unless noted, defects are: PT, 5°-25°, PL, RO, SN

method	core-lift	water	weathering	defect type	roughness
DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	 casing used  barrel withdrawn graphic log/core recovery  core recovered  indicate material  no core recovered	 10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating

Borehole No. **R17-BH12**

Engineering Log - Cored Borehole

Sheet 3 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **10.6.2011**

Principal:

Date completed: **10.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Hydrapower Scout Truck				Easting:		slope: -90°		R.L. Surface: 2.8				
hole diameter: 100 mm				Drilling fluid:		Northing:		bearing: N/A				
datum: AHD												
drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	IS ₍₅₀₎ MPa D- diam- A- axial	RQD % 30 100 300 1000 3000	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
NMLC			-14	17		SANDSTONE: Medium to coarse grained, pale grey, distinctly bedded at 5°-25°. (continued)	FR		D 2.48 A 2.14	88		JT, 60°, PL, RO, CN
			-15	18								
						R17-BH12 terminated at 18m			D 2.49 A 1.98			
			-16	19								
			-17	20								
			-18	21								
			-19	22								
			-20	23								
			-21	24								

method
DT diatube
AS auger screwing
AD auger drilling
RR roller/tricone
CB claw or blade bit
NMLC NMLC core
NQ, HQ, PQ wireline core

core-lift
 casing used
 barrel withdrawn
graphic log/core recovery
 core recovered
- graphic symbols indicate material
 no core recovered

water
 10/1/98 water level on date shown
 water inflow
 partial drill fluid loss
 complete drill fluid loss
 water pressure test result (lugeons) for depth interval shown

weathering
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam
planarity
PL planar
CU curved
UN undulating
ST stepped
IR irregular
roughness
VR very rough
RO rough
SO smooth
SL slickensided
coating
CN clean
SN stained
VN veneer
CO coating

Borehole No. **R17-BH13**

Sheet 3 of 3

Project No. **GEOTLCOV24303AC**

Date started: **9.6.2011**

Date completed: **9.6.2011**

Logged by: **RC**

Checked by: **SS**

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Sydney Entertainment Centre, Haymarket, NSW**

drill model & mounting: Hydrapower Scout Truck Easting: slope: -90° R.L. Surface: 3.15

hole diameter: 100 mm Drilling fluid: Northing: bearing: N/A datum: AHD

drilling information					material substance					rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₅₀ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description		
								VL L M H VH EH			30 100 300 1000 3000	particular	general	
			-5											
			-6	9										
			-7	10		Continued from non-cored borehole								
			-8	11		NO CORE: 0.70m								
			-9	12		SANDSTONE: Medium to coarse grained, pale grey mottled orange-brown, indistinctly bedded at 5°-15°	XW SW							
			-10	13		12.40m to 13.0m - Distinctly bedded	SW-MW							
			-11	14		14.43m to 14.50m - with some fine grained quartz gravel								
			-12	15		R17-BH13 terminated at 14.7m								
			-13	16										

method	core-lift	water	weathering	defect type	roughness
DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	 casing used  barrel withdrawn graphic log/core recovery  core recovered - graphic symbols indicate material  no core recovered	 10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **17.6.2011**

Principal:

Date completed: **17.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drilling information				material substance				rock mass defects					
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₅₀ MPa	D- diam- etral A- axial	RQD %	defect spacing mm	defect description	
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH				30 100 300 1000 3000	particular	general
			-4		Continued from non-cored borehole	MW-HW						PT, 20°, PL, RO, VN, Clay	
				8						86		PT, 20°, PL, RO, SN PT, 20°, PL, RO, VN, Clay PT, 15°, PL, RO, SN SM, 10°, PL, RO, Clay, 6mm SM, 20°, PL, RO, Clay, 5mm PT, 15°, PL, RO, SN PT, 25°, PL, RO, SN PT, 20°, PL, RO, SN PT, 20°, PL, RO, VN	
			-5			MW							
				9						86		PT, 25°, PL, RO, VN PT, 20°, PL, RO, CO, Clay, XW, 4mm	
			-6									PT, 20°, PL, RO, SN PT, 20°, PL, RO, SN PT, 20°, PL, RO, VN PT, 20°, PL, RO, VN	
				10								SM, 5°, PL, RO, Clay, 3mm JT, 78°, PL, RO, SN	
			-7									PT, 10°, PL, RO, VN PT, 10°, PL, RO, VN PT, 5°, IR, RO, VN	
				11									
			-8									PT, 30°, PL, RO, SN	
				12								PT, 15°, PL, RO, SN	
			-9										
				13									
			-10		SANDSTONE: Medium to coarse grained, pale grey, distinctly bedded at 20°.	SW						PT, 15°, CU, RO, CN PT, 20°, CU, RO, VN, carbonaceous material SM, 10°, PL, RO, Clay, 45mm pp = 180kPa	
				14								JT, 15°, PL, RO, SN PT, 10°, PL, RO, CN PT, 15°, PL, RO, VN SM, 30°, PL, RO, XW, 30mm	
			-11		13.95m - With some fine grained, shale gravel.								
				15								JT, 25°, PL, RO, CN JT, 10°, IR, RO, CN JT, 10°, PL, RO, CN	
					12.50m - Trace of fine grained quartz gravel.								
					13.40m to 13.50m - With some fine grained, quartz gravel.	FR							
					SANDSTONE: Medium grained, pale grey, massive, with some carbonaceous flecks.								
					R17-BH14 terminated at 15m								

method		core-lift		water		weathering		defect type		roughness	
DT	diatube		casing used	10/1/98	water level on date shown	FR	fresh	JT	joint	VR	very rough
AS	auger screwing		barrel withdrawn		water inflow	SW	slightly weathered	PT	parting	RO	rough
AD	auger drilling				partial drill fluid loss	MW	moderately weathered	SM	seam	SO	smooth
RR	roller/tricone				complete drill fluid loss	HW	highly weathered	SZ	sheared zone	SL	slickensided
CB	claw or blade bit					XW	extremely weathered	SS	sheared surface		
NMLC	NMLC core					DW	distinctly weathered (covers MW and HW)	CS	crushed seam		
NQ, HQ, PQ	wireline core										
		graphic log/core recovery				strength		planarity		coating	
		core recovered				VL		PL		CN	
		- graphic symbols indicate material				L		CU		SN	
		no core recovered				M		UN		VN	
						H		ST		CO	
						VH		IR			
						EH					

Borehole No. **R17-BH15**

Sheet 3 of 3

Project No. **GEOTLCOV24303AC**

Date started: **21.6.2011**

Date completed: **21.6.2011**

Logged by: **LJG**

Checked by: **SS**

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Harbour Street, Haymarket, NSW**

drilling information				material substance				rock mass defects					
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₅₀ MPa	D- diam- A- axial	RQD %	defect spacing mm	defect description	
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH					type, inclination, planarity, roughness, coating, thickness	
					Continued from non-cored borehole							particular	
NMLC		Not monitored		9	SANDSTONE: Medium to coarse grained, pale to red brown, pale grey, indistinctly bedded at 20°, with some dark grey laminations and black carbonaceous flecks.	MW			D 1.05 A 0.96			PT, 10°, PL, VR, CN PT, 10°, PL, VR, CN PT, 5°, CU, RO, CN PT, 15°, PL, RO, CO / Clayey sand x2 JT, 30°, IR-CU, VR, CN x2 JT, 30°, IR-CU, VR, CN PT, 0°, PL, RO, CO, Sand JT, 48°, PL, RO, CN JT, 5°, CU, RO, SN, Iron JT, 15°, PL, RO, SN, Iron PT, 0°, PL, RO, SN, Iron JT, 44°, PL, RO, SN, Iron SM, 5°, PL, RO, Clayey sand JT, 25°, IR, RO, CN JT, 60°, PL-UN, VR-RO, SN Iron	
				10		SW			D 1.08 A 0.66	66		PT, 0°, IR, RO, CN PT, 15°, PL, RO, CO, Iron PT, 5°, PL, RO, CN JT, 48°, PL, RO, SN, Iron PT, 0°, PL, RO, CO-Clay PT, 4°, PL, RO, CO, Clay	
				11									
				12					D 1.42 A 1.66				
				13	SANDSTONE: Medium to coarse grained, pale grey to orange white, massive, with some black flecks and fine quartz gravel.	FR			D 2.04 A 2.05	87			
				14									
				15	SANDSTONE: Medium to coarse grained, pale grey to orange white, distinctly bedded at 0°-10°, with some dark grey laminations and black carbonaceous flecks.								
				16	SANDSTONE: Medium to coarse grained, pale grey to orange white, massive, with some black carbonaceous flecks.				D 1.15 A 1	100			
				17	R17-BH15 terminated at 15.45m								

method

DT diatube

AS auger screwing

AD auger drilling

RR roller/tricone

CB claw or blade bit

NMLC NMLC core

NQ, HQ, PQ wireline core

core-lift

 casing used

 barrel withdrawn

graphic log/core recovery

 core recovered

 - graphic symbols indicate material

 no core recovered

water

 10/1/98 water level on date shown

 water inflow

 partial drill fluid loss

 complete drill fluid loss

 water pressure test result (lugeons) for depth interval shown

weathering

FR fresh

SW slightly weathered

MW moderately weathered

HW highly weathered

XW extremely weathered

DW distinctly weathered (covers MW and HW)

strength

VL very low

L low

M medium

H high

VH very high

EH extremely high

defect type

JT joint

PT parting

SM seam

SZ sheared zone

SS sheared surface

CS crushed seam

planarity

PL planar

CU curved

UN undulating

ST stepped

IR irregular

roughness

VR very rough

RO rough

SO smooth

SL slickensided

coating

CN clean

SN stained

VN veneer

CO coating

All joints are: PT, 0°-20°, PL, ROK, CN, unless noted

Borehole No. **R17-BH16**

Sheet 3 of 6

Project No. **GEOTLCOV24303AC**

Date started: **20.6.2011**

Date completed: **21.6.2011**

Logged by: **LJG**

Checked by: **SS**

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Harbour Street, Haymarket, NSW**

drill model & mounting: Hydrapower Scout Truck Easting: slope: -75° R.L. Surface: 3.30

hole diameter: 100 mm Drilling fluid: Northing: bearing: 177.5° datum: AHD

drilling information				material substance				rock mass defects			
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₍₅₀₎ MPa	D- diam- A- axial	defect spacing mm	defect description
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH				type, inclination, planarity, roughness, coating, thickness
					Continued from non-cored borehole						particular general
NQ				14	SANDSTONE: Coarse grained, pale grey, pale brown, indistinctly bedded at 20°-30°.	FR			D 0.3 A 0.52		JT, 50°, PL, RO, CN
				15							JT, 90°, PL, RO, CN, 260mm
				16	NO CORE: 0.27m						JT, 90°, PL, RO, CN, 210mm
				17	SANDSTONE: Coarse grained, pale grey, pale brown, indistinctly bedded at 20°-30°.	FR			D 0.88 A 0.89		Multiple PT, 110mm
				18							JT, 85°, PL, RO, CN, 340mm
				19							SM, 10°, PL, Sand & Clay filled
				20							JT, 75°, PL, RO, CN, 30mm
				21							PT
				22							PT, 15°, PL, RO, Clay CO
				23							JT, 65°, PL, RO, CN
				24							JT, 65°, PL, RO, CN
				25							PT, 45°, IR, RO, Black carbonaceous SN
				26							JT, 60°, PL, RO, SN
				27							PT, 25°, PL, RO, CN, 10mm
				28							JT, 45°, PL, RO, Fe SN, 50mm
				29							PT, 20°, PL, RO, CN, 10mm
				30							JT, 75°, PL, RO, Fe SN, 70mm
				31							PT, 30°, PL, RO, CN, 20mm
				32							PT, 30°, PL, RO, CN, 20mm
				33							PT, 30°, PL, RO, CN, 30mm
				34							PT, 40°, PL, VR, Fe SN, 40mm
				35							JT, 0°, PL, VR, CN

All defects are: PT, 10°-20°, PL, RO, CN unless noted

Borehole No. **R17-BH16**

Engineering Log - Cored Borehole

Sheet 4 of 6
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **20.6.2011**

Principal:

Date completed: **21.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Hydrapower Scout Truck Easting: slope: -75° R.L. Surface: 3.30
hole diameter: 100 mm Drilling fluid: Northing: bearing: 177.5° datum: AHD

drilling information					material substance					rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material	weathering alteration	estimated strength	IS ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description		
						rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH				particular	general	
NQ			-18	22		21.63m - Bedded at 10°-25°. 21.70m - Indistinctly bedded to massive. SANDSTONE: Coarse grained, pale grey, pale brown, indistinctly bedded at 20°-30°. (continued)	FR					JT, 0°, PL, VR, CN JT, 0°, PL, VR, CN		
						22.51m - Distinctly bedded at 10°.						CS, 5°, PL, RO, Clay filled		
			-19	23		22.90m - fine to medium grained, distinctly bedded at 15°.						JT, 85°, PL-IR, RO, CN, 450mm/PT		
						SANDSTONE: Coarse grained, pale grey, grey with dark grey laminations, indistinctly bedded at 20°-25°, with some black carbonaceous flecks and some staining.						XW SM, Clay & sand filled, 40mm		
			-20	24								SM, 0°, PL, RO, Clay filled, 10mm		
						24.90m - Indistinctly bedded 10°-25°.								
			-21	25		25.20m - Distinctly bedded 15° 25.28m - Pale grey with some dark grey laminations bedded at 25°.						SM, 20°, PL, RO, Clay CO, 10mm		
			-22	26		26.05m - Distinctly bedded 15°-20°.						Highly fractured zone 40mm		
			-23	27								PT x2 10mm		
			-24	28		SANDSTONE: Coarse grained, pale grey, with some dark grey laminations, indistinctly cross bedded at 10°-20°, with some black carbonaceous flecks, micaceous.						JT, 85°, PL, RO, CN, 160mm		
			-25	29		29m - With some spotted staining.								

All defects are: PT, 10°-20°, PL, RO, CN unless noted

method	core-lift	water	weathering	defect type	roughness
DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	 casing used  barrel withdrawn graphic log/core recovery  core recovered  indicate material  no core recovered	 10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating

Borehole No. **R17-BH16**
 Sheet 5 of 6
 Project No. **GEOTLCOV24303AC**
 Date started: **20.6.2011**
 Date completed: **21.6.2011**
 Logged by: **LJG**
 Checked by: **SS**

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Harbour Street, Haymarket, NSW**

drill model & mounting: Hydrapower Scout Truck Easting: slope: -75° R.L. Surface: 3.30
 hole diameter: 100 mm Drilling fluid: Northing: bearing: 177.5° datum: AHD

drilling information				material substance						rock mass defects											
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength			Is ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness							
								VL	L	M	H	VH	EH		30	100	300	1000	3000	particular	general
NQ				30		NO CORE: 0.05m	FR							92							
			-26			SANDSTONE: Medium to coarse grained, pale grey, grey, distinctly bedded at 10°, with some black carbonaceous flecks and laminations trace of voids.	FR														
				31		SANDSTONE: Coarse grained, grey, massive with some fine gravel inclusions and black carbonaceous flecks and voids. 30.60m - Distinctly bedded 10°, medium to coarse grained. 30.93m - Indistinctly bedded to massive. 31.10m - Coarse grained, with some fine gravel inclusions 150mm 31.30m - Distinctly laminated 15°-25°, medium to coarse grained.															
			-27																		
				32																	
			-28																		
				33		32.50m - With some black carbonaceous laminations and fine gravel inclusions 100mm 32.70m - Distinctly cross bedded 10°-30°.															
			-29																		
				34																	
			-30																		
				35		34.97m - Coarse grained, indistinctly bedded 10°-20°, with some fine gravel inclusions black flecks and laminations.															
			-31																		
				36																	
			-32																		
				37																	
			-33			SANDSTONE: Fine to medium grained, grey to dark grey, indistinct/alterd bedding to massive, with some black carbonaceous flecks.	HA														
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core				core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered		water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown		weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high				defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating									

All defects are: PT, 10°-20°, PL, RO, CN unless noted

Borehole No. **R17-BH16**

Engineering Log - Cored Borehole

Sheet 6 of 6
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **20.6.2011**

Principal:

Date completed: **21.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Hydrapower Scout Truck		Easting:		slope: -75°		R.L. Surface: 3.30						
hole diameter: 100 mm		Drilling fluid:		Northing:		bearing: 177.5°						
datum: AHD												
drilling information			material substance				rock mass defects					
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	Is ₍₅₀₎ MPa D- diam- etral A- axial	RQD % 30 100 300 1000 3000	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
NQ				38		DOLERITE: Fine to medium grained, grey, mottled green, massive, possible bedding.	HA					particular
				39		NO CORE: 0.38m	FR					general
				40		DOLERITE: Fine to medium grained, grey, mottled green, massive.	FR					
				41			FR-HA					
				42								
				43								
				44								
				45								
R17-BH16 terminated at 40.5m												
Unless noted, defects are: JT, 30°-45°, PL, RO, CN, VN												
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered - graphic symbols indicate material  no core recovered water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating												

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **16.6.2011**

Principal:

Date completed: **16.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Edson 3000 Truck Easting: slope: -90° R.L. Surface: 3.2
hole diameter: 100 mm Drilling fluid: Northing: bearing: N/A datum: AHD

drilling information				material substance				rock mass defects			
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	Is ₍₅₀₎ MPa D- diam- A- axial	RQD % 30 100 300 1000 3000	defect description type, inclination, planarity, roughness, coating, thickness
NMLC				11		Continued from non-cored borehole					
				11		NO CORE: 0.30m					
				12		SANDSTONE: Coarse grained, pale grey, with some darker grey laminations, indistinctly bedded at 10°-25°, with some black carbonaceous flecks.	FR		D 0.42 A 0.39	13	XW, SM, Sand filled, multiple PT, 250mm PT, 10°, PL, RO, VN PT, 20°, PL, RO, Clay, VN PT, 10°, PL, RO, VN PT, 20°, PL, RO, VN PT, 10°, PL, RO, VN PT, 10°, PL, RO, VN PT, 10°, PL, RO, VN SM, Clay and fine gravel filled 10mm PT, 15°, PL, RO, VN PT, 10°, PL, RO, VN
				12		11.89m - Fine grained rounded gravel inclusions.	FR				
				12		NO CORE: 0.05m					
				12		SANDSTONE: Coarse grained, pale grey, bedded at 10°-20°, with some black carbonaceous flecks.	SW				
				12		12.50m - Slightly iron stained yellow, red, orange.			D 1.51 A 1.38	85	Wedge, 15°-25°, PL, RO, CN
				13					D 2.64 A 2.08		PT, 25°, PL, RO, VN-CN
				14					D 1.23 A 2.19		PT, 0°, PL, RO, Fe SN
				15		15.30m - Indistinctly bedded 20°-30°.	SW-FR		D 1.02 A 0.97	79	PT, 0°, PL, RO, CN JT, 45°, PL, RO, VN PT, 0°, PL, RO, VN
				15		15.50m - Indistinctly cross-bedded 40°.					
				15		15.56m - Indistinctly bedded 10°-20°.					
				15		15.75m - Thinly laminated 0°-10°.					
				15		15.87m - Indistinctly bedded 10°-25°.					
				16		16.40m - Heavily iron stained.	MW-SW				
				17		16.80m - Slightly iron stained.					
				17		16.96m - Heavily iron stained, medium grained.					
				17		17.05m - Slightly iron stained, coarse grained.	SW				
				17		NO CORE: 0.05m					
				18		SANDSTONE: Coarse grained, pale grey (stained red orange brown to 17.58m), with some black and dark grey laminations. Indistinctly bedded at 10°-30°, with some black carbonaceous flecks and some fine gravel inclusions.	FR		D 2.67 A 2.17	86	PT, 10°, PL, RO, SN JT, 5°, PL, RO, SN HFZ 50mm JT, 85°, PL, RO, SN, 200mm PT, 10°, PL, RO, SN PT, 10°, PL, RO, SN PT, 10°, PL, RO, SN PT, 25°, PL, RO, SN PT, 15°, PL, RO, SN PTx2, 15°, PL, RO, SN, 10mm PT, 25°, PL, RO, black carbonaceous SN

All defects are PT, 10°-25°, PL, RO, CN unless noted

method	core-lift	water	weathering	defect type	roughness
DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered	10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown	FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **16.6.2011**

Principal:

Date completed: **16.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Harbour Street, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Edson 3000 Truck		Easting:		slope: -90°		R.L. Surface: 3.2						
hole diameter: 100 mm		Drilling fluid:		bearing: N/A		datum: AHD						
drilling information			material substance				rock mass defects					
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
NMLC			-16	19		SANDSTONE: Coarse grained, pale grey (stained red orange brown to 17.58m), with some black and dark grey laminations. Indistinctly bedded at 10°-30°, with some black carbonaceous flecks and some fine gravel inclusions. <i>(continued)</i> 19.20m - Heavily iron stained 40mm	FR	VL L M H VH EH		96		SM, 0°, PL, RO, Fe SN Clay CO 10mm
			-17	20		19.95m - Trace of coal			D 3.36 A 3.28			PT, 10°, PL, RO, SN, Black PT, 10°, PL, VR, SN Black
			-18	21		NO CORE: 0.10m SANDSTONE: Medium grained, grey, indistinctly bedded 10°, with black carbonaceous flecks.	FR		D 2.13 A 1.94	100		PT, 0°, PL, RO, CN PT, 0°, PL, RO, CN
			-19	22		SANDSTONE: Coarse grained, pale grey, with grey laminations indistinctly bedded at 20°, black carbonaceous flecks.						
			-19	23		R17-BH17 terminated at 22m						
			-20	24								
			-21	25								
			-22	26								
			-23									

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--	--

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **3.6.2011**

Principal:

Date completed: **3.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drilling information				material substance				rock mass defects			
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₅₀ MPa	D- diam- A- axial	defect spacing mm	defect description
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH			30 100 300 1000 3000	particular
					Continued from non-cored borehole						general
			-5		SANDSTONE: Medium to coarse grained, orange-brown, distinct laminations at 0° to 10°.	HW					
				9	8.06m - Colour change to pale grey and pale orange brown.	MW			D 0.35 A 0.4	47	PT, 10°, PL, CO, clayey sand infill, 1mm
			-6		9.0m - Colour change to pale orange brown with dark pink/red banding.						JT, 30°, PL, RO, CN
			-7	10						84	CS, 10mm
			-8			HW			D 0.87 A 0.5		
			-9	11							
			-10	12	SANDSTONE: Medium grained, pale grey with some dark grey. Distinct cross laminations in places. Some shale inclusions between bedding planes.	FR			D 1.08 A 0.79		JT, 45°, PL, RO, CN
			-11		SHALE: Dark grey, distinct fine laminations at 0° to 5°, can be remoulded into clay in places.						PT, 10°, PL, Fe SN, RO
			-12	13	NO CORE: 0.05m	FR			A 1.07	50	PT, 0°-5°, PL, shale infill, 1mm
					SHALE: Dark grey, distinct fine laminations at 0° to 5°, can be remoulded into clay in places.	FR					SM, 0°-15°, UN, 150mm, Shale
				14	NO CORE: 0.09m	FR			A 0.12		SM, 0°-10°, UN, 1mm - 100mm, Shale
					SHALE: Dark grey, distinct fine laminations at 0° to 5°, can be remoulded into clay in places.						CS Shale
			-11	15	SANDSTONE: Fine grained, grey with dark grey bands. Distinct laminations at 0° to 5°, 1mm to 3mm shale bands in bedding planes.				D 0.14 A 0.13	49	12.94m to 13m - Zone of PT, 0°-5°, PL, CN, RO
			-12	16	SANDSTONE: Medium to coarse grained, pale grey with distinct laminations at 5° to 15°.					96	13.09m to 13.27m - Zone of PT, 0°-5°, PL, CN, RO

All defects are: PT, 0°-15°, PL, RO, CN unless otherwise noted

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--

Borehole No. **R17-BH2**

Engineering Log - Cored Borehole

Sheet 3 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **3.6.2011**

Principal:

Date completed: **3.6.2011**Project: **SICEEP**

Logged by: ***RH***

Borehole Location: ***Darling Drive, Haymarket, NSW***

Checked by: **SS**

drill model & mounting: Ausroc 4000 Truck						Easting:		slope: -90°		R.L. Surface: 3.5						
hole diameter: 100 mm Drilling fluid:						Northing:		bearing: N/A		datum: AHD						
drilling information						material substance				rock mass defects						
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength					Is ₍₅₀₎ MPa D- diam- etral A- axial	defect spacing mm	defect description	
								VL	L	M	H	VH			EH	RQD %
			-13	17		SANDSTONE: Medium to coarse grained, pale grey with distinct laminations at 5° to 15°. (continued)	FR					D A 0.62 0.45	96		JT, 45°, PL, RO, CN	
			-14	18		NO CORE: 0.08m SANDSTONE: Medium to coarse grained, pale grey with distinct laminations at 5° to 15°.						D A 0.64 0.57			JT, 75°, PL, RO, CN	
			-15	19		18.60m - Black, carbonaceous particles evident within sandstone.										
			-16	20		19.37m - Colour change to a very pale grey/white with pale grey laminations.						D A 1.72 1.29				
			-17	21		NO CORE: 0.10m SANDSTONE: Medium to coarse grained, pale grey with distinct laminations at 5° to 15°.						D A 1.16	88			
			-18	22								D A 1.32 1.32				
			-19	23		R17-BH2 terminated at 22m										
			-20	24												
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core						core-lift casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered		water 10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown		weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high		defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating				

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Darling Drive, Haymarket, NSW**

Borehole No. **R17-BH3**

Sheet 3 of 4

Project No: **GEOTLCOV24303AC**

Date started: **2.6.2011**

Date completed: **2.6.2011**

Logged by: **RH**

Checked by: **SS**

drill model & mounting: Ausroc 4000 Truck Easting: slope: -90° R.L. Surface: 3.5
hole diameter: 100 mm Drilling fluid: Northing: bearing: N/A datum: AHD

drilling information					material substance					rock mass defects						
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components Continued from non-cored borehole	weathering alteration	estimated strength					Is ₅₀ MPa D- diam- etral A- axial	defect spacing mm	defect description	
								VL	L	M	H	VH	EH	RQD % 30 100 300 1000 3000	type, inclination, planarity, roughness, coating, thickness particular general	
NMLC						NO CORE: 0.18m										
				-6		SANDSTONE: Medium to coarse grained, pale orange-brown, indistinct laminations.	HW/MW						D A 0.16 0.17	27	8.68m - 8.82m - Highly fractured zone of PTs/Sand SMs 8.94m - 9.00m - SM, 0°-5°, 60mm, sand JT, 0°-5°, CU, RO, CN	
						NO CORE: 0.20m							A 0.15		SM, 0°-5°, 30mm, Clayey sand	
				-7		SANDSTONE: Medium to coarse grained, pale orange-brown, indistinct laminations. 10.37m - Pinkish-red banding 2mm to 150mm wide along laminations.							D A 0.37 0.61	38	9.8m - 9.9m - SM, 0°-10°, 100mm, Sand JT, 85°, PL, RO, CN 10.23m - 10.24m - Clay, SM, 5°, 10mm JT, 60°, PL, RO, CN JT, 40°, PL, RO, CN JT, 40°, PL, RO, CN JT, 40°, PL, RO, CN	
						NO CORE: 0.23m									JT, 5°-10°, CU, RO, CN	
				-8		SANDSTONE: Medium to coarse grained, pale orange-brown, indistinct laminations. 11.2m - Colour change to pale grey and pale orange brown with distinct laminations. 11.83m - 12.95m - Band of pinkish-red ironstaining.							D A 0.77 1	33	11.13m - 1.19m - SM, 5°-15°, 60mm, Clay JT, 0°-5°, PL, RO, CN JT, 30°, PL, RO, CN 11.68m - 11.88m - Zone of JT, 40°-45°, PR, RO, CN 11.95m - 11.96m - SM, 10°, 10mm, Clay	
						NO CORE: 0.16m									JT, 80°, PL, RO, CN	
				-9		SANDSTONE: Medium to coarse grained, pale orange-brown, indistinct laminations.									Zone of JT, 40°-90°	
				-10			HW/XW							A 0.08	40	JT, 60°, PL, Clay Infill, 1mm 13.2m - 13.85m - Zone of clayey sand SM
				-11		13.8m - 14.38m - Fine to medium grained quartz gravel within sandstone.	MW/SW						D 0.19	28	JT, CU, RO, Fe SN 14.08m - 14.12m - Fe SN, sandy clay SM, 40°, 40mm 14.24m - 14.26m - Sandy clay SM, 35°, 20mm Sandy clay SM, 40°, 1mm 14.40m - 14.43m - SM, 10°, 30mm 14.47m - 14.52m - Zone of PT & JT 14.49m - 14.52m - SM, 40°, Clay infill, 3mm 14.54m - 15.00m - Zone of JT, 0°-90°	
				-12									D A 0.64 0.41	55		
				-13			MW/HW						D A 0.64 0.41	46	16.0m - 16.18m - Sand SM, 40°, 180mm JT, CU, RO, CN JT, CU, RO, CN	

All defects are: PT, 0°-10°; PL, RO, CN unless otherwise noted

method	core-lift	water	weathering	defect type	roughness
DT diatube	AS casing used	10/1/98 water level on date shown	FR fresh	JT joint	VR very rough
AS auger screwing	AD barrel withdrawn	water inflow	SW slightly weathered	PT parting	RO rough
AD auger drilling		partial drill fluid loss	MW moderately weathered	SM seam	SO smooth
RR roller/tricone		complete drill fluid loss	HW highly weathered	SZ sheared zone	SL slickensided
CB claw or blade bit			XW extremely weathered	SS sheared surface	
NMLC NMLC core			DW distinctly weathered (covers MW and HW)	CS crushed seam	
NQ, HQ, PQ wireline core					
	graphic log/core recovery		strength	planarity	coating
	core recovered		VL very low	PL planar	CN clean
	- graphic symbols		L low	CU curved	SN stained
	indicate material		M medium	UN undulating	VN veneer
	no core recovered		H high	ST stepped	CO coating
			VH very high	IR irregular	
			EH extremely high		
		water pressure test result (lugeons) for depth interval shown			

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **2.6.2011**

Principal:

Date completed: **2.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Ausroc 4000 Truck				Easting:				slope: -90°				R.L. Surface: 3.5			
hole diameter: 100 mm Drilling fluid:				Northing:				bearing: N/A				datum: AHD			
drilling information				material substance						rock mass defects					
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength		Is ₍₅₀₎ MPa D- diam- A- axial	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness			
								VL L M H VH EH			30 100 300 1000 3000	particular	general		
NMLC				17		16.85m - Sandstone paler and more coarse grained. NO CORE: 0.14m SANDSTONE: Medium to coarse grained, pale orange-brown, indistinct laminations.	MW/HW SW			0.47 0.3	46	JT, 40°, PL, RO, CN JT, 35°, PL, RO, CN 16.74m - 16.78m - SM, 0°-10°, 40mm, Sand JT, 90°, PL, RO, CN JT, 45°, PL, RO, CN	All defects are; PT, 0°-10°, PL, RO, CN unless otherwise noted		
			-14	18					D A 0.54 1.45	70	PT, 0°-5°, CO, Clay, 1mm PT, 10°, PL, RO, Fe SN				
			-15	19			MW/HW		D A 0.39 0.66		18.69m - 18.77m - Zone of PT, 0°-15°, PL, RO SM, 10°, Clay infill, 1mm JT, 85°, CU, RO, CN 19m - 19.1m - SM, 100mm, Sand 19.16m - 19.35m - Zone of coarse grained sand SM				
			-16	20		NO CORE: 0.20m SANDSTONE: Medium to coarse grained, pale orange-brown, indistinct laminations. 19.55m - 19.68m - Heavily ironstained band SHALE: Dark grey, fine distinct laminations at 0°-15°. NO CORE: 0.04m SHALE: Dark grey, fine distinct laminations at 0°-15°.	HW FR		A 0.33	45	JT, 45°, PL, RO, CN PT, 5°, PL, RO, Clay CO				
			-17	21		SANDSTONE: Pale grey with some bands of distinct laminations at 5°-15°.			D A 0.25 0.46						
			-18	22					D 0.86	81	JT, 35°, PL, RO, CN JT, 40°, PL, RO, CN JT, 35°, PL, RO, CN JT, 45°, PL, RO, CN JT, 60°, PL, RO, CN				
						R17-BH3 terminated at 22m			A 0.2						
			-19	23											
			-20	24											
			-21												
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core				core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered			water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown			weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high			defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating		

All defects are: PT, 0°-10°, PL, RO, CN unless otherwise noted

Borehole No. **R17-BH4**

Engineering Log - Cored Borehole

Sheet 3 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **6.6.2011**

Principal:

Date completed: **6.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drilling information				material substance				rock mass defects			
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₅₀ MPa	D- diam- etral A- axial	defect spacing mm	defect description
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH			30 100 300 1000 3000	particular
NMLC				9	Continued from non-cored borehole	SW			D A		
				10		MW			0.99 1.16		PT, 10°, CU, RO, Fe SN
				11							
				12	12.22m - Colour change to pale grey with dark grey laminations.	SW			D A		Clay SM, 5°, PL, 2mm
				13		FR			1.59 1.36		JT, 45°, UN, RO, CN
				14							JT, 55°, PL, RO, CN
				15	14.4m - Laminations becoming indistinct.	SW			D A		JT, 35°, PL, RO, CN
				16	14.7m - Trace of rounded white quartz and rounded lithic fine to medium grained gravel.	MW			0.94 1.2		Sand SM, 17°, PL, 3mm
				17							
				18							
				19							
				20							
				21							
				22							
				23							
				24							
				25							
				26							
				27							
				28							
				29							
				30							
				31							
				32							
				33							
				34							
				35							
				36							
				37							
				38							
				39							
				40							
				41							
				42							
				43							
				44							
				45							
				46							
				47							
				48							
				49							
				50							
				51							
				52							
				53							
				54							
				55							
				56							
				57							
				58							
				59							
				60							
				61							
				62							
				63							
				64							
				65							
				66							
				67							
				68							
				69							
				70							
				71							
				72							
				73							
				74							
				75							
				76							
				77							
				78							
				79							
				80							
				81							
				82							
				83							
				84							
				85							
				86							
				87							
				88							
				89							
				90							
				91							
				92							
				93							
				94							
				95							
				96							
				97							
				98							
				99							
				100							
				101							
				102							
				103							
				104							
				105							
				106							
				107							
				108							
				109							
				110							
				111							
				112							
				113							
				114							
				115							
				116							
				117							
				118							
				119							
				120							
				121							
				122							
				123							
				124							
				125							
				126							
				127							
				128							
				129							
				130							
				131							
				132							
				133							
				134							
				135							
				136							
				137							
				138							
				139							
				140							
				141							
				142							
				143							
				144							
				145							
				146							
				147							
				148							
				149							
				150							
				151							
				152							
				153							
				154							
				155							
				156							
				157							
				158							
				159							
				160							
				161							
				162							
				163							
				164							
				165							
				166							
				167							
				168							
				169							

Borehole No. **R17-BH4**

Engineering Log - Cored Borehole

Sheet 4 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **6.6.2011**

Principal:

Date completed: **6.6.2011**

Project: **SICEEP**

Logged by: **RH**

Borehole Location: **Darling Drive, Haymarket, NSW**

Checked by: **SS**

drill model & mounting: Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 3.3						
hole diameter: 100 mm		Drilling fluid:		bearing: N/A		datum: AHD						
drilling information			material substance				rock mass defects					
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	IS ₍₅₀₎ MPa D- diam- etral A- axial	RQD % 30 100 300 1000 3000	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
NMLC				17		SANDSTONE: Coarse grained, pale orange-brown and pale pink, indistinct laminations, trace of fine grained white quartz and grey lithic, rounded gravel. <i>(continued)</i>	MW			95		JT, 85°, PL, RO, CN
				18		17.35m - Coarsening of sandstone (dominated by coarse grained sand and fine grained quartz gravel). 17.60m - Fining of sandstone (medium to coarse grained no gravels)			1.08 2.03			Clay SM, 0°-10°, PL, 30mm
				19		18.30m - Laminations becoming distinct.	SW		1.38 1.13			JT, 85°, PL, RO, FeSN
				20					1.44 1.04	77		Zone of PT, 0°-15°, PL, RO, CN approx 40mm spacing
				21		20.80m - Colour change to pale grey with dark grey laminations.	FR		2.17 3.41			
				22					1.75 1.48	87		PT, 0°-10°, UN, RO, CN Clay SM, 0°-10°, PL, 30mm
				23		SHALE: Dark grey, distinct laminations at 0°-10°. R17-BH4 terminated at 21.98m						
				24								
				25								

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--	--

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Lackey Street, Haymarket, NSW**

Borehole No. **R17-BH5**

Sheet 4 of 4

Project No: **GEOTLCOV24303AC**

Date started: **14.6.2011**

Date completed: **15.6.2011**

Logged by: **LJG**

Checked by: **SS**

drill model & mounting: Ausroc 4000 Truck Easting: slope: -90° R.L. Surface: 2.4
hole diameter: 100 mm Drilling fluid: Northing: bearing: N/A datum: AHD

drilling information				material substance				rock mass defects			
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₅₀ MPa	D- diam- A- axial	defect spacing mm	defect description
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH				type, inclination, planarity, roughness, coating, thickness
					Continued from non-cored borehole						particular
NMLC			-14		SANDSTONE: Coarse grained, pale grey, with dark grey laminations, distinctly bedded at 5°-15°, with some black carbonaceous flecks.	SW					JT, 80°, PL, RO, CN-VN, 80mm
				17	At 16.85m - Indistinctly bedded at 10°-30°	FR					PT, 10°, PL, RO, CN
			-15								20mm
				18							10mm
											PT, 15°, PL, RO, CN
											JT, 70°, PL, RO, CN, 60mm
											PT, 15°, PL, RO, CN
											PT, 15°, PL, RO, CN
											10mm
			-16								PT, 10°, PL, RO, VN
				19	18.80m - Indistinctly bedded at 30°						JT, 80°, PL, RO, CN, 200mm
											SM, Clay and Sand filled, 70mm
											JT, 80°, PL, RO, CN, 200mm
			-17								PT, 10°-20°, PL-IR, RO, CN, 10mm
				20							20mm
											20mm
											20mm
											10mm
			-18								PT, 10°, PL, RO, CN
				21							JT, 85°-90°, PL, RO, CN, VN, >10mm
											HFZ, 100mm
											SM, Clay and Gravel filled, 50mm
											SM, Sand filled, 100mm
											PT, 0°, PL, RO, CN
			-19		Interbedded SANDSTONE and SHALE: Medium to coarse grained, grey sandstone with indistinct laminations at 0°-15°. Dark-grey shale with distinct laminations at 0°-15°.						JT, 90°, PL, RO, CN, 90mm
				22	SANDSTONE: Medium to coarse grained, pale grey to grey with indistinct laminations at 10°.						PT, 10°, IR, RO, CN
											PT, 10°, IR, RO, CN
			-20		R17-BH5 terminated at 22.35m						
				23							
			-21								
				24							

method	core-lift	water	weathering	defect type	roughness
DT diatube	□ casing used	10/1/98 water level on date shown	FR fresh	JT joint	VR very rough
AS auger screwing	□ barrel withdrawn	▶ water inflow	SW slightly weathered	PT parting	RO rough
AD auger drilling		▶ partial drill fluid loss	MW moderately weathered	SM seam	SO smooth
RR roller/tricone		▶ complete drill fluid loss	HW highly weathered	SZ sheared zone	SL slickensided
CB claw or blade bit			XW extremely weathered	SS sheared surface	
NMLC NMLC core			DW distinctly weathered (covers MW and HW)	CS crushed seam	
NQ, HQ, PQ wireline core					
	graphic log/core recovery		strength	planarity	coating
	□ core recovered		VL very low	PL planar	CN clean
	□ - graphic symbols indicate material		L low	CU curved	SN stained
	□ no core recovered		M medium	UN undulating	VN veneer
			H high	ST stepped	CO coating
			VH very high	IR irregular	
			EH extremely high		

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Principal:

Project: **SICEEP**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Borehole No. **R17-BH6**

Sheet 3 of 4

Project No: **GEOTLCOV24303AC**

Date started: **9.6.2011**

Date completed: **9.6.2011**

Logged by: **LJG**

Checked by: **SS**

drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₍₅₀₎ MPa	D- diam- A- axial	RQD %	defect spacing mm	defect description
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH			30 100 300 1000 3000		particular
NMLC				16	Continued from non-cored borehole							
				17	NO CORE: 0.10m SANDSTONE: Coarse grained, pale grey to grey, indistinctly bedded at 10°-15°, with some black carbonaceous flecks and laminations and fine gravel inclusions. 15.95m to 16.05m - Ironstained.	MW FR						Highly fractured zone 30mm
				18								16.40m - 17.33m - Multiple vertical 75°-90° JT, PL-CU, RO, CN
				19								HFZ 50mm
				20								HFZ of multiple PT, 15°, PL, RO, CN
				21								SM, 10°, Clay and sand filled 10mm
				22								JT, 45°, PL, RO, CN
				23								HFZ 110mm
				24								PT x2 10mm
				25								PT, CS, JT, 50mm 10°-90°, PL, RO, CN
				26								JT, 45°, CU, RO, CN, 80mm
				27								JT, 80°, PL, RO, CN, 250mm
				28								Multiple at 200mm
				29								PT/JT, 80°, PL, RO, CN, 80mm
				30								PT/JT, 90°, PL, RO, CN, 90mm
				31								PT/JT, 75°, PL, RO, CN, 80mm
				32								PT/JT, 45°, PL, RO, CN
				33								HFZ of multiple JT and PT
				34	NO CORE: 0.20m							HFZ of multiple JT and PT
				35	SANDSTONE: Coarse grained, pale grey, indistinctly bedded at 30°, with some black carbonaceous flecks and laminations, micaceous.	FR						JT, 85, PL, RO, CN, 190mm
				36								PT/JT, 90°, PL, RO, CN
				37								Highly fractured zone of multiple PT/JT
				38	SHALE: Black, thinly laminated at 0°, with some sandstone gravel inclusions.	FR						XW, SM, Silt/clay filled 100mm
				39	NO CORE: 0.25m							Highly fractured zone of multiple JT/PT, 590mm
				40	SANDSTONE: Coarse grained, pale grey, indistinctly bedded at 0°-10°, with some black carbonaceous laminations and flecks. 21.27m - Massive.							JT, 80°, PL, RO, CN, 240mm
				41								PT/JT, 90°, PL, Closed, 180mm
				42								JT, 50°, PL, RO, CN
				43								PT, 30°, PL, RO, Clay, CO
				44								HFZ 40mm
				45								PT, 30°, PL, RO, CN
				46								JT, 80°, PL-CU, RO, CN
				47								PT, 35°, PL, RO, CN
				48								JT
				49								PT, 15°, PL, RO, Black CO - coal/carbonaceous material
				50								CS, 10°, PL, Gravel filled
				51								PT/JT, 30°, PL, RO, CN-UN
				52								PT x2, 10°, PL, RO, CN

All defects are: PT, 10°-30°, PL, RO, CN unless otherwise noted

Borehole No. **R17-BH6**

Sheet 4 of 4
Project No: **GEOTLCOV24303AC**

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **9.6.2011**

Principal:

Date completed: **9.6.2011**

Project: **SICEEP**

Logged by: **LJG**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model & mounting: Ausroc 4000 Truck		Easting:		slope: -90°		R.L. Surface: 2.6								
hole diameter: 100 mm		Drilling fluid:		bearing: N/A		datum: AHD								
drilling information			material substance				rock mass defects							
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	Is ₍₅₀₎ MPa D- diam- A- axial	defect spacing mm RQD % 30 100 300 1000 3000	defect description type, inclination, planarity, roughness, coating, thickness			
NMLC	▲		-22	24		SANDSTONE: Medium to coarse grained, grey with brown, black and dark grey laminations, distinctly bedded at 10°-20°, with black carbonaceous flecks and laminations, micaceous. (continued)	FR			85	PTx2, 10°, PL, RO, CN PT, 5°, PL, RO, CN Multiple JT, 160mm infilled with clay 45°-75° PT, 10°, PL, RO, VN			
			-23	25		R17-BH6 terminated at 24.94m			0.27 0.22					
			-24	26										
			-25	27										
			-26	28										
			-27	29										
			-28	30										
			-29	31										
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core			core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered - graphic symbols indicate material  no core recovered			water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown			weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high			defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating		

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **15.6.2011**

Principal:

Date completed: **17.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drilling information				material substance				rock mass defects			
method	core-lift	water	RL	depth metres	material	weathering alteration	estimated strength	IS ₅₀ MPa	D- diam- A- axial	defect spacing mm	defect description
					rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH			30 100 300 1000 3000	particular
NQ			-12	17	SANDSTONE: Coarse grained, pale brown, indistinctly bedded at 20°-40°.	HW/MW			D A 1.32 1.79		PT, 15°, PL, RO, SN PT, 20°, PL, RO, SN PT, 30°, PL, RO, SN PT, 25°, PL, RO, SN
			-13	18	16.90m - Red band, 200mm	SW					PT, 30°, PL, RO, SN
			-14	19					D A 1.56 2.2		PT, 20°, PL, RO, VN, Clay PT, 30°, PL, RO, VN, Clay PT, 5°, PL, RO, SN PT, 5°, PL, RO, VN, Clay JT, 60°, UN, RO, VN, Clay PT, 15°, PL, RO, VN, Clay
			-15	20	NO CORE: 0.40m				D A 0.52 0.41		PT, 15°, PL, RO, VN clay
			-16	21	SANDSTONE: Medium grained, pale grey, indistinctly bedded at 10°-30°.	FR			D A 1.33 1.4		PT, 10°, PL, RO, SN JT, 70°, PL, RO, SN
			-17	22	NO CORE: 0.10m				D A 0.17 0.41		JT, 0°, IR, RO, SN
			-18	23	SHALE AND LAMINATE: Dark grey, grey.	FR					PT, 20°, UN, RO, CN
			-19	24	SANDSTONE: Medium grained, pale grey, massive contact angle = 20°.				D A 1.58 1.91		SM, 20°, PL, RO, Clay, 10mm PT, 10°, PL, RO, SN SM, 25°, PL, RO, Clay, 35mm JT, 45°, PL, RO, VN SM, 25°, IR, RO, Clay, 40mm
			-20	25	SANDSTONE: Medium grained, pale grey, distinctly bedded at 40°.				D A 1.8 1.69		PT, 20°, PL, RO, VN SM, 20°, PL, RO, Clay, 50mm JT, 70°, PL, RO, CN, Sand, 20mm

Unless noted defects are: PT, 10°-40°, PL, RO, CN

method	core-lift	water	weathering	defect type	roughness
DT diatube	□ casing used	10/1/98 water level on date shown	FR fresh	JT joint	VR very rough
AS auger screwing	□ barrel withdrawn	▶ water inflow	SW slightly weathered	PT parting	RO rough
AD auger drilling		◀ partial drill fluid loss	MW moderately weathered	SM seam	SO smooth
RR roller/tricone	graphic log/core recovery	◀ complete drill fluid loss	HW highly weathered	SZ sheared zone	SL slickensided
CB claw or blade bit	□ core recovered		XW extremely weathered	SS sheared surface	
NMLC NMLC core	□ - graphic symbols indicate material		DW distinctly weathered (covers MW and HW)	CS crushed seam	
NQ, HQ, PQ wireline core	□ no core recovered		strength	planarity	coating
		25 water pressure test result (lugeons) for depth interval shown	VL very low	PL planar	CN clean
			L low	CU curved	SN stained
			M medium	UN undulating	VN veneer
			H high	ST stepped	CO coating
			VH very high	IR irregular	
			EH extremely high		

Borehole No. **R17-BH7**

Engineering Log - Cored Borehole

Sheet 5 of 6
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **15.6.2011**

Principal:

Date completed: **17.6.2011**Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model & mounting: Hdrapower Scout Truck				Easting:		slope: -60°		R.L. Surface: 2.6				
hole diameter: 100 mm				Drilling fluid:		Northing:		bearing: 213.5°				
								datum: AHD				
drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	Is ₅₀ MPa D- diam- etral A- axial	defect spacing mm	defect description	
											particular	general
NQ				-19	25	SANDSTONE: Medium grained, pale grey, distinctly bedded at 40°. (continued)	FR				PT, 20°, UN, RO, CN JT, 40°, PL, RO, CN	Unless noted defects are: PT, 10°-40°, PL, RO, CN
				-19		NO CORE: 0.10m					JT, 20°, PL, RO, CO, Clay, 3mm JT, 70°, PL, RO, CN PT, 30°, PL, RO, CO, Clay, 2mm	
				-20	26	SANDSTONE: Medium to coarse grained, pale grey, indistinctly bedded at 40°. SANDSTONE: Coarse grained, pale grey, massive.	FR				JT, 60°, PL, RO, CN	
				-20							JT, 60°, PL, RO, CN	
				-21	27						SM, 20°, PL, RO, XW, 40mm JT, 50°, PL, RO, CN	
				-22	28	SANDSTONE: Medium grained, pale grey, indistinctly bedded at 20°.					JT, 60°, PL, RO, CN JT, 80°, PL, RO, CN JT, 70°, PL, RO, CN	
				-22							JT, 75°, PL, RO, CN JT, 85°, UN, RO, VN	
				-23	29	28.90m - Interface angle = 30°. DOLERITE: Coarse grained, pale brown, grey, speckled white and green.	HA				PT, 30°, PL, RO, VN JT, 30°, PL, RO, CO, Clay JT, 30°, PL, RO, CO, Clay	
				-23		NO CORE: 0.40m					SM, 30°, PL, RO, Clay, 40mm, pp = 100kPa JT, 45°, PL, RO, CN SM, 35°, PL, RO, Clay, unknown thickness	
				-24	30	DOLERITE: Coarse grained, pale brown, grey, speckled green.	HA				SM, 30°, PL, RO, Clay, 12mm	
				-24	31						JT, 60°, PL, RO, CN JT, 50°, PL, RO, CN	
				-25	32	DOLERITE: Coarse grained, dark grey, speckled green.	FR				JT, 25°, PL, RO, VN, Calcium JT, 35°, PL, RO, CN, Calcium JT, 30°, PL, RO, SN JT, 30°, PL, RO, SN JT, 15°, IR, RO, CN JT, 15°, IR, RO, CN	
				-25		NO CORE: 0.10m						
				-25		DOLERITE: Coarse grained, dark grey, speckled green.	FR					

method	DT AS AD RR CB NMLC NQ, HQ, PQ	diatube auger screwing auger drilling roller/tricone claw or blade bit NMLC core wireline core
core-lift	casing used barrel withdrawn	graphic log/core recovery core recovered - graphic symbols indicate material no core recovered
water	10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high
defect type	JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam	roughness VR very rough RO rough SO smooth SL slickensided planarity PL planar CU curved UN undulating ST stepped IR irregular coating CN clean CU stained VN veneer CO coating

Borehole No. **R17-BH7**

Engineering Log - Cored Borehole

Sheet 6 of 6
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **15.6.2011**

Principal:

Date completed: **17.6.2011**Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model & mounting: Hydropower Scout Truck						Eastings:		slope: -60°		R.L. Surface: 2.6						
hole diameter: 100 mm Drilling fluid:						Northing:		bearing: 213.5°		datum: AHD						
drilling information						material substance				rock mass defects						
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength					Is ₍₅₀₎ MPa D- diam- etral A- axial	defect spacing mm	defect description	
								VL	L	M	H	VH			EH	RQD %
NQ			-26	33		DOLERITE: Coarse grained, dark grey, speckled green. (continued) From 32.95, with bands of pale brown, pale grey.	SA MA					A 4.27		JT, 20°, PL, RO, VN JT, 45°, PL, RO, VN, Calcium 32.65m - 33.03m - Highly fractured rock JT, 20°-40°, PL, RO, VN JT, 55°, PL, RO, CN JT, 55°, PL, RO, CN JT, 55°, PL, RO, CN JT, 60°, PL, RO, VN JT, 30°, PL, RO, VN JT, 40°, PL, RO, VN 33.80m - 33.94m - Highly fractured rock JT, 30°, PL, RO, VN JT, 30°, PL, RO, VN 34.20m - 35.10m - Highly fractured rock		
			-27	34		33.65m - Becoming pale grey, pale brown bands of dark grey.						D 4.88				
			-28	35		NO CORE: 0.90m										
			-29	36		DOLERITE: Pale grey	HA					D 0.32	A 0.27		SM, 30°, IR, RO, Clay, 20mm	
			-29	37		37m - Interface angle = 60°	XA									
			-30	38		SANDSTONE: Medium grained, dark grey to black, distinctly bedded at 40°.	FR					D 3.38	A 4.87		JT, 70°, PL, RO, SN JT, 80°, PL, RO, SN JT, 70°, PL, RO, SN SM, 20°, PL, RO, XA, 10mm JT, 65°, PL, RO, CO Clay, 5mm JT, 30°, PL, RO, SN JT, 30°, PL, VR, CN	
			-31	39		NO CORE: 0.35m										
			-31	40		SANDSTONE: Medium to coarse grained, pale grey, grey, indistinctly bedded at 40°.	FR					D 2			JT, 30°, PL, VR, CN	
			-32	40		R17-BH7 terminated at 40m										
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core			core-lift casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered			water 10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown			weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high			defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean CU stained VN veneer CO coating				

Borehole No. **R17-BH8**

Engineering Log - Cored Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **14.6.2011**

Principal:

Date completed: **14.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model & mounting: Hydrapower Scout Truck Easting: slope: -90° R.L. Surface: 2.5
hole diameter: 100 mm Drilling fluid: Northing: bearing: N/A datum: AHD

drilling information					material substance					rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material	weathering alteration	estimated strength	IS ₅₀ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description		
						rock type; grain characteristics, colour, structure, minor components		VL L M H VH EH				type, inclination, planarity, roughness, coating, thickness	particular	general
ADT			2			FILL: ASPHALT: Dark grey, 70mm thickness sandy gravel: medium grained, grey sand, fine grained, grey gravel								
				1		FILL: SAND: Fine to medium grained, dark brown, with some clay and fine gravel.								
						FILL: ASPHALT: Dark grey, 250mm.								
NMLC			1			FILL: CONCRETE: Pale grey, 410mm.								
						1m - With some dark grey gravel aggregate and steel.								
						VOID:								
				3		R17-BH8 terminated at 3m								
				4										
				5										
				6										
				7										
				8										

method	core-lift	water	weathering	defect type	roughness
DT diatube	casing used	10/1/98 water level on date shown	FR fresh	JT joint	VR very rough
AS auger screwing	barrel withdrawn	water inflow	SW slightly weathered	PT parting	RO rough
AD auger drilling		partial drill fluid loss	MW moderately weathered	SM seam	SO smooth
RR roller/tricone		complete drill fluid loss	HW highly weathered	SZ sheared zone	SL slickensided
CB claw or blade bit			XW extremely weathered	SS sheared surface	
NMLC NMLC core			DW distinctly weathered (covers MW and HW)	CS crushed seam	
NQ, HQ, PQ wireline core					
	graphic log/core recovery		strength	planarity	coating
	core recovered	water pressure test result (lugeons) for depth interval shown	VL very low	PL planar	CN clean
	no core recovered		L low	CU curved	SN stained
			M medium	UN undulating	VN veneer
			H high	ST stepped	CO coating
			VH very high	IR irregular	
			EH extremely high		

Borehole No. **R17-BH9**

Engineering Log - Cored Borehole

Sheet 1 of 1
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **15.6.2011**

Principal:

Date completed: **15.6.2011**

Project: **SICEEP**

Logged by: **RC**

Borehole Location: **Back of House of Sydney Entertainment Centre**

Checked by: **SS**

drill model & mounting: Hydrapower Scout Truck				Easting:		slope: -90°		R.L. Surface: 2.75				
hole diameter: 100 mm				Drilling fluid:		Northing:		bearing: N/A				
datum: AHD												
drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material	weathering alteration	estimated strength	IS ₅₀ MPa	D- diam- etral A- axial	defect spacing mm	defect description
ADT	Not Observed		2			FILL: ASPHALT: Dark grey 70mm, overlying sandy gravel, medium grained, brown sand, dark grey gravel. FILL: SAND: Medium to coarse grained, yellow, with some fine to coarse sandstone gravel. 0.60m - Becoming brown, with some coarse dolerite gravel. FILL: ASPHALT: Grey, 150mm FILL: CONCRETE: Pale grey, 50mm. R17-BH9 terminated at 0.85m						
				1								
				1								
				2								
				0								
				3								
				-1								
				4								
				-2								
				5								
				-3								
				6								
				-4								
				7								
				-5								
				8								

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--	--

Borehole No. **NRH1**

Engineering Log - Cored Borehole

Sheet 2 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **19.4.2012**

Principal:

Date completed: **19.4.2012**Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: XP60 Ute						Easting: 333372		slope: -90°		R.L. Surface: 2.85						
hole diameter: 100 mm Drilling fluid:						Northing: 6250503		bearing: N/A		datum: AHD						
drilling information				material substance				rock mass defects								
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength				Is ₍₅₀₎ MPa D- diam- A- axial	defect spacing mm	defect description		
								VL	L	M	H			VH	EH	RQD %
			-2	1												
			-1	2												
			0	3												
			-1	4		Continued from non-cored borehole										
NMLC			-2	5		SANDSTONE: Coarse grained, pale brown-dark brown, distinctly bedded at 10°-20°, with some dark grey carbonaceous laminations	MW				D 0.8 A 1.51	82	PT, 15°, PL, RO, CN 4.14m to 4.17m - Fractured Zone, 30mm 4.23m to 4.27m - PT, 20°, PL, RO, CN PT, 0°, PL, RO, CN PT, 10°, PL, VR, CN PT, 0°, PL, RO, FeSN			
			-3	6		SANDSTONE: Medium to coarse grained, pale brown to orange-brown iron stained, cross bedded at 0°-10°, with some shale breccia.					D 0.72 A 1.69		PT, 0°, PL, RO, FeSN PT, 0°, PL, RO, SN			
			-4	7		SANDSTONE: Medium to coarse grained, pale grey with dark grey carbonaceous laminae, quartz grains. INTERLAMINATED SHALE (70%) AND SANDSTONE (30%): Fine grained, pale grey and dark grey. SHALE: Dark grey.	SW				D 0.66 A 0.21	93	PT, 0°, PL, RO, Clay VN PT, 0°, PL, SO, CN PT, 0°, PL, SO, CN 7.43m to 7.74m - Closely spaced defects PT, 0°, PL, SO, CN, 50mm spacing unless noted SM, Clay, 10mm PT, 0° PL, SO, Clay VN			
			-5	8		SANDSTONE: Fine to medium grained, pale grey, with dark grey carbonaceous	FR				D 0.56 A 0.95					
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core			core-lift casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered			water 10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown			weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high			defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating				

Borehole No. **NBH1**

Engineering Log - Cored Borehole

Sheet 3 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **19.4.2012**

Principal:

Date completed: **19.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: XP60 Ute				Easting: 333372		slope: -90°		R.L. Surface: 2.85				
hole diameter: 100 mm Drilling fluid:				Northing: 6250503		bearing: N/A		datum: AHD				
drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
NMLC						laminae and shale breccia bedded at 0°-10°. SANDSTONE: Fine to medium grained, pale grey, with dark grey laminations, indistinctly bedded at 0°-5° (<i>continued</i>)	FR	VL L M H VH EH	D 1.22 A 1.42	93		
			-6	9		NBH1 terminated at 8.9m						
			-7	10								
			-8	11								
			-9	12								
			-10	13								
			-11	14								
			-12	15								
			-13	16								

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--

Borehole No. **NBH10**

Engineering Log - Cored Borehole

Sheet 5 of 5
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **30.4.2012**

Principal:

Date completed: **1.5.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₍₅₀₎ MPa D- diam- A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
			-19	25								
			-20	26								
			-21	27								
			-22	28								
			-23	29								
			-24	30								
			-25	31		Continued from non-cored borehole			D A 1.68 1.88			
NQ			-26	32		SANDSTONE: Fine grained, pale grey, indistinctly bedded at 0°-5°, with dark grey laminations	FR		D A 1.57 1.91	100		PT, 0°, PL, RO, CN

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	drilling NBH10 terminated at 31.9m  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--	--

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **26.4.2012**

Principal:

Date completed: **26.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: Ausrock 3000 Truck				Easting: 333583		slope: -90°		R.L. Surface: 5.4					
hole diameter: 100 mm Drilling fluid:				Northing: 6250177		bearing: N/A		datum: AHD					
drilling information				material substance				rock mass defects					
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	IS ₅₀ MPa D- diam- etral A- axial	RQD % 30 100 300 1000 3000	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness	
			-11	17									
			-12	18									
			-13			Continued from non-cored borehole							
NMLC			-14	19		NO CORE: 0.07m SANDSTONE: Fine grained, yellow brown.	MW				64	SM, clay, high plasticity, grey, 40mm	
			-15	20		NO CORE: 0.1m SANDSTONE: Fine to coarse grained, brown, iron stained, indistinctly bedded at 0°-5°	MW		D 1.03 A 0.95		85	PT, 0°, UN, RO, CN	
			-16	21		SANDSTONE: Fine grained, pale grey, massive. 20.2m - With some mudstone clasts/breccia 20.7m - With some carbonaceous laminae	FR		D 0.85 A 1.12		75	PT, 0°, PL, RO, CN XW seam, gravelly clay, low plasticity, yellow brown, fine to medium gravel, 80mm	
			-17	22		NBH14 terminated at 21m						JT, 20°, PL, RO, Fe-SN PT, 5°, IR, RO, clay VN PT, 5°, PL, SO, clay CO	
			-18	23									
			-19	24									
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core			core-lift casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered			water 10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown			weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high			defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating	

Borehole No. **NBH17**

Engineering Log - Cored Borehole

Sheet 3 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: Ausrock 3000 Truck										Easting: 333635		slope: -90°		R.L. Surface: 2.4			
hole diameter: 100 mm					Drilling fluid:					Northing: 6250073		bearing: N/A		datum: AHD			
drilling information					material substance							rock mass defects					
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength					Is ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description	
								VL	L	M	H	VH				EH	particular
			-6														
				9													
			-7														
				10													
			-8														
				11													
			-9														
				12													
			-10														
				13													
			-11														
				14													
			-12														
				15													
			-13														
						Continued from non-cored borehole											
NMLC				16		SANDSTONE: Fine to medium grained, pale grey, with some iron oxide bands.	HW					D A 0.06 0.05				PT, 10°, IR, Fe SN PT, 25°, IR, RO, CN PT, 10°, IR, RO, Clayey Sand CO	
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core				core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols  indicate material  no core recovered			water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown			weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high				defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating			

Borehole No. **NBH17**

Engineering Log - Cored Borehole

Sheet 4 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: Ausrock 3000 Truck				Easting: 333635		slope: -90°		R.L. Surface: 2.4						
hole diameter: 100 mm Drilling fluid:				Northing: 6250073		bearing: N/A		datum: AHD						
drilling information				material substance				rock mass defects						
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₅₀ MPa D- diam- etral A- axial	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness			
NMLC			-14			15.9m to 10.1m - Becoming distinctly bedded at 0°-5° with carbonaceous laminae. SANDSTONE: Fine to medium grained, pale grey, with some iron oxide bands. (continued)	HW			56	PT, 20°, PL, RO, Sand CO JT, 90°, PL, RO, Clay Seam (10mm) in between joints (200mm) PT, 0°, PL, RO, clayey sand CO			
			-15	17		SANDSTONE: Medium to coarse grained, yellow brown, indistinctly bedded at 0°-5°. NO CORE: 0.3m	HW		D A 0.03 0.04 D A 0.09 0.11	39	16.83m to 16.93m - PT, 0°, PL, SO, Fe SN			
			-15			SHALE: Dark grey, with some fine sandstone bands and occasional iron staining.								
			-15	18		SANDSTONE: Fine grained, pale grey, carbonaceous veins. SHALE: Dark grey, disturbed bedding.	MW				PT, 0°, PL, RO, Fe SN			
			-16			SANDSTONE: Medium grained, pale grey, massive, with some carbonaceous laminae and iron staining. NBH17 terminated at 18m								
			-17	19										
			-18	20										
			-19	21										
			-20	22										
			-21	23										
			-21	24										
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core			core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered			water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown			weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high			defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating		

Borehole No. **NBH2**

Engineering Log - Cored Borehole

Sheet 2 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **1.5.2012**

Principal:

Date completed: **1.5.2012**

Project: **SICEEP**

Logged by: **DB**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: XP60 6x6 Ute				Easting:		slope: -90°		R.L. Surface: 2.82				
hole diameter: 100 mm Drilling fluid:				Northing:		bearing: N/A		datum: AHD				
drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	Is ₍₅₀₎ MPa D- diam- etral A- axial	RQD % 30 100 300 1000 3000	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
			2	1								
			1	2								
			0	3								
			-1	4								
Continued from non-cored borehole												
RR			-2	5		SANDSTONE: Fine to coarse grained, orange brown to pale grey, iron stained, indistinctly bedded at 0°-5°.	MW		D A 1.02 1.15	100		
										93		PT, 0°-5°, IR, RO, CN
			-3	6					D A 1.59 1.27			PT, 5°, IR, VR, SN iron
												PT, 0°, PL, RO, SN iron
			-4	7					D A 0.75 0.74	90		PT, 5°, CU, VR, SN iron
												PT, 0°, CU, VR, SN iron
			-5	8		SANDSTONE: Fine to medium grained, pale grey, indistinctly bedded at 0°-5°, with some dark grey laminations.	FR		D A 0.86 0.93	100		PT, 5°, PL RO, CN PT, 5°, PL, RO, CN 7.40m to 7.45m - SM, 0°, PL, Clay (10mm) SM, 0°, PL, sandy clay (30mm)
method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core				core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered		water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown		weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high		defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating		

CORED BOREHOLE GINTGEOTLCOV24303AC_COMBINED WITH AA GINT.GPJ COFFEY.GDT 5.15.12

Borehole No. **NBH2**

Engineering Log - Cored Borehole

Sheet 3 of 3
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **1.5.2012**

Principal:

Date completed: **1.5.2012**

Project: **SICEEP**

Logged by: **DB**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: XP60 6x6 Ute				Easting:		slope: -90°		R.L. Surface: 2.82				
hole diameter: 100 mm Drilling fluid:				Northing:		bearing: N/A		datum: AHD				
drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
RR			-6	9		SANDSTONE: Fine to medium grained, pale grey, indistinctly bedded at 0°-5°, with some dark grey laminations. <i>(continued)</i>	FR	VL L M H VH EH	D 1.15 A 1.55	100		
			-7	10		NBH2 terminated at 9.25m						
			-8	11								
			-9	12								
			-10	13								
			-11	14								
			-12	15								
			-13	16								

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--	--

Borehole No. **NBH28**

Engineering Log - Cored Borehole

Sheet 3 of 4
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **20.4.2012**

Principal:

Date completed: **23.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: Ausrock 3000 Truck Easting: 333703 slope: -90° R.L. Surface: 2.3
hole diameter: 100 mm Drilling fluid: Northing: 6250005 bearing: N/A datum: AHD

drilling information					material substance					rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength					defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
								VL	L	M	H	VH	EH	A-axial
			-6											
				9										
			-7											
				10										
			-8											
				11										
			-9											
				12										
			-10											
				13										
			-11											
				14										
			-12											
				15										
			-13											
				16		Continued from non-cored borehole								
NMLC						SANDSTONE: Medium to coarse grained, mottled yellow brown, red brown, off-white, distinctly bedded at 10°-20°	MW							PT, 20°, PL, RO, CN PT, 20°, PL, RO, CN PT, 20°, PL, RO, CN

method	core-lift	water	weathering	defect type	roughness
DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered	10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown	FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating

Borehole No. **NBH28**

Engineering Log - Cored Borehole

Sheet 4 of 4
Project No. **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **20.4.2012**

Principal:

Date completed: **23.4.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: Ausrock 3000 Truck Easting: 333703 slope: -90° R.L. Surface: 2.3
hole diameter: 100 mm Drilling fluid: Northing: 6250005 bearing: N/A datum: AHD

drilling information					material substance					rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness		
								VL L M H VH EH			30 100 300 1000 3000	particular	general	
NMLC			-14				MW					PT, 10°, PL, RO, CN		
			-15	17		SANDSTONE: Medium grained, pale grey with dark grey laminations, indistinctly bedded at 0°-5°, with some coarse grained quartz bands	FR		D 0.28 A 0.55	67		PT, 0°, IR, RO, Sand CO 16.85m to 17.08m - Vertical Fracture, JT, 80°, PL, RO, Clay VN		
			-16	18		SANDSTONE: Medium to coarse grained, red-brown, orange and pale grey, iron stained, with dark grey shale laminations, distinctly bedded at 20°	SW		D 0.71 A 0.56			PT, 20°, PL, RO, CN PT, 20°, PL, RO, CN 17.38m to 17.6m - Vertical Fracture, JT, 5°, PL, RO, Sand CO		
			-17	19		18.5m - Becoming pale grey with slight iron staining	SW-FR		D 0.63 A 0.62	91		PT, 0°, PL, RO, Clay, CO PT, 5°, PL, SO, Clay, CO PT, 20°, PL, SO, Clay, VN		
			-18	20		SANDSTONE: Medium to coarse grained, pale grey with dark grey shale laminations, distinctly bedded at 0°-20°	FR		D 2.62 A 2.48			PT, 20°, PL, RO, CN PT, 20°, PL, RO, CN 19.54m to 19.65m - Vertical Fracture, JT, 70°, PL, RO, CN		
			-19	21		Grouted to surface finish with concrete plug NBH28 terminated at 20.6m			D 1.73 A 2.06			PT, 0°, UN, RO, CN JT, 40°, IR, RO, CN		
			-20	22										
			-21	23										
			-22	24										

method	core-lift	water	weathering	defect type	roughness
DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	 casing used  barrel withdrawn graphic log/core recovery  core recovered  - graphic symbols indicate material  no core recovered	 10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	FR fresh JT slightly weathered SW moderately weathered MW highly weathered HW extremely weathered XW distinctly weathered (covers MW and HW) DW strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating

Borehole No. **NBH3**

Engineering Log - Cored Borehole

Sheet 4 of 5
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **4.5.2012**

Principal:

Date completed: **4.5.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: Mobile Drill B80 Truck				Easting: 333487		slope: -90°		R.L. Surface: 3.5						
hole diameter: 100 mm Drilling fluid:				Northing: 6250411		bearing: N/A		datum: AHD						
drilling information				material substance				rock mass defects						
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	IS ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness		
			-13	17										
			-14	18										
			-15	19										
			-16	20										
			-17	21										
			-18	22										
			-19	23		Continued from non-cored borehole								
NMLC			-19	23		SANDSTONE: Medium to coarse grained, pale grey with iron staining, indistinctly bedded at 15°	MW-SW		0.2 0.41			PT, 15°, PL, SO, Silt CO PT, 20°, PL, RO, CN		
			-20	24		SANDSTONE: Medium to coarse grained, pale grey, indistinctly bedded at 0°-20°, with dark grey laminations . 23.1m to 23.35m - Iron stained	FR		1.16 1.35	84		22.66m to 22.84m - XW Seam, Sandy Clay, high plasticity, grey, 180mm CS, Clayey Sand, fine grained, black/pale orange, 10mm PT, 0°, PL, SO, Silt CO CS, Clayey Sand, fine grained, dark grey, 10mm PT, 10°, PL, RO, Fe SN		
method				core-lift		water		weathering		defect type			roughness	
DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core				casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered		10/1/98 water level on date shown water inflow partial drill fluid loss complete drill fluid loss water pressure test result (lugeons) for depth interval shown		FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high		JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular			VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating	

CORED BOREHOLE GINTGEOTLCOV24303AC_COMBINED WITH AA GINT.GPJ COFFEY.GDT 5.15.12

Borehole No. **NBH3**

Engineering Log - Cored Borehole

Sheet 5 of 5
Project No: **GEOTLCOV24303AC**

Client: **Infrastructure NSW**

Date started: **4.5.2012**

Principal:

Date completed: **4.5.2012**

Project: **SICEEP**

Logged by: **JW**

Borehole Location: **See Figure 1**

Checked by: **DS**

drill model & mounting: Mobile Drill B80 Truck				Easting: 333487		slope: -90°		R.L. Surface: 3.5				
hole diameter: 100 mm Drilling fluid:				Northing: 6250411		bearing: N/A		datum: AHD				
drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength VL L M H VH EH	Is ₍₅₀₎ MPa D- diam- A- axial	RQD %	defect spacing mm 30 100 300 1000 3000	defect description type, inclination, planarity, roughness, coating, thickness particular general
NMLC			-21	25		SANDSTONE: Medium to coarse grained, pale grey, indistinctly bedded at 0°-20°, with dark grey laminations . (continued)	FR		D A 1.85 1.82	84		CS, Gravelly Sand, fine grained, grey, gravel is fine, 10mm PT, 0°, PL, RO, CN PT, 0°, PL, RO, CN PT, 15°, PL, RO, CN
			-22	26		NBH3 terminated at 25.1m			D A 2.03 2.14			
			-23	27								
			-24	28								
			-25	29								
			-26	30								
			-27	31								
			-28	32								

method DT diatube AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit NMLC NMLC core NQ, HQ, PQ wireline core	core-lift  casing used  barrel withdrawn graphic log/core recovery  core recovered - graphic symbols indicate material  no core recovered	water  10/1/98 water level on date shown  water inflow  partial drill fluid loss  complete drill fluid loss  water pressure test result (lugeons) for depth interval shown	weathering FR fresh SW slightly weathered MW moderately weathered HW highly weathered XW extremely weathered DW distinctly weathered (covers MW and HW) strength VL very low L low M medium H high VH very high EH extremely high	defect type JT joint PT parting SM seam SZ sheared zone SS sheared surface CS crushed seam planarity PL planar CU curved UN undulating ST stepped IR irregular	roughness VR very rough RO rough SO smooth SL slickensided coating CN clean SN stained VN veneer CO coating
--	---	---	--	--	--

Borehole No. **NBH8**

Sheet 3 of 3
Project No: **GEOTLCOV24303AC**

Engineering Log - Cored Borehole

Client: **Infrastructure NSW**

Date started: **27.4.2012**

Principal:

Date completed: **27.4.2012**

Project: **SICEEP**

Logged by: **DB**

Borehole Location: **See Figure 1**

Checked by: **DS**

drilling information				material substance				rock mass defects				
method	core-lift	water	RL	depth metres	graphic log core recovery	material rock type; grain characteristics, colour, structure, minor components	weathering alteration	estimated strength	Is ₍₅₀₎ MPa D- diam- etral A- axial	RQD %	defect spacing mm	defect description type, inclination, planarity, roughness, coating, thickness
			-5	9								
			-6	10								
			-7									
			-8	11		Continued from non-cored borehole			D A			
			-9	12		SANDSTONE: Fine to medium grained, orange-brown to red-brown, iron stained through substance, indistinctly cross-bedded at 5°-20°.	MW		1.17 1.31			PT, 5°, PL, RO, CN PT, 5°, PL, RO, CN PT, 30°, PL, RO, CN PT, 5°, PL, RO, CN SM, 0°, PL, Sandy clay, 10mm
			-10	13		SANDSTONE: Fine to medium grained, pale grey, indistinctly cross bedded at 0°-5°.	SW		0.86 0.81			PT, 12°, PL, RO, CN
			-11	14			FR		0.86 0.86			PT, 5°, PL, VR, CN SZ, 0°, IR, VR, CO-Sand, 30mm JT, 60°, PL, RO, CN JT, 75°, PL, VR, CO-Clay, 10mm thick
			-12	15		NBH8 terminated at 13.07m						
			-13	16								

method	core-lift	water	weathering	defect type	roughness
DT diatube	casing used	10/1/98 water level on date shown	FR fresh	JT joint	VR very rough
AS auger screwing	barrel withdrawn	water inflow	SW slightly weathered	PT parting	RO rough
AD auger drilling		partial drill fluid loss	MW moderately weathered	SM seam	SO smooth
RR roller/tricone		complete drill fluid loss	HW highly weathered	SZ sheared zone	SL slickensided
CB claw or blade bit			XW extremely weathered	SS sheared surface	
NMLC NMLC core			DW distinctly weathered (covers MW and HW)	CS crushed seam	
NQ, HQ, PQ wireline core					

graphic log/core recovery	strength	planarity	coating
core recovered	VL very low	PL planar	CN clean
- graphic symbols indicate material	L low	CU curved	SN stained
no core recovered	M medium	UN undulating	VN veneer
	H high	ST stepped	CO coating
	VH very high	IR irregular	
	EH extremely high		

Appendix B

Laboratory Data

**Acid Sulfate Soil Assessment and Preliminary Management Plan
Haymarket Precinct, Darling Harbour, Sydney NSW**



ANALYTICAL REPORT

SE100700 R0

Parameter	Sample Number	SE100700.001	SE100700.002	SE100700.003	SE100700.004	SE100700.005
	Sample Matrix	Soil	Soil	Soil	Soil	Soil
	Sample Date	07 Jun 2011	07 Jun 2011	07 Jun 2011	07 Jun 2011	07 Jun 2011
	Sample Name	BH1 1.0	BH1 3.0	AS01 3.0	AS01 5.5	AS01 1.0
Parameter	Units	LOR				

Full 8270 SVOC in Soil Method: AN420 (continued)
Other SVOCs

Methyl methanesulfonate	mg/kg	1	-	<1	-	-	-
Ethyl methanesulfonate	mg/kg	1	-	<1	-	-	-
Dibenzofuran	mg/kg	0.5	-	<0.5	-	-	-
Benzyl alcohol	mg/kg	1	-	<1	-	-	-
Safrole	mg/kg	0.5	-	<0.5	-	-	-
Isosafrole Isomer 1	mg/kg	1	-	<1	-	-	-
Isosafrole Isomer 2	mg/kg	1	-	<1	-	-	-
1,4-naphthoquinone	mg/kg	0.5	-	<0.5	-	-	-
Thionazin	mg/kg	1	-	<1	-	-	-

Speciated Routine Phenols

3/4-methyl phenol (m/p-cresol)	mg/kg	1	-	<1	-	-	-
2-methyl phenol (o-cresol)	mg/kg	0.5	-	<0.5	-	-	-
2,6-dichlorophenol	mg/kg	0.5	-	<0.5	-	-	-
2,3,4,6 and 2,3,5,6-tetrachlorophenol	mg/kg	1	-	<1	-	-	-
2,4,5-trichlorophenol	mg/kg	0.5	-	<0.5	-	-	-
4-chloro-3-methylphenol	mg/kg	1	-	<1	-	-	-
2-chlorophenol	mg/kg	0.5	-	<0.5	-	-	-
2,4-dichlorophenol	mg/kg	0.5	-	<0.5	-	-	-
2,4-dimethyl phenol	mg/kg	0.5	-	<0.5	-	-	-
2-nitrophenol	mg/kg	0.5	-	<0.5	-	-	-
Phenol	mg/kg	0.5	-	<0.5	-	-	-
2,4,6-trichlorophenol	mg/kg	0.5	-	<0.5	-	-	-
Pentachlorophenol	mg/kg	0.5	-	<0.5	-	-	-
4-nitrophenol	mg/kg	0.5	-	<0.5	-	-	-

Surrogates

d5-phenol (Surrogate)	%	-	-	106	-	-	-
d5-nitrobenzene (Surrogate)	%	-	-	113	-	-	-
2-fluorobiphenyl (Surrogate)	%	-	-	128	-	-	-
2,4,6-tribromophenol (Surrogate)	%	-	-	128	-	-	-
d14-p-terphenyl (Surrogate)	%	-	-	128	-	-	-

Field pH for Acid Sulphate Soil Method: AN104

PHf	pH Units	-	-	-	8.0	8.3	-
PHlox	pH Units	-	-	-	2.9	4.0	-
Reaction*	No unit	-	-	-	XXX	X	-
pH Difference*	pH Units	-10	-	-	5.1	4.3	-

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	3	9	-	-	-
Cadmium, Cd	mg/kg	0.3	0.3	<0.3	-	-	-
Chromium, Cr	mg/kg	0.3	9.0	16	-	-	-
Copper, Cu	mg/kg	0.5	13	21	-	-	-
Lead, Pb	mg/kg	1	15	25	-	-	-
Nickel, Ni	mg/kg	0.5	7.7	3.6	-	-	-
Zinc, Zn	mg/kg	0.5	30	25	-	-	-



ANALYTICAL REPORT

SE100700 R0

Parameter	Sample Number	SE100700.006	SE100700.007	SE100700.008	SE100700.009	SE100700.010
	Sample Matrix	Soil	Soil	Soil	Soil	Soil
	Sample Date	07 Jun 2011	09 Jun 2011	09 Jun 2011	09 Jun 2011	09 Jun 2011
	Sample Name	AS013.0	BH13 1.0	BH13 1.5	BH13 2.0	BH 13 2.5
Parameter	Units	LOR				

Full 8270 SVOC in Soil Method: AN420 (continued)
Surrogates

d5-phenol (Surrogate)	%	-	-	-	-	-	-
d5-nitrobenzene (Surrogate)	%	-	-	-	-	-	-
2-fluorobiphenyl (Surrogate)	%	-	-	-	-	-	-
2,4,6-tribromophenol (Surrogate)	%	-	-	-	-	-	-
d14-p-terphenyl (Surrogate)	%	-	-	-	-	-	-

Field pH for Acid Sulphate Soil Method: AN104

PHf	pH Units	-	-	-	-	8.1	-
PHfox	pH Units	-	-	-	-	6.3	-
Reaction*	No unit	-	-	-	-	X	-
pH Difference*	pH Units	-10	-	-	-	1.7	-

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	-	-	10	-	-
Cadmium, Cd	mg/kg	0.3	-	-	0.8	-	-
Chromium, Cr	mg/kg	0.3	-	-	9.3	-	-
Copper, Cu	mg/kg	0.5	-	-	70	-	-
Lead, Pb	mg/kg	1	-	-	140	-	-
Nickel, Ni	mg/kg	0.5	-	-	6.2	-	-
Zinc, Zn	mg/kg	0.5	-	-	730	-	-

Mercury in Soil Method: AN312

Mercury	mg/kg	0.05	-	-	0.45	-	-
---------	-------	------	---	---	------	---	---

Fibre Identification in soil Method: AN602
FibreID

Asbestos Detected	No unit	-	No	No	Yes	-	Yes
-------------------	---------	---	----	----	-----	---	-----

Moisture Content Method: AN234

% Moisture	%	0.5	-	-	15	18	-
------------	---	-----	---	---	----	----	---

Volatile Petroleum Hydrocarbons in Water Method: AN433/AN434

TRH C6-C9	mg/L	0.04	-	-	-	-	-
Benzene	µg/L	0.5	-	-	-	-	-
Toluene	µg/L	0.5	-	-	-	-	-
Ethylbenzene	µg/L	0.5	-	-	-	-	-
m/p-xylene	µg/L	1	-	-	-	-	-
o-xylene	µg/L	0.5	-	-	-	-	-
Total BTEX*	µg/L	3	-	-	-	-	-
Total Xylenes*	µg/L	1.5	-	-	-	-	-

Surrogates

Trifluorotoluene (Surrogate)	%	-	-	-	-	-	-
Dibromofluoromethane (Surrogate)	%	-	-	-	-	-	-
d4-1,2-dichloroethane (Surrogate)	%	-	-	-	-	-	-
d8-toluene (Surrogate)	%	-	-	-	-	-	-
Bromofluorobenzene (Surrogate)	%	-	-	-	-	-	-



ANALYTICAL REPORT

SE100700 R0

Parameter	Sample Number	SE100700.011	SE100700.012	SE100700.013	SE100700.014	SE100700.015
	Sample Matrix	Soil	Soil	Soil	Soil	Soil
	Sample Date	09 Jun 2011	09 Jun 2011	09 Jun 2011	09 Jun 2011	09 Jun 2011
	Sample Name	BH13 4.0	BH13 5.5	BH6 2.0	BH6 2.5	BH6 4.0
Parameter	Units	LOR				

Full 8270 SVOC in Soil Method: AN420 (continued)

Other SVOCs

Methyl methanesulfonate	mg/kg	1	-	-	-	-	-
Ethyl methanesulfonate	mg/kg	1	-	-	-	-	-
Dibenzofuran	mg/kg	0.5	-	-	-	-	-
Benzyl alcohol	mg/kg	1	-	-	-	-	-
Safrole	mg/kg	0.5	-	-	-	-	-
Isosafrole Isomer 1	mg/kg	1	-	-	-	-	-
Isosafrole Isomer 2	mg/kg	1	-	-	-	-	-
1,4-naphthoquinone	mg/kg	0.5	-	-	-	-	-
Thionazin	mg/kg	1	-	-	-	-	-

Speciated Routine Phenols

3/4-methyl phenol (m/p-cresol)	mg/kg	1	-	-	-	-	-
2-methyl phenol (o-cresol)	mg/kg	0.5	-	-	-	-	-
2,6-dichlorophenol	mg/kg	0.5	-	-	-	-	-
2,3,4,6 and 2,3,5,6-tetrachlorophenol	mg/kg	1	-	-	-	-	-
2,4,5-trichlorophenol	mg/kg	0.5	-	-	-	-	-
4-chloro-3-methylphenol	mg/kg	1	-	-	-	-	-
2-chlorophenol	mg/kg	0.5	-	-	-	-	-
2,4-dichlorophenol	mg/kg	0.5	-	-	-	-	-
2,4-dimethyl phenol	mg/kg	0.5	-	-	-	-	-
2-nitrophenol	mg/kg	0.5	-	-	-	-	-
Phenol	mg/kg	0.5	-	-	-	-	-
2,4,6-trichlorophenol	mg/kg	0.5	-	-	-	-	-
Pentachlorophenol	mg/kg	0.5	-	-	-	-	-
4-nitrophenol	mg/kg	0.5	-	-	-	-	-

Surrogates

d5-phenol (Surrogate)	%	-	-	-	-	-	-
d5-nitrobenzene (Surrogate)	%	-	-	-	-	-	-
2-fluorobiphenyl (Surrogate)	%	-	-	-	-	-	-
2,4,6-tribromophenol (Surrogate)	%	-	-	-	-	-	-
d14-p-terphenyl (Surrogate)	%	-	-	-	-	-	-

Field pH for Acid Sulphate Soil Method: AN104

PHI	pH Units	-	-	8.3	7.6	-	-
PHfox	pH Units	-	-	3.4	5.1	-	-
Reaction*	No unit	-	-	XXX	X	-	-
pH Difference*	pH Units	-10	-	4.9	2.5	-	-

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	180	-	8	-	-
Cadmium, Cd	mg/kg	0.3	<0.3	-	<0.3	-	-
Chromium, Cr	mg/kg	0.3	17	-	6.4	-	-
Copper, Cu	mg/kg	0.5	11	-	9.3	-	-
Lead, Pb	mg/kg	1	49	-	15	-	-
Nickel, Ni	mg/kg	0.5	11	-	1.2	-	-
Zinc, Zn	mg/kg	0.5	18	-	12	-	-



ANALYTICAL REPORT

SE100700 R0

	Sample Number	SE100700.016	SE100700.017	SE100700.018	SE100700.019	SE100700.020
	Sample Matrix	Soil	Soil	Soil	Water	Soil
	Sample Date	09 Jun 2011	09 Jun 2011	09 Jun 2011	09 Jun 2011	10 Jun 2011
	Sample Name	BH6 6.0	BH6 9.5	BH6 14.0	QC03	BH10 1.1-1.3
Parameter	Units	LOR				

Full 8270 SVOC in Soil Method: AN420 (continued)
Surrogates

d5-phenol (Surrogate)	%	-	-	-	-	-	-
d5-nitrobenzene (Surrogate)	%	-	-	-	-	-	-
2-fluorobiphenyl (Surrogate)	%	-	-	-	-	-	-
2,4,6-tribromophenol (Surrogate)	%	-	-	-	-	-	-
d14-p-terphenyl (Surrogate)	%	-	-	-	-	-	-

Field pH for Acid Sulphate Soil Method: AN104

PHI	pH Units	-	7.2	5.8	-	-	-
PHIox	pH Units	-	5.9	5.1	-	-	-
Reaction*	No unit	-	XXX	XXX	-	-	-
pH Difference*	pH Units	-10	1.4	0.7	-	-	-

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	25	-	3	-	4
Cadmium, Cd	mg/kg	0.3	0.8	-	<0.3	-	<0.3
Chromium, Cr	mg/kg	0.3	13	-	13	-	11
Copper, Cu	mg/kg	0.5	1.2	-	16	-	44
Lead, Pb	mg/kg	1	12	-	12	-	280
Nickel, Ni	mg/kg	0.5	1.3	-	13	-	7.7
Zinc, Zn	mg/kg	0.5	7.9	-	22	-	72

Mercury in Soil Method: AN312

Mercury	mg/kg	0.05	<0.05	-	<0.05	-	0.13
---------	-------	------	-------	---	-------	---	------

Fibre Identification in soil Method: AN602
FibreID

Asbestos Detected	No unit	-	-	-	-	-	No
-------------------	---------	---	---	---	---	---	----

Moisture Content Method: AN234

% Moisture	%	0.5	18	24	21	-	8.9
------------	---	-----	----	----	----	---	-----

Volatile Petroleum Hydrocarbons in Water Method: AN433/AN434

TRH C6-C9	mg/L	0.04	-	-	-	<0.04	-
Benzene	µg/L	0.5	-	-	-	<0.5	-
Toluene	µg/L	0.5	-	-	-	<0.5	-
Ethylbenzene	µg/L	0.5	-	-	-	<0.5	-
m/p-xylene	µg/L	1	-	-	-	<1	-
o-xylene	µg/L	0.5	-	-	-	<0.5	-
Total BTEX*	µg/L	3	-	-	-	<3	-
Total Xylenes*	µg/L	1.5	-	-	-	<2.1	-

Surrogates

Trifluorotoluene (Surrogate)	%	-	-	-	-	78	-
Dibromofluoromethane (Surrogate)	%	-	-	-	-	-	-
d4-1,2-dichloroethane (Surrogate)	%	-	-	-	-	-	-
d8-toluene (Surrogate)	%	-	-	-	-	-	-
Bromofluorobenzene (Surrogate)	%	-	-	-	-	-	-



ANALYTICAL REPORT

SE100700 R0

Parameter	Sample Number	SE100700.021	SE100700.022	SE100700.023	SE100700.024	SE100700.025
	Sample Matrix	Soil	Soil	Soil	Soil	Soil
	Sample Date	10 Jun 2011	10 Jun 2011	10 Jun 2011	10 Jun 2011	10 Jun 2011
	Sample Name	BH10 2.0	BH10 3.0	BH10 4.0	BH10 8.0	BH12 0.5
Units						
LOR						

Full 8270 SVOC in Soil Method: AN420 (continued)
Other SVOCs

Methyl methanesulfonate	mg/kg	1	-	-	-	-	-
Ethyl methanesulfonate	mg/kg	1	-	-	-	-	-
Dibenzofuran	mg/kg	0.5	-	-	-	-	-
Benzyl alcohol	mg/kg	1	-	-	-	-	-
Safrole	mg/kg	0.5	-	-	-	-	-
Isosafrole Isomer 1	mg/kg	1	-	-	-	-	-
Isosafrole Isomer 2	mg/kg	1	-	-	-	-	-
1,4-naphthoquinone	mg/kg	0.5	-	-	-	-	-
Thionazin	mg/kg	1	-	-	-	-	-

Speciated Routine Phenols

3/4-methyl phenol (m/p-cresol)	mg/kg	1	-	-	-	-	-
2-methyl phenol (o-cresol)	mg/kg	0.5	-	-	-	-	-
2,6-dichlorophenol	mg/kg	0.5	-	-	-	-	-
2,3,4,6 and 2,3,5,6-tetrachlorophenol	mg/kg	1	-	-	-	-	-
2,4,6-trichlorophenol	mg/kg	0.5	-	-	-	-	-
4-chloro-3-methylphenol	mg/kg	1	-	-	-	-	-
2-chlorophenol	mg/kg	0.5	-	-	-	-	-
2,4-dichlorophenol	mg/kg	0.5	-	-	-	-	-
2,4-dimethyl phenol	mg/kg	0.5	-	-	-	-	-
2-nitrophenol	mg/kg	0.5	-	-	-	-	-
Phenol	mg/kg	0.5	-	-	-	-	-
2,4,6-trichlorophenol	mg/kg	0.5	-	-	-	-	-
Pentachlorophenol	mg/kg	0.5	-	-	-	-	-
4-nitrophenol	mg/kg	0.5	-	-	-	-	-

Surrogates

d5-phenol (Surrogate)	%	-	-	-	-	-	-
d5-nitrobenzene (Surrogate)	%	-	-	-	-	-	-
2-fluorobiphenyl (Surrogate)	%	-	-	-	-	-	-
2,4,6-tribromophenol (Surrogate)	%	-	-	-	-	-	-
d14-p-terphenyl (Surrogate)	%	-	-	-	-	-	-

Field pH for Acid Sulphate Soil Method: AN104

PHf	pH Units	-	-	6.8	-	6.7	-
PHlox	pH Units	-	-	6.5	-	4.9	-
Reaction*	No unit	-	-	X	-	X	-
pH Difference*	pH Units	-10	-	0.3	-	1.0	-

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	-	8	4	-	5
Cadmium, Cd	mg/kg	0.3	-	<0.3	<0.3	-	<0.3
Chromium, Cr	mg/kg	0.3	-	13	13	-	13
Copper, Cu	mg/kg	0.5	-	4.9	35	-	13
Lead, Pb	mg/kg	1	-	19	160	-	34
Nickel, Ni	mg/kg	0.5	-	1.2	4.7	-	9.3
Zinc, Zn	mg/kg	0.5	-	18	110	-	83



ANALYTICAL REPORT

SE100700 R0

Parameter	Sample Number	SE100700.026	SE100700.027	SE100700.028	SE100700.029	SE100700.030
	Sample Matrix	Soil	Soil	Soil	Soil	Soil
	Sample Date	10 Jun 2011	10 Jun 2011	10 Jun 2011	10 Jun 2011	10 Jun 2011
	Sample Name	BH12 1.0	BH12 1.5	BH12 2.0	BH12 3.0	BH12 4.5
Parameter	Units	LOR				

Full 8270 SVOC in Soil Method: AN420 (continued)

Surrogates							
d5-phenol (Surrogate)	%	-	-	85	-	-	-
d5-nitrobenzene (Surrogate)	%	-	-	88	-	-	-
2-fluorobiphenyl (Surrogate)	%	-	-	108	-	-	-
2,4,6-tribromophenol (Surrogate)	%	-	-	101	-	-	-
d14-p-terphenyl (Surrogate)	%	-	-	108	-	-	-

Field pH for Acid Sulphate Soil Method: AN104

PHf	pH Units	-	-	-	-	6.2	7.8
PHox	pH Units	-	-	-	-	4.2	2.7
Reaction*	No unit	-	-	-	-	X	XXXX
pH Difference*	pH Units	-10	-	-	-	2.1	6.2

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	<3	6	6	8	-
Cadmium, Cd	mg/kg	0.3	<0.3	0.4	<0.3	<0.3	-
Chromium, Cr	mg/kg	0.3	13	14	11	16	-
Copper, Cu	mg/kg	0.5	39	36	3.8	5.1	-
Lead, Pb	mg/kg	1	31	240	24	13	-
Nickel, Ni	mg/kg	0.5	13	7.8	1.0	1.7	-
Zinc, Zn	mg/kg	0.5	64	92	380	620	-

Mercury in Soil Method: AN312

Mercury	mg/kg	0.05	0.11	0.18	<0.05	<0.05	-
---------	-------	------	------	------	-------	-------	---

Fibre Identification in soil Method: AN602

FibreID							
Asbestos Detected	No unit	-	-	No	-	-	-

Moisture Content Method: AN234

% Moisture	%	0.5	5.5	11	20	18	21
------------	---	-----	-----	----	----	----	----

Volatile Petroleum Hydrocarbons in Water Method: AN433/AN434

TRH C6-C9	mg/L	0.04	-	-	-	-	-
Benzene	µg/L	0.5	-	-	-	-	-
Toluene	µg/L	0.5	-	-	-	-	-
Ethylbenzene	µg/L	0.5	-	-	-	-	-
m/p-xylene	µg/L	1	-	-	-	-	-
o-xylene	µg/L	0.5	-	-	-	-	-
Total BTEX*	µg/L	3	-	-	-	-	-
Total Xylenes*	µg/L	1.5	-	-	-	-	-

Surrogates							
Trifluorotoluene (Surrogate)	%	-	-	-	-	-	-
Dibromofluoromethane (Surrogate)	%	-	-	-	-	-	-
d4-1,2-dichloroethane (Surrogate)	%	-	-	-	-	-	-
d8-toluene (Surrogate)	%	-	-	-	-	-	-
Bromofluorobenzene (Surrogate)	%	-	-	-	-	-	-



ANALYTICAL REPORT

SE100711 R0

Parameter	Sample Number	SE100711.001	SE100711.002	SE100711.003	SE100711.004
	Sample Matrix	Soil	Soil	Soil	Water
	Sample Depth	2.5	5.5	-	-
	Sample Date	17 Jun 2011	17 Jun 2011	17 Jun 2011	17 Jun 2011
	Sample Name	BH14_2.5	BH14_5.5	QC	TB
	Units	LOR			

Field pH for Acid Sulphate Soil Method: AN104

PHf	pH Units	-	10.7	8.1	-	-
PHfox	pH Units	-	8.0	6.8	-	-
Reaction*	No unit	-	XXXX	XX	-	-
pH Difference*	pH Units	-10	2.7	1.3	-	-

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	7	6	6	-
Cadmium, Cd	mg/kg	0.3	0.5	0.5	<0.3	-
Chromium, Cr	mg/kg	0.3	18	14	14	-
Copper, Cu	mg/kg	0.5	120	9.4	36	-
Lead, Pb	mg/kg	1	170	19	38	-
Nickel, Ni	mg/kg	0.5	14	6.8	12	-
Zinc, Zn	mg/kg	0.5	340	130	94	-

Mercury in Soil Method: AN312

Mercury	mg/kg	0.05	1.0	0.08	0.08	-
---------	-------	------	-----	------	------	---

Fibre Identification in soil Method: AN602

FibreID

Asbestos Detected	No unit	-	No	-	-	-
-------------------	---------	---	----	---	---	---

Volatile Petroleum Hydrocarbons in Water Method: AN433/AN434

Benzene	µg/L	0.5	-	-	-	<0.5
Toluene	µg/L	0.5	-	-	-	<0.5
Ethylbenzene	µg/L	0.5	-	-	-	<0.5
m/p-xylene	µg/L	1	-	-	-	<1
o-xylene	µg/L	0.5	-	-	-	<0.5
Total BTEX*	µg/L	3	-	-	-	<3
Total Xylenes*	µg/L	1.5	-	-	-	<1.5

Surrogates

Trifluorotoluene (Surrogate)	%	-	-	-	-	78
Dibromofluoromethane (Surrogate)	%	-	-	-	-	-
d4-1,2-dichloroethane (Surrogate)	%	-	-	-	-	-
d8-toluene (Surrogate)	%	-	-	-	-	-
Bromofluorobenzene (Surrogate)	%	-	-	-	-	-

Moisture Content Method: AN234

% Moisture	%	0.5	25	24	23	-
------------	---	-----	----	----	----	---



ANALYTICAL REPORT

SE100735 R0

	Sample Number	SE100735.001	SE100735.002	SE100735.003	SE100735.004	SE100735.005
	Sample Matrix	Soil	Soil	Soil	Soil	Soil
	Sample Date	14 Jun 2011	14 Jun 2011	14 Jun 2011	15 Jun 2011	15 Jun 2011
	Sample Name	BH5_1/5-1.6	BH5_2/5-2.6	BH5_4-4.1	BH5_8.5m	BH5_14.5m
Parameter	Units	LOR				

Volatile Petroleum Hydrocarbons in Soil Method: AN433/AN434 (continued)

Surrogates

Trifluorotoluene (Surrogate)	%	-	101	-	103	-	-
Dibromofluoromethane (Surrogate)	%	-	-	-	-	-	-
d4-1,2-dichloroethane (Surrogate)	%	-	-	-	-	-	-
d8-toluene (Surrogate)	%	-	-	-	-	-	-
Bromofluorobenzene (Surrogate)	%	-	-	-	-	-	-

TRH (Total Recoverable Hydrocarbons) in Soil Method: AN403

TRH C10-C14	mg/kg	20	<20	-	<20	-	-
TRH C15-C28	mg/kg	50	<50	-	<50	-	-
TRH C29-C36	mg/kg	50	<50	-	<50	-	-

Surrogates

TRH (Surrogate)	%	-	-	-	-	-	-
-----------------	---	---	---	---	---	---	---

PAH (Polynuclear Aromatic Hydrocarbons) in Soil Method: AN420

Naphthalene	mg/kg	0.1	<0.1	-	<0.1	-	-
Acenaphthylene	mg/kg	0.1	<0.1	-	<0.1	-	-
Acenaphthene	mg/kg	0.1	<0.1	-	<0.1	-	-
Fluorene	mg/kg	0.1	<0.1	-	<0.1	-	-
Phenanthrene	mg/kg	0.1	0.2	-	<0.1	-	-
Anthracene	mg/kg	0.1	0.1	-	<0.1	-	-
Fluoranthene	mg/kg	0.1	0.5	-	<0.1	-	-
Pyrene	mg/kg	0.1	0.5	-	<0.1	-	-
Benzo(a)anthracene	mg/kg	0.1	0.2	-	<0.1	-	-
Chrysene	mg/kg	0.1	0.2	-	<0.1	-	-
Benzo(b)fluoranthene	mg/kg	0.1	0.5	-	<0.1	-	-
Benzo(k)fluoranthene	mg/kg	0.1	0.4	-	<0.1	-	-
Benzo(a)pyrene	mg/kg	0.05	0.24	-	<0.05	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	0.1	-	<0.1	-	-
Dibenzo(a&h)anthracene	mg/kg	0.1	<0.1	-	<0.1	-	-
Benzo(ghi)perylene	mg/kg	0.1	0.1	-	<0.1	-	-
Total PAH	mg/kg	1.75	2.2	-	<1.81	-	-

Surrogates

d5-nitrobenzene (Surrogate)	%	-	112	-	113	-	-
2-fluorobiphenyl (Surrogate)	%	-	109	-	108	-	-
d14-p-terphenyl (Surrogate)	%	-	83	-	84	-	-

Field pH for Acid Sulphate Soil Method: AN104

PHf	pH Units	-	-	-	-	8.3	6.2
PHfox	pH Units	-	-	-	-	2.3	6.9
Reaction*	No unit	-	-	-	-	X	X
pH Difference*	pH Units	-10	-	-	-	6.0	-0.7

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	4	-	6	-	-
Cadmium, Cd	mg/kg	0.3	<0.3	-	<0.3	-	-
Chromium, Cr	mg/kg	0.3	9.6	-	11	-	-
Copper, Cu	mg/kg	0.5	26	-	14	-	-
Lead, Pb	mg/kg	1	57	-	37	-	-
Nickel, Ni	mg/kg	0.5	13	-	5.7	-	-
Zinc, Zn	mg/kg	0.5	96	-	25	-	-



ANALYTICAL REPORT

SE100735 R0

		Sample Number	SE100735.011
		Sample Matrix	Soil
		Sample Date	16 Jun 2011
		Sample Name	BH17_8-8.1
Parameter	Units	LOR	

TRH (Total Recoverable Hydrocarbons) in Soil Method: AN403 (continued)			
Surrogates			
TRH (Surrogate)	%	-	-

PAH (Polynuclear Aromatic Hydrocarbons) in Soil Method: AN420			
Naphthalene	mg/kg	0.1	-
Acenaphthylene	mg/kg	0.1	-
Acenaphthene	mg/kg	0.1	-
Fluorene	mg/kg	0.1	-
Phenanthrene	mg/kg	0.1	-
Anthracene	mg/kg	0.1	-
Fluoranthene	mg/kg	0.1	-
Pyrene	mg/kg	0.1	-
Benzo(a)anthracene	mg/kg	0.1	-
Chrysene	mg/kg	0.1	-
Benzo(b)fluoranthene	mg/kg	0.1	-
Benzo(k)fluoranthene	mg/kg	0.1	-
Benzo(a)pyrene	mg/kg	0.05	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	-
Dibenzo(a&h)anthracene	mg/kg	0.1	-
Benzo(ghi)perylene	mg/kg	0.1	-
Total PAH	mg/kg	1.75	-

Surrogates			
d5-nitrobenzene (Surrogate)	%	-	-
2-fluorobiphenyl (Surrogate)	%	-	-
d14-p-terphenyl (Surrogate)	%	-	-

Field pH for Acid Sulphate Soil Method: AN104			
PHf	pH Units	-	7.6
PHfox	pH Units	-	3.7
Reaction*	No unit	-	XX
pH Difference*	pH Units	-10	3.8

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320			
Arsenic, As	mg/kg	3	16
Cadmium, Cd	mg/kg	0.3	0.5
Chromium, Cr	mg/kg	0.3	13
Copper, Cu	mg/kg	0.5	8.8
Lead, Pb	mg/kg	1	13
Nickel, Ni	mg/kg	0.5	2.5
Zinc, Zn	mg/kg	0.5	27

Mercury in Soil Method: AN312			
Mercury	mg/kg	0.05	<0.05

Fibre Identification in soil Method: AN602			
FibreID			
Asbestos Detected	No unit	-	-



ANALYTICAL REPORT

SE100739 R0

		Sample Number	SE100739.001	SE100739.002	SE100739.003	SE100739.004
		Sample Matrix	Soil	Soil	Soil	Soil
		Sample Date	21 Jun 2011	21 Jun 2011	21 Jun 2011	21 Jun 2011
		Sample Name	BH15_(1.0-1.1m)	BH15_(2.5-2.6m)	BH15_(4.0-4.1m)	BH15_(7.5-7.6m)
Parameter	Units	LOR				

Field pH for Acid Sulphate Soil Method: AN104

PHf	pH Units	-	-	-	8.4	7.2
PHfox	pH Units	-	-	-	8.9	8.8
Reaction*	No unit	-	-	-	XX	XX
pH Difference*	pH Units	-10	-	-	1.5	0.3

Metals in Soil by ICPOES from EPA 200.8 Digest (SYDNEY) Method: AN040/AN320

Arsenic, As	mg/kg	3	6	11	-	-
Cadmium, Cd	mg/kg	0.3	<0.3	0.5	-	-
Chromium, Cr	mg/kg	0.3	12	31	-	-
Copper, Cu	mg/kg	0.5	61	79	-	-
Lead, Pb	mg/kg	1	110	300	-	-
Nickel, Ni	mg/kg	0.5	3.7	14	-	-
Zinc, Zn	mg/kg	0.5	100	100	-	-

Mercury in Soil Method: AN312

Mercury	mg/kg	0.05	0.74	2.2	-	-
---------	-------	------	------	-----	---	---

Fibre Identification in soil Method: AN602

FibreID

Asbestos Detected	No unit	-	No	No	-	-
-------------------	---------	---	----	----	---	---

Moisture Content Method: AN234

% Moisture	%	0.5	16	32	23	16
------------	---	-----	----	----	----	----

LABORATORY REPORT COVERSHEET

Date: 8 July 2011

To: Coffey Geotechnics Pty Ltd
8/12 Mars Road
LANE COVE WEST NSW 2266

Attention: Cissilla Young

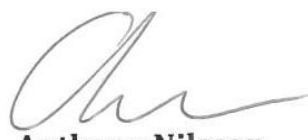
Your Reference: SE100700A - GEOTLCOV24303AA - Sydney Convention
Laboratory Report No: CE72860

Samples Received: 6/07/2011
Samples / Quantity: 3 Soils

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.



Jon Dicker
Manager
CAIRNS



Anthony Nilsson
Operations Manager
CAIRNS



CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72860

PROJECT: SE100700A - GEOTLCOV24303AA - Sydney Convention

LABORATORY REPORT

Chromium Suite - Acid Base Accounting Our Reference Your Reference Type of Sample Date Sampled	Units	CE72860-1 BH13_4.0 Soil 9/06/2011	CE72860-2 BH6_9.5 Soil 9/06/2011	CE72860-3 BH12_4.5 Soil 10/06/2011
Date Extracted		6/07/2011	6/07/2011	6/07/2011
Date Analysed		7/07/2011	7/07/2011	7/07/2011
Moisture	% w/w	26	20	7
pH KCl	pH Units	8.0	5.2	9.2
s-TAA pH 6.5	% w/w S	<0.01	0.02	<0.01
TAA pH 6.5	mole H ⁺ /t	<5	11	<5
Chromium Reducible Sulfur (SCR)	% w/w	0.92	<0.005	0.028
a-Chromium Reducible Sulfur	mole H ⁺ / t	570	<5	17
SHCl	% w/w	NA	NA	NA
S KCl	% w/w	NA	NA	NA
S NAS	% w/w	NA	NA	NA
Acid Neutralisation Capacity ANCBT	% CaCO ₃	0.8	NA	NA
s-ANCBT	% w/w S	0.26	NA	NA
a-ANCBT	mole H ⁺ / t	160	NA	NA
s-Net Acidity	% w/w S	0.74	0.02	0.03
a-Net Acidity	mole H ⁺ /t	460	12	16
Liming Rate	kg CaCO ₃ /tonne	35	NA	NA
Verification s-Net Acidity	% w/w S	0.74	NA	NA
a-Net Acidity without ANC	mole H ⁺ /t	570	12	16
Liming Rate without ANC	kg CaCO ₃ /tonne	43	NA	NA



CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72860

PROJECT: SE100700A - GEOTLCOV24303AA - Sydney Convention

LABORATORY REPORT

TEST PARAMETERS	UNITS	LOR	METHOD
Chromium Suite - Acid Base Accounting			
Date Extracted			
Date Analysed			
Moisture	% w/w	0.1	AN002 RL2A1
pH _{KCl}	pH Units	0.1	AS4969.2 / AN219
s-TAA pH 6.5	% w/w S	0.01	AS4969.2 / AN219
TAA pH 6.5	mole H ⁺ /t	5	AS4969.2 / AN219
Chromium Reducible Sulfur (SCR)	% w/w	0.005	AS4969.7
a-Chromium Reducible Sulfur	mole H ⁺ / t	5	AS4969.7
SHCl	% w/w	0.005	AS4969.8 / AN014
S _{KCl}	% w/w	0.005	AS4969.4
S _{NAS}	% w/w	0.005	AS4969.11
Acid Neutralisation Capacity ANCBT	% CaCO ₃	0.1	AN214
s-ANCBT	% w/w S	0.01	AS4969.13 / AN214
a-ANCBT	mole H ⁺ / t	5	AS4969.13 / AN214
s-Net Acidity	% w/w S	0.01	Calculation
a-Net Acidity	mole H ⁺ /t	5	Calculation
Liming Rate	kg CaCO ₃ /tonne	0.1	AS4969.14 / AN220
Verification s-Net Acidity	% w/w S		Calculation
a-Net Acidity without ANC	mole H ⁺ /t	5	Calculation
Liming Rate without ANC	kg CaCO ₃ /tonne	0.1	ASSMAC_23H



CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72860

PROJECT: SE100700A - GEOTLCOV24303AA - Sydney Convention

LABORATORY REPORT

QUALITY CONTROL	UNITS	Blank	Duplicate Sm#	Duplicate Sample Duplicate	Spike	CMS Recovery
Date Extracted		-	CE72860-1	6/07/2011 6/07/2011	Batch Spike	-
Date Analysed		-	CE72860-1	7/07/2011 7/07/2011	Batch Spike	-
Moisture	% w/w	-	CE72860-1	26 [N/T]	Batch Spike	-
pH _{KCl}	pH Units	5.8	CE72860-1	8.0 8.1 RPD: 1	Batch Spike	-
s-TAA pH 6.5	% w/w S	-	CE72860-1	<0.01 <0.01	Batch Spike	-
TAA pH 6.5	mole H ⁺ /t	-	CE72860-1	<5 <5	Batch Spike	93%
Chromium Reducible Sulfur (SCR)	% w/w	-	CE72860-1	0.92 0.86 RPD: 7	Batch Spike	105%
a-Chromium Reducible Sulfur	mole H ⁺ / t	-	CE72860-1	570 540 RPD: 5	Batch Spike	-
SHCl	% w/w	-	CE72860-1	NA NA	Batch Spike	-
S _{KCl}	% w/w	-	CE72860-1	NA NA	Batch Spike	-
S _{NAS}	% w/w	-	CE72860-1	NA NA	Batch Spike	-
Acid Neutralisation Capacity ANCBT	% CaCO ₃	-	CE72860-1	0.8 0.94 RPD: 16	Batch Spike	-
s-ANCBT	% w/w S	-	CE72860-1	0.26 0.30 RPD: 14	Batch Spike	-
a-ANCBT	mole H ⁺ / t	-	CE72860-1	160 190 RPD: 17	Batch Spike	-
s-Net Acidity	% w/w S	-	CE72860-1	0.74 0.66 RPD: 11	Batch Spike	-
a-Net Acidity	mole H ⁺ /t	-	CE72860-1	460 410 RPD: 11	Batch Spike	-
Liming Rate	kg CaCO ₃ /tonne	-	CE72860-1	35 31 RPD: 12	Batch Spike	-
Verification s-Net Acidity	% w/w S	-	CE72860-1	0.74 0.66 RPD: 11	Batch Spike	-
a-Net Acidity without ANC	mole H ⁺ /t	-	CE72860-1	570 530 RPD: 7	Batch Spike	-
Liming Rate without ANC	kg CaCO ₃ /tonne	-	CE72860-1	43 40 RPD: 7	Batch Spike	-

CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72860

PROJECT: SE100700A - GEOTLCOV24303AA - Sydney Convention

LABORATORY REPORT

NOTES:

LOR - Limit of Reporting.

The significance of all reported results are defined by their analytical limit of reporting.

Liming rate calculated using a Fineness factor of 1.5 (which is equivalent to finely divided Ag Lime <0.5mm) and Neutralising Value (NV) of 100%

If using Liming Material <100% NV, then Liming Rate can be adjusted as follows:

Actual Liming Rate equals Calculated Liming Rate times 100 divided by NV of actual Liming Material

Bulk Density of Material of 1g/cm³ assumed.

If Bulk Density differs from 1g/cm³ then Liming rate can be adjusted as follows:

Actual Liming Rate equals Calculated Liming Rate times Actual Bulk Density

Geneva Legal Comment

This document is issued by the Company subject to its General Conditions of Service (www.sgs.com/terms_and_conditions.htm).

Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein.

This document is to be treated as an original within the meaning of UCP 600. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

ISO 17025

Unless otherwise stated the results shown in this test report only refer to the sample(s) tested and such sample(s) are only retained for 60 days only. This document cannot be reproduced except in full, without prior approval of the Company.

Analysis Date: Between 6/07/11 and 8/07/11

Disclaimer:

SGS and the authors have prepared this document in good faith, consulting with Ahern CR, McElnea AE, Sullivan LA (2004)

Acid Sulphate Soils Laboratory Methods Guidelines,

Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Qld Aust.

While this is done exercising all due care and attention, no representation or warranty, expressed or implied is made as to the accuracy, completeness or fitness of the document in respect of any user's circumstances.

Users of the results or data should seek appropriate expert advice where necessary in relation to their particular situation or circumstances.

Any representation, statement, opinion or advice, expressed or implied on this publication is made in good faith and on the basis that SGS, its agents and employees are not liable to any person taking or not taking (as the case may be) action in respect of any representation, statement or advice referred to above.

SGS Terms and Conditions are available from www.au.sgs.com

Page 5 of 5

LABORATORY REPORT COVERSHEET

Date: 8 July 2011

To: Coffey Geotechnics Pty Ltd
8/12 Mars Road
LANE COVE WEST NSW 2266

Attention: Cissillia Young

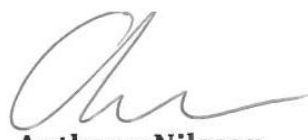
Your Reference: SE100711A - GEOTLCOV24303AA - Sydney Entertainment
Laboratory Report No: CE72861

Samples Received: 6/07/2011
Samples / Quantity: 1 Soil

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.



Jon Dicker
Manager
CAIRNS



Anthony Nilsson
Operations Manager
CAIRNS

CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72861

PROJECT: SE100711A - GEOTLCOV24303AA - Sydney Entertainment

LABORATORY REPORT

Chromium Suite - Acid Base Accounting Our Reference Your Reference Type of Sample Date Sampled	Units	CE72861-1 BH14_2.5 Soil 17/06/2011
Date Extracted		6/07/2011
Date Analysed		7/07/2011
Moisture	% w/w	19
pH KCl	pH Units	8.6
s-TAA pH 6.5	% w/w S	<0.01
TAA pH 6.5	mole H ⁺ /t	<5
Chromium Reducible Sulfur (SCR)	% w/w	0.013
a-Chromium Reducible Sulfur	mole H ⁺ / t	8.0
SHCl	% w/w	NA
S KCl	% w/w	NA
S NAS	% w/w	NA
Acid Neutralisation Capacity ANCBT	% CaCO ₃	NA
s-ANCBT	% w/w S	NA
a-ANCBT	mole H ⁺ / t	NA
s-Net Acidity	% w/w S	0.01
a-Net Acidity	mole H ⁺ /t	6.7
Liming Rate	kg CaCO ₃ /tonne	NA
Verification s-Net Acidity	% w/w S	NA
a-Net Acidity without ANC	mole H ⁺ /t	6.7
Liming Rate without ANC	kg CaCO ₃ /tonne	NA



CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72861

PROJECT: SE100711A - GEOTLCOV24303AA - Sydney Entertainment

LABORATORY REPORT

TEST PARAMETERS	UNITS	LOR	METHOD
Chromium Suite - Acid Base Accounting			
Date Extracted			
Date Analysed			
Moisture	% w/w	0.1	AN002 RL2A1
pH _{KCl}	pH Units	0.1	AS4969.2 / AN219
s-TAA pH 6.5	% w/w S	0.01	AS4969.2 / AN219
TAA pH 6.5	mole H ⁺ /t	5	AS4969.2 / AN219
Chromium Reducible Sulfur (SCR)	% w/w	0.005	AS4969.7
a-Chromium Reducible Sulfur	mole H ⁺ / t	5	AS4969.7
SHCl	% w/w	0.005	AS4969.8 / AN014
S _{KCl}	% w/w	0.005	AS4969.4
S _{NAS}	% w/w	0.005	AS4969.11
Acid Neutralisation Capacity ANCBT	% CaCO ₃	0.1	AN214
s-ANCBT	% w/w S	0.01	AS4969.13 / AN214
a-ANCBT	mole H ⁺ / t	5	AS4969.13 / AN214
s-Net Acidity	% w/w S	0.01	Calculation
a-Net Acidity	mole H ⁺ /t	5	Calculation
Liming Rate	kg CaCO ₃ /tonne	0.1	AS4969.14 / AN220
Verification s-Net Acidity	% w/w S		Calculation
a-Net Acidity without ANC	mole H ⁺ /t	5	Calculation
Liming Rate without ANC	kg CaCO ₃ /tonne	0.1	ASSMAC_23H

CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72861

PROJECT: SE100711A - GEOTLCOV24303AA - Sydney Entertainment

LABORATORY REPORT

NOTES:

LOR - Limit of Reporting.

The significance of all reported results are defined by their analytical limit of reporting.

Liming rate calculated using a Fineness factor of 1.5 (which is equivalent to finely divided Ag Lime <0.5mm) and Neutralising Value (NV) of 100%

If using Liming Material <100% NV, then Liming Rate can be adjusted as follows:

Actual Liming Rate equals Calculated Liming Rate times 100 divided by NV of actual Liming Material

Bulk Density of Material of 1g/cm³ assumed.

If Bulk Density differs from 1g/cm³ then Liming rate can be adjusted as follows:

Actual Liming Rate equals Calculated Liming Rate times Actual Bulk Density

Geneva Legal Comment

This document is issued by the Company subject to its General Conditions of Service (www.sgs.com/terms_and_conditions.htm).

Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein.

This document is to be treated as an original within the meaning of UCP 600. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of client's instructions, if any.

The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

ISO 17025

Unless otherwise stated the results shown in this test report only refer to the sample(s) tested and such sample(s) are only retained for 60 days only. This document cannot be reproduced except in full, without prior approval of the Company.

Analysis Date: Between 6/07/11 and 8/07/11

Disclaimer:

SGS and the authors have prepared this document in good faith, consulting with Ahern CR, McElnea AE, Sullivan LA (2004)

Acid Sulphate Soils Laboratory Methods Guidelines,

Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Qld Aust.

While this is done exercising all due care and attention, no representation or warranty, expressed or implied is made as to the accuracy, completeness or fitness of the document in respect of any user's circumstances.

Users of the results or data should seek appropriate expert advice where necessary in relation to their particular situation or circumstances.

Any representation, statement, opinion or advice, expressed or implied on this publication is made in good faith and on the basis that SGS, its agents and employees are not liable to any person taking or not taking (as the case may be) action in respect of any representation, statement or advice referred to above.

SGS Terms and Conditions are available from www.au.sgs.com

LABORATORY REPORT COVERSHEET

Date: 8 July 2011

To: Coffey Geotechnics Pty Ltd
8/12 Mars Road
LANE COVE WEST NSW 2266

Attention: Cissillia Young

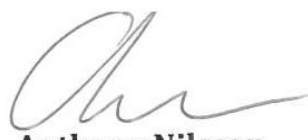
Your Reference: SE100735A - GEOTLCOV24303AA - SMCEC
Laboratory Report No: CE72862

Samples Received: 6/07/2011
Samples / Quantity: 2 Soils

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.



Jon Dicker
Manager
CAIRNS



Anthony Nilsson
Operations Manager
CAIRNS



CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72862

PROJECT: SE100735A - GEOTLCOV24303AA - SMCEC

LABORATORY REPORT

Chromium Suite - Acid Base Accounting Our Reference Your Reference Type of Sample Date Sampled	Units	CE72862-1 BH5_8.5 Soil 15/06/2011	CE72862-2 BH17_5.0-5.1 Soil 16/06/2011
Date Extracted		6/07/2011	6/07/2011
Date Analysed		7/07/2011	7/07/2011
Moisture	% w/w	17	19
pH KCl	pH Units	7.5	7.3
s-TAA pH 6.5	% w/w S	<0.01	<0.01
TAA pH 6.5	mole H ⁺ /t	<5	<5
Chromium Reducible Sulfur (SCR)	% w/w	<0.005	0.066
a-Chromium Reducible Sulfur	mole H ⁺ / t	<5	41
SHCl	% w/w	NA	NA
S KCl	% w/w	NA	NA
S NAS	% w/w	NA	NA
Acid Neutralisation Capacity ANCBT	% CaCO ₃	NA	0.2
s-ANCBT	% w/w S	NA	0.06
a-ANCBT	mole H ⁺ / t	NA	37
s-Net Acidity	% w/w S	<0.01	0.02
a-Net Acidity	mole H ⁺ /t	<5	15
Liming Rate	kg CaCO ₃ /tonne	NA	NA
Verification s-Net Acidity	% w/w S	NA	0.03
a-Net Acidity without ANC	mole H ⁺ /t	<5	40
Liming Rate without ANC	kg CaCO ₃ /tonne	NA	3.0



CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72862

PROJECT: SE100735A - GEOTLCOV24303AA - SMCEC

LABORATORY REPORT

TEST PARAMETERS	UNITS	LOR	METHOD
Chromium Suite - Acid Base Accounting			
Date Extracted			
Date Analysed			
Moisture	% w/w	0.1	AN002 RL2A1
pH _{KCl}	pH Units	0.1	AS4969.2 / AN219
s-TAA pH 6.5	% w/w S	0.01	AS4969.2 / AN219
TAA pH 6.5	mole H ⁺ /t	5	AS4969.2 / AN219
Chromium Reducible Sulfur (SCR)	% w/w	0.005	AS4969.7
a-Chromium Reducible Sulfur	mole H ⁺ / t	5	AS4969.7
SHCl	% w/w	0.005	AS4969.8 / AN014
S _{KCl}	% w/w	0.005	AS4969.4
S _{NAS}	% w/w	0.005	AS4969.11
Acid Neutralisation Capacity ANCBT	% CaCO ₃	0.1	AN214
s-ANCBT	% w/w S	0.01	AS4969.13 / AN214
a-ANCBT	mole H ⁺ / t	5	AS4969.13 / AN214
s-Net Acidity	% w/w S	0.01	Calculation
a-Net Acidity	mole H ⁺ /t	5	Calculation
Liming Rate	kg CaCO ₃ /tonne	0.1	AS4969.14 / AN220
Verification s-Net Acidity	% w/w S		Calculation
a-Net Acidity without ANC	mole H ⁺ /t	5	Calculation
Liming Rate without ANC	kg CaCO ₃ /tonne	0.1	ASSMAC_23H

CLIENT: Coffey Geotechnics Pty Ltd

Laboratory Report No: CE72862

PROJECT: SE100735A - GEOTLCOV24303AA - SMCEC

LABORATORY REPORT

NOTES:

LOR - Limit of Reporting.

The significance of all reported results are defined by their analytical limit of reporting.

Liming rate calculated using a Fineness factor of 1.5 (which is equivalent to finely divided Ag Lime <0.5mm) and Neutralising Value (NV) of 100%

If using Liming Material <100% NV, then Liming Rate can be adjusted as follows:

Actual Liming Rate equals Calculated Liming Rate times 100 divided by NV of actual Liming Material

Bulk Density of Material of 1g/cm³ assumed.

If Bulk Density differs from 1g/cm³ then Liming rate can be adjusted as follows:

Actual Liming Rate equals Calculated Liming Rate times Actual Bulk Density

Geneva Legal Comment

This document is issued by the Company subject to its General Conditions of Service (www.sgs.com/terms_and_conditions.htm).

Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein.

This document is to be treated as an original within the meaning of UCP 600. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

ISO 17025

Unless otherwise stated the results shown in this test report only refer to the sample(s) tested and such sample(s) are only retained for 60 days only. This document cannot be reproduced except in full, without prior approval of the Company.

Analysis Date: Between 6/07/11 and 8/07/11

Disclaimer:

SGS and the authors have prepared this document in good faith, consulting with Ahern CR, McElnea AE, Sullivan LA (2004)

Acid Sulphate Soils Laboratory Methods Guidelines,

Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Qld Aust.

While this is done exercising all due care and attention, no representation or warranty, expressed or implied is made as to the accuracy, completeness or fitness of the document in respect of any user's circumstances.

Users of the results or data should seek appropriate expert advice where necessary in relation to their particular situation or circumstances.

Any representation, statement, opinion or advice, expressed or implied on this publication is made in good faith and on the basis that SGS, its agents and employees are not liable to any person taking or not taking (as the case may be) action in respect of any representation, statement or advice referred to above.

SGS Terms and Conditions are available from www.au.sgs.com

Page 4 of 4

Appendix C

Information from Dear et al (2002)

**Acid Sulfate Soil Assessment and Preliminary Management Plan
Haymarket Precinct, Darling Harbour, Sydney NSW**

The guard layer should be employed as a precaution to neutralise acidity that has not been adequately treated during the soil neutralisation process.

The rate of neutralising agent used in the guard layer will depend on the final treatment pile height, existing and potential acidity of the sediments, and the soil texture. The rate may need to be increased where the receiving environmental values warrant higher protection. The rate may also need to be increased to enable a neutralising agent to be incorporated in situations where significant delays occur in drying soils due to soil texture or climatic conditions.

Note: Reapplication of the guard layer may be necessary under temporary treatment pads, if the guard layer is disturbed or removed with the treated soil.

Soil treatment

Soils may be neutralised on a temporary treatment pad or alternatively the soils may be neutralised as they are placed permanently. Essentially, treatment of the soils is the same process whether it is performed on a temporary treatment pad, or on a treatment pad in their permanent location. Treating soils on a temporary treatment pad may promote better mixing of the neutralising agent with the soil as the soils and agent may be further mixed as they are moved. However, there is the added expense of double handling of the soil.

Acid sulfate soil material should be placed on top of the guard layer in 150 to 300 mm thick layers on the treatment pad, to allow drying. The appropriate amount of neutralising agent, including the calculated safety factor should be spread once the ASS are sufficiently dry. The ASS may require reworking several times to achieve adequate mixing of the neutralising agent and/or drying of the soil. The treated layer will require Phase 3 sampling (ie. verification analysis) to confirm whether appropriate amounts of the neutralising agent have been incorporated into the soil, which should be subsequently compacted before treatment of the next layer commences, or when moved to the permanent placement area if initially mixed on temporary treatment pads.

ASS Tip 16 – Depth of soil

If wet materials are being placed, shrinkage may be allowed for. To allow for shrinkage, layers of greater depth may be initially placed.

Ultimately it is up to the contractor to ensure that they have appropriate equipment to incorporate the neutralising agent to the depth of fill.

Guard layers may need to be applied between each compacted ASS layer as a precaution in environmentally sensitive areas, areas with high levels of sulfides or where soils are difficult to mix.

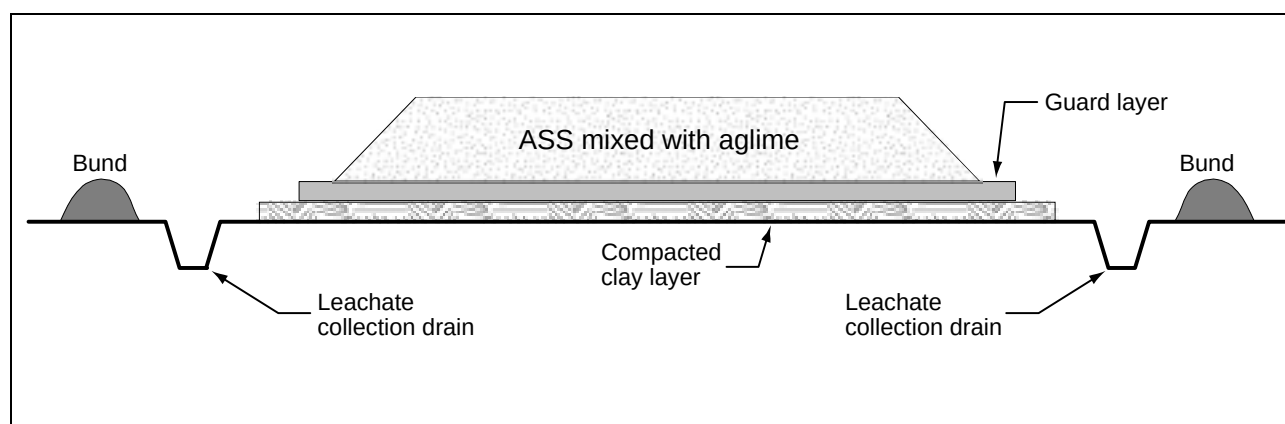


Figure 4. Schematic cross-section of a treatment pad, including a compacted clay layer, guard layer, leachate collection system and containment with bunding.

11.1.2 Management considerations

Stockpiling untreated ASS should be minimised by preparing a detailed earthworks strategy that documents the timing of soil volumes to be moved, treatment locations and capacity of those areas to accept materials. Stockpiling may mean double-handling and increased earthmoving costs. It is important to account for risk from wet weather and plan for other contingencies.

Short-term stockpiles

The recommended maximum time period for which soils can be temporarily stockpiled without treatment is detailed in Table 4.

Table 4. Indicative maximum periods for short-term stockpiling of untreated ASS.

Type of Material		Duration of stockpiling	
Texture range (McDonald <i>et al.</i> 1990)	Approx clay content (%)	Days	Hours
<i>Coarse texture</i> Sands to loamy sands	≤5	Overnight	18 hours
<i>Medium texture</i> Sandy loams to light clays	5–40	2½ days	70 hours
<i>Fine texture</i> Medium to heavy clays and silty clays	≥40	5 days	140 hours

At some sites these figures may be too conservative, and in some circumstances not conservative enough (eg. during hot weather some sands may begin to oxidise within a matter of hours). It is recommended that appropriate operational delay times be determined (preferably well prior to the creation of the stockpile) for the specific circumstances. The use of a guard layer under the short-term stockpiles may be warranted under certain circumstances.

The total volume of material that is placed in short-term stockpiles should not exceed 20% of a day's total extraction.

Note: These timeframes do not apply to monosulfidic black oozes. These materials should not be stockpiled without a risk assessment, and the implementation of strict environmental management protocols.

Medium-term stockpiles

Situations where it is necessary to stockpile untreated ASS for moderate periods will need to be justified to the relevant administering agency. Management to reduce the oxidation of sulfides and the collection and treatment of all leachate and runoff water will need to be implemented during the stockpiling period. The maximum time period for which soils can be temporarily stockpiled in the medium-term is listed in Table 5.

Table 5. Indicative maximum periods for medium-term stockpiling of untreated ASS.

Type of Material		Duration of stockpiling	
Texture range (McDonald <i>et al.</i> 1990)	Approx clay content (%)	Days	Weeks
<i>Coarse texture</i> Sands to loamy sands	≤5	14 days	2 weeks
<i>Medium texture</i> Sandy loams to light clays	5–40	21 days	3 weeks
<i>Fine texture</i> Medium to heavy clays & silty clays	≥40	28 days	4 weeks