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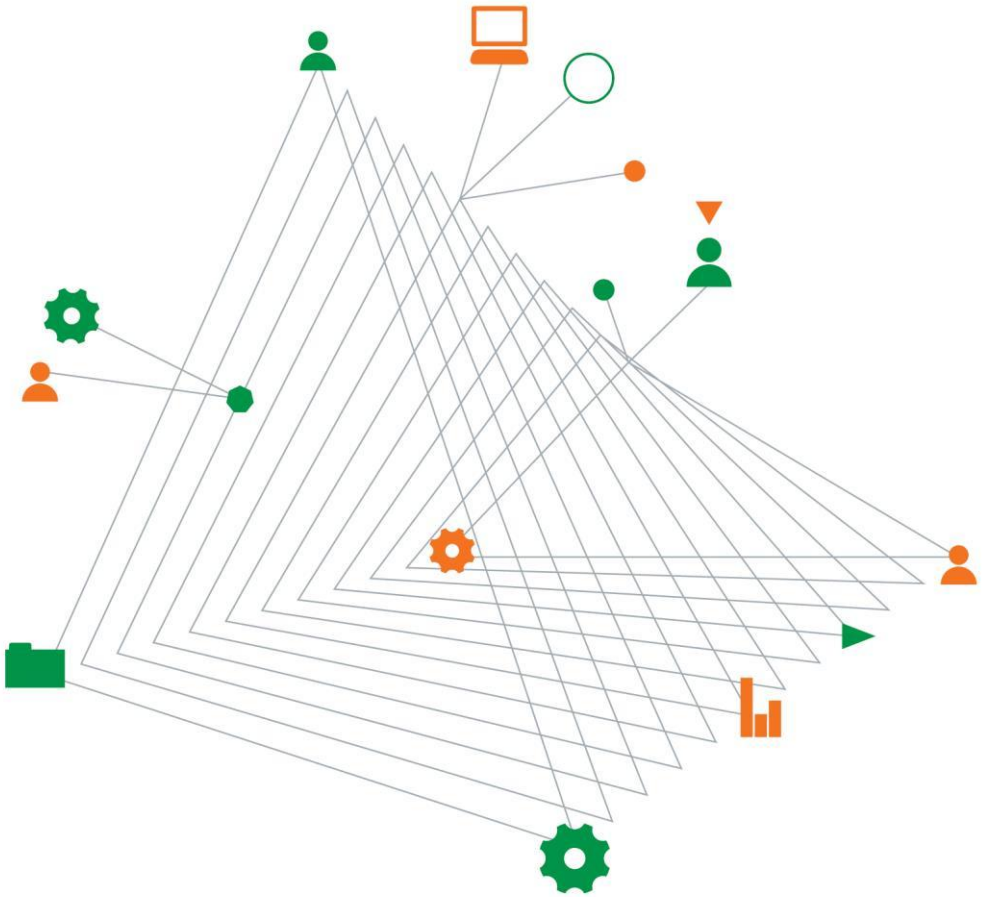
Lend Lease Building Pty Ltd

University of Sydney Health Precinct Blackburn Building (D06), Dangerous Goods Store (D15) and Proposed Shared Pedestrian & Vehicular Pathway Camperdown, NSW

Geotechnical Investigation

20 January 2017



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Geotechnical Investigation – USYD Health Precinct, Blackburn Building (D06), Dangerous Goods Store (D15) and Proposed Shared Pedestrian Pathway, Camperdown, NSW

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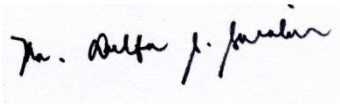

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Table of contents

Important information about your Coffey Report

Tables

Figures

Appendices

1. Introduction

This draft report presents the results of a geotechnical investigation carried out by Coffey for the proposed redevelopment of the Blackburn Building located at the Health Precinct within the University of Sydney – Camperdown Campus, NSW. The investigation was commissioned by Lend Lease Building Pty Ltd (LLB) and was carried out in general accordance with our proposals GEOTLCOV25283AF-AA, dated 30 September 2016 and GEOTLCOV25283AF-AB, dated 6 October 2016.

We understand that the proposed redevelopment will include:

- The demolition of the existing Blackburn Building (D06) and Dangerous Goods Store (D15)
- Redevelopment of the Blackburn Building site with a building likely to be slightly larger in footprint (nominally 60m to 70m square) and up to 38m high, with possibly basement levels up to about 6m below general current outside ground level.
- Construction of a shared pedestrian and vehicular access road between the Dangerous Goods Store (D15) and University Oval No. 1.

The objective of the geotechnical investigation was to provide geotechnical data to support the application and approval process and assist design development for the basement retention system, pavements and building foundations. At the time of our investigation, no architectural plans had been provided.

This report also presents structural assessment to assist vibration management during demolition of the existing Blackburn Building.

In conjunction with this geotechnical investigation, a contamination assessment was also carried out by Coffey. The findings from the contamination assessment are presented in a separate report. Some of the test locations described in Section 2.1 were for both geotechnical and environmental sampling.

2. Method of investigation

2.1. Borehole drilling

Borehole drilling for the geotechnical investigation was carried out between 14 and 22 November 2016 and comprised the drilling of six boreholes (BH1 to BH6). These boreholes were drilled to depths ranging from 10.4 m to 12.3 m (RL between about 10m and 12m AHD) below the existing ground surface (RL 21.7m to 21.9m AHD).

Eight shallow hand augered boreholes (HA01 to HA08), mainly for contamination purposes, were drilled to maximum depth of 1.0 m below the existing ground surface. These were located around the Dangerous Goods Store and proposed alignment for the shared access way.

The borehole locations were measured from existing site features and the reduced levels were interpolated from a supplied survey drawing. Figure 1 shows the borehole locations.

BH1 to BH6 were drilled using either a truck or a track mounted drilling rig and were advanced using hand auger for the top 1 m depth and using solid flight augers with a Tungsten Carbide (TC) drill bit in soils and weathered bedrock. Standard Penetration Testing (SPT) was carried out in soil at selected depth intervals to assess soil strength and to obtain samples for logging. Soil samples for environmental purposes were also collected at selected intervals. Once low strength rock was encountered, NMLC coring method was used to core the rock.

On completion, boreholes were backfilled with cuttings and capped with concrete except for BH2, BH4 and BH6 where groundwater monitoring wells were installed.

Fieldwork was observed by a Coffey Geotechnical Engineer who was present throughout the drilling operations to undertake sampling and testing, record test results, and log materials encountered.

2.2. Groundwater sampling and monitoring

In each of BH2, BH4 and BH6, a groundwater monitoring well was installed. The screened section of the well is located at the bottom 6 m for BH2 well and 9 m for BH4 and BH6 wells. The wells were finished with a gatic cover flush with surrounding ground levels.

On 22 November 2016, a groundwater sample was collected from the BH6 well for contamination testing. The results of the groundwater testing will be presented in the final contamination assessment report for the site.

Data loggers are to be installed in each well to enable ongoing groundwater level measurements. Once groundwater monitoring is completed at about end January 2017, a groundwater assessment report will be prepared to provide advice on the groundwater impact with respect to basement design.

2.3. Laboratory testing

The following laboratory tests were carried out on selected soil and rock samples:

- Five natural moisture content tests;
- Four pH, sulphate and chloride tests;
- Two particle size distribution;
- Five Atterberg limits and linear shrinkage test; and
- Point Load Strength Index Tests on rock cores at about 1 m intervals.

3. Results of investigation

3.1. Site description

The site is located within the Health Precinct of the University of Sydney – Camperdown Campus, NSW, which is at the western part of the campus.

At the time of our investigation, the site was occupied by a 5-storey Blackburn Building with an area of about 60 m square. RPA Hospital is located to the west, No. 1 Oval to the north and Bosch Building to the south and Blackburn Circuit to the east. A single storey Dangerous Good Store (about 25 m^2) is located near the north eastern corner of the Blackburn Building, adjacent to No.1 Oval.

At the location of the proposed shared pedestrian and vehicular access road between the Dangerous Goods Store (D15) and University Oval No. 1, the area is currently used as a walkway, paved (asphalt and pavers) and unpaved. Eastern part of the area is covered with vegetation.

Within the vicinity of the Blackburn Building, the ground surface is generally flat except at the southern end where there is a ramp down to a partial basement level. The ground surface generally rises gradually in all directions away from the current building.

3.2. Local geology and desk study

The Sydney 1:100,000 Geological Sheet indicates that the locality is underlain by Ashfield Shale described as typically black to dark grey shale and laminite. The Ashfield Shale is the lowermost unit of the Wianamatta Group, underlain by the Mittagong Formation and Hawkesbury Sandstone.

The Sydney 1:100,000 Soil Landscape Map indicates that the locality is within the "Blacktown" soil landscape described as gently undulating rises on Wianamatta Group shales. Soils are shallow to moderately deep on crests, upper slopes and well drained areas while deep on lower slopes and in areas of poor drainage. Potential issues for development on this soil unit include moderately reactive highly plastic subsoil and poor soil drainage.

LLB provided Coffey with geotechnical information that included:

1. Douglas Partners report dated 2003 (ECHTEC building) involving two cored boreholes to the south east of the Blackburn Building

2. Douglas Partners desk study report dated 2015 for the Health Precinct, which summarises geotechnical and contamination investigations within an area bounded by No.1 Oval, RPA Hospital, Wesley college and St Andrew's College

3. JK Geotechnics report dated 2016 for Infrastructure Augmentation Works which includes 4 boreholes within about 100 m of the Blackburn Building.

Whilst the ground conditions reported in each of these documents vary, the general ground profile evident from these reports is about 3 m depth of clay (fill and natural soil), underlain by about 5 m thickness of extremely/distinctly weathered, very low/low strength shale/siltstone, grading to medium or high strength shale/siltstone.

Groundwater conditions reported are variable but the indication is that the groundwater table is about 6 m depth or below, but with localised seepage in the soil and weathered rock above this depth.

3.3. Encountered geotechnical conditions

3.3.1. Blackburn Site

The Coffey engineering borehole logs and rock core photographs are presented in Appendix A, together with explanation sheets which describe the terms and symbols used in the logs. An interpreted cross sections on a north-west to south-east diagonal through the site is presented in Figure 2.

The site is generally underlain by fill, residual soil and shale bedrock. Table 1 below shows a summary of the geotechnical conditions encountered in the boreholes around the Blackburn Building footprint.

Table 1: Inferred geotechnical model – Blackburn site

Unit	Material/Origin	Description	Approximate Thickness [2] (m)	Depth[2] to Top of Unit (m)	Level[2] to Top of Unit (m AHD)
1	Fill[1]	Asphalt 50 mm thick over Clayey Gravelly Sand, Gravelly Sandy Clay	0.7 to 2.2	Surface	21.7 to 21.9
2	Residual Soil	Clay, some low to medium plasticity over generally medium to high plasticity, stiff to hard.	2.0 to 5.2	0.7 to 2.2	19.7 to 21.2
3	Bedrock	Class V/IV Shale[3,4] extremely to moderately weathered, generally very low to low strength with occasional medium strength bands	1.8 to 4.0	4.0 to 6.6	15.1 to 17.9
4	Bedrock	Class III Shale[3,4] moderately weathered to fresh, generally medium strength, with some high strength.	Not Penetrated	6.0 to 8.9	13.0 to 15.7

Notes:

1. Fill thicknesses and composition could be variable.
2. The depth and layer thicknesses are based on subsurface conditions observed at the borehole locations and may not be representative of all areas of the site.
3. Rock classification per Pells et al (1998) “Foundations on Sandstone and Shale in the Sydney Region” (Aust. Geomech. Jnl, Dec 1998). This classification is generalised to model average conditions of rock strength and defects interpreted from the boreholes.
4. The rock is broadly classified as shale, but also comprises interbedded laminite and siltstone. Although generally medium strength, the shale is classified as Class III based on defect frequency.

The geotechnical section in Figure 2 suggests a general fall in Units 3 and 4 to the north-west at about 2%.

The geotechnical conditions at the Blackburn site are generally consistent with the general ground model developed during the desk study and with the rock strength and defects (and of the variability of both) detected in nearby cored boreholes by JK Geotechnics.

3.3.2. Shared accessway

At the location of the proposed shared pedestrian and vehicular access road where shallow hand augered boreholes were drilled, subsurface conditions comprise fill and/topsoil (Unit 1) to about 0.1 m to 1.0 m depth over residual soil (Unit 2) of generally low to medium plasticity.

The previous investigation in this area generally indicated similar conditions where fill overlies residual soil.

3.4. Groundwater

During drilling seepage was encountered only at the Unit 2/Unit 3 interface in BH3.

After drilling had been completed groundwater was measured in BH6 at 6.4 m below the ground surface (RL 15.5 m AHD), which is generally consistent with desk study information. This level is typically in the Unit 3 weathered shale.

On-going groundwater monitoring is currently underway. Once monitoring is completed and the results are available, a separate groundwater investigation report (Ref: GEOTLCOV25283AF-AF) will be provided.

3.5. Laboratory testing results

3.5.1. Geotechnical Testing

Appendix B contains laboratory test certificates. The particle size distribution test carried out on sample from BH4 1.5 m to 1.95 m (Unit 2 Residual Soil) indicated 82% silt and clay particles. The sample from BH3 4.5 m to 4.95m located at the lower layer of Unit 2 Residual Soil and described as shaley clay indicated 28% silt and clay particles and 48% gravels. The high percentage of fines grained soil is consistent with low permeability.

The Atterberg Limits test results for samples taken from Unit 2 Residual Soil and at the Blackburn Building area indicate medium plasticity while the samples from the proposed shared pedestrian and vehicular access road and within Unit 2 Residual Soil indicate low to medium plasticity. These results are generally lower plasticity than typically associated with the Blacktown soil landscape.

No Atterberg Limits test was conducted on residual soils from the previous investigations. The borehole logs described the residual soil as medium to high plasticity.

3.5.2. Soil aggressivity

Chemical testing (pH, Sulphate and Chloride) was undertaken on four samples within Unit 2 Residual Soil to aid in the assessment of aggressivity to concrete and steel structures. The test result certificates are presented in Appendix B and summarised below.

- pH value of 4.4 to 5.3;
- Chloride levels <10 mg/kg to 39; and
- Sulphate concentrations of 100 mg/kg to 250 mg/kg.

4. Discussion and recommendations

4.1. Proposed development

The proposed redevelopment of the Blackburn Building site will include the demolition of the existing building and construction of a new building likely to be slightly larger in footprint (nominally 60m to 70m square) and up to 38m high, with basement levels about 6 m deep (about RL 16mAHD).

4.2. Excavation conditions

Excavation contractors should be provided with the borehole logs and be required to make their own assessment of the suitability and productivity of particular excavation plant.

Based on basement excavation to 6 m below existing ground level, excavations will penetrate Unit 1 Fill, Unit 2 Residual Soil and some Unit 3 Shale. Excavation of these materials would typically be possible with conventional earthmoving plant such as tracked excavators with rock teeth or wheeled or tracked loaders. Localised higher strength rock conditions could occur, requiring more robust plant.

4.3. Temporary unsupported batters

For temporary excavations above groundwater or in dewatered ground, unsupported excavation batter slopes should be less than 3m total vertical height and flatter than:

- 2H: 1V for Unit 1,
- 1.5H:1V for Unit 2 and
- 1H:1V for Unit 3

Temporary batters should not be in place for longer than three months. The recommended maximum batters are based on no structures or surcharge located at or near the crest of the cuts. Steeper slopes in the fill, soil and weathered rock materials may require engineer designed support or retention. Site specific advice is recommended for unsupported cuts greater than 3 m in height.

Depending on basement footprint, there may not be room to form temporary unsupported batters at the basement perimeters, but this is doubtful due to the multitude of underground services that could be affected. It is expected that the perimeter excavation walls will require shoring during construction (discussed in Section 4.2.3).

4.4. Shoring

Shoring will be required to support vertical excavation in Units 1, 2 and 3. In Sydney, the use of a contiguous pile walls or soldier piles with shotcrete or concrete infill panels is common in ground associated with the Blacktown soil landscape.

Cantilevered walls for a 6m deep basement excavation is not recommended as the induced ground movements behind the wall may be unacceptable. Lateral stability of the wall could be provided during construction by anchors installed progressively as the excavation proceeds. As an alternative to anchors, internally braced or propped support systems, or top down construction could be considered. These systems may involve contiguous pile walls connected by a capping beam, with carefully planned propping and excavation sequence strategies.

Table 2 provides preliminary design parameters for retaining walls.

Table 2: Earth pressure coefficients for retaining wall design

Geotechnical Unit	Bulk Unit Weight (kN/m^3)	Effective Cohesion (kPa)	Effective Friction Angle (degrees)	At Rest Earth Pressure (K_0)	Horizontal Modulus E_h (MPa)
Unit 1 – Fill	18	0	25	0.5	10
Unit 2 – Residual Soil	20	5	25	0.5	15
Unit 3 – Class V/IV Shale	22	10	25	0.5	40

Notes:

1. The K_0 values are modified rather than in-situ K_0 values which assumes that at least a small amount of wall movement (say about 0.1 to 0.3% of the wall height) could occur. In-situ K_0 values may be significantly higher particularly in residual soil and weathered rock units.
2. If in-situ K_0 values are required for detailed soil-structure analysis, specific testing should be carried out.

Retaining wall analyses will need to consider surcharges, footing loads from adjacent structures and hydrostatic pressure. If drained walls are to be used then adequate drainage will need to be provided behind the walls, and a permanent water collection system will be required together with flushing points for drainage system periodic maintenance.

4.5. Ground anchors

Where it is important to limit adjacent ground movements due to the presence of nearby sensitive structures or services, the use of a relatively stiff shoring with bracing and/or tie-back anchors designed to resist pressures higher than active earth pressures may be required. Anchor designs should be based on allowing effective bonding to be developed behind an 'active zone' determined by drawing a line at 45^o from the base of the retaining wall to intersect the ground surface behind the excavated face. The following ultimate bond stresses may be adopted for preliminary design:

- Unit 2 Residual Soil 75 kPa
- Unit 3 Class V/IV Shale 150 kPa
- Unit 4 Class III Shale 500 kPa

Anchor bond lengths should be at least 3 m and not more than 7 m long. Each anchor should be proof loaded to 1.5 times its working load prior to locking off. In addition to bond strength, anchors should be checked for a cone pull-out mechanism.

4.6. Excavation induced ground movements

The proposed excavation could induce ground movements adjacent to the excavation due to removal of lateral support. Within the retained soil and weathered rock profile, the magnitude of adjacent ground movements will depend on the ground conditions, design lateral pressure, shoring system adopted, construction sequence and workmanship. Documented data has shown that for well-constructed shoring, vertical and lateral movements may be in the order of 0.1% to 0.3% of the retained height, and may be experienced for lateral distances equal to twice the excavation depth.

These ground movements could affect adjacent structures or underground services. If this aspect is critical, numerical analysis should be carried out to assess likely ground movements when designing the shoring system.

The location, foundation type, layout and founding depth for adjacent structures, buried services, and roads neighbouring surrounding the site should be assessed prior to excavation works. Where adjacent structures are located close to the excavation footprint, the foundation bearing capacity could be reduced or the footings could surcharge the temporary and permanent basement retention.

Prior to the commencement of the bulk excavation works, we recommend that dilapidation surveys of the adjacent structures be carried out to provide a baseline for excavation monitoring and management works. We also recommend monitoring of movement of the retaining wall be included as part of the instrumentation and monitoring plan for the works.

4.7. Groundwater and basement design

Current investigation information suggests the groundwater level is located at about proposed basement floor level. Further groundwater level monitoring is in progress to better assess groundwater fluctuations.

Based on the groundwater information to date, we expect that groundwater seepage into the excavation during construction could be controlled by conventional sump pumping methods for discharge into the stormwater network subject to receipt of regulatory approvals including environmental assessment and approval.

For the current groundwater level, a drained basement would appear to be feasible for the site. Permanent floor and wall drainage will need to be maintained throughout the life of the structure. It is expected that such a drainage system would include provision of a drainage blanket at the bottom of the basement slab with slotted drainage pipes and a sump and pump system with the ability to effectively back flush the system for long-term maintenance. Granular, free-draining material is recommended to be used as a drainage blanket.

4.8. Foundations

As the rock profile slopes down to the northwest, the base of the proposed 6 m excavation will expose either Unit 2 Residual Soil on the northwest side and Unit 3 Class V/IV Shale to the northeast, south and southwest. For the building loads expected, we recommend that the structures be supported on the same Unit to reduce differential settlement. Whilst parameters are provided for Unit 3 Shale, this material may deteriorate due to exposure during construction and the presence of groundwater. In our view the building should be founded on Unit 4 Shale.

For the design of shallow footings or bored piles, we recommend the parameters in Table 3. We have included serviceability bearing pressures to assist preliminary design.

Table 3: Recommended foundation design parameters

Geotechnical Unit	Material Description	Allowable End Bearing Pressure (MPa)[2]	Ultimate End Bearing Pressure (MPa)[2]	Ultimate Shaft Adhesion (kPa)[3,5]	Young's Modulus E_v (MPa)[4]
2	Residual Soil	N/A[1]	N/A[1]	50	25
3	Class V/IV Shale	0.7	3	100	100
4	Class III Shale	3	20	500	500

Notes:

1. Footings on residual soil are not recommended.
2. Assumes a minimum embedment of 0.3 m into the relevant bearing stratum. Settlement where allowable end bearing design is carried out should be less than 1% of footing width.
3. Shaft adhesion should only be adopted where piles have a minimum embedment of at least 3 pile diameters into the relevant bearing stratum.
4. If limit state design is adopted serviceability should be assessed using the modulus value to check that settlements are within tolerable limits.
5. Shaft adhesion should be ignored for pad footings.

For limit state design a geotechnical reduction factor (ϕ_g) is to be applied to the ultimate geotechnical pile capacity assessed using the ultimate shaft resistance and end bearing values shown in Table 4 to derive the design ultimate geotechnical pile capacity.

In accordance with AS2159-2009, ϕ_g is dependent on assignment of an Average Risk Rating (ARR) which takes into account various geotechnical uncertainties, redundancy of the foundation system, construction supervision, and the quantity and type of pile testing. The assessment of ϕ_g therefore depends on the structural design of the foundation system as well as the design and construction method, and testing (if any) to be employed by the designer and piling contractor. Where testing is undertaken, it may be possible to adopt a ϕ_g value that leads to a more economical design.

To assist you with preliminary design, Coffey recommends a ϕ_g value of 0.4 assuming no pile load testing. However, once the pile designer has evaluated the ARR, this value could be revised and we recommend that Coffey review the resulting ϕ_g.

The use of limit state design also requires that serviceability performance of the foundation system be assessed, including pile group interaction effects. Such assessment should be carried out by an experienced geotechnical professional using well-established and soundly based methods. The elastic modulus values given in Table 3 may be adopted for such assessment, but it should be recognised that the accuracy of settlement prediction is a function of construction methodology as well as the assessed values of material stiffness, both of which can involve considerable uncertainty. Therefore, the accuracy of settlement predictions may be no better than ± 50%. Where foundation settlement is critical to the performance of the structure, serviceability pile load testing should be carried out to confirm the design assumptions and/or assess prediction accuracy.

4.9. Earthquake design parameter

Based on AS1170.4-2007 “Structural design actions Part 2: Earthquake actions in Australia” the following parameters should be adopted for seismic design:

- Seismic Hazard Factor (Z) 0.08
- Sub-Soil Class Ce

The Earthquake Design Category could then be assessed based on a Probability Factor, k_p, (which is related to an Annual Probability of being Exceeded) as defined in Table 3.1 of AS 1170.4 – 2007).

4.10. Soil aggressivity

The 1:25,000 Botany Bay Acid Sulfate Soil (ASS) Risk Map indicates that the site is located where there is low probability of occurrence of acid sulfate soil. The geotechnical investigation did not encounter alluvial soils, so the presence of acid sulfate soil would not be feasible.

Four selected samples were tested which were collected within Unit 2 Residual Soil. The soil aggressivity test results were assessed in accordance with Australian Standard AS2159-2009 Piling – “Design and Installation”. Chemical test results indicate a moderate exposure classification to concrete and non-aggressive classification to steel elements.

4.11. Pavement design for shared accessway

The Atterberg Limits test results for samples taken from the proposed shared pedestrian and vehicular access road location and within Unit 2 Residual Soil indicate low to medium plasticity. Based on these results, we consider that a CBR of 5% could be adopted for the design of shared accessway pavement where Unit 2 Residual Soil forms the pavement subgrade. We recommend that during construction, when the subgrade is exposed, CBR value should be verified because CBR tests on high plasticity clay by JK Geotechnics yielded lower CBR values.

Satisfactory performance of the pavement will require careful attention to surface and subsurface drainage to prevent the subgrade soil from wetting up. Site landscaping should be designed to prevent the ponding of water adjacent to pavements and also structures. Sub-surface drainage should be provided.

5. Structural Assessment

Refer Appendix C for Structural Dilapidation Report.

5.1. Structural Setting

The Blackburn building is a five-storey steel and reinforced concrete framed structure, clad with dark red face bricks. The basement of the structure is constructed of sandstone. Construction of the building was completed in 1933. The Blackburn building is located approximately 30 metres east of the Royal Prince Alfred Hospital (R.P.A.H), 6 metres north of the Bosch Building 1B and 6 metres south of the R.P.A.H Chapel. Two reinforced concrete pedestrian footbridges connect the Blackburn building to the Bosch building. A small underground tunnel connects the Blackburn building to the R.P.A.H Chapel at a maximum depth of approximately 2350 mm below the road surface.

5.2. Surrounding Structures

R.P.A.H. Main Hospital Building

The R.P.A.H. main hospital building appears to be a well-constructed modern structure with limited signs of damage. Due to the structural condition and the proximity to the Blackburn building, it is not expected to be adversely affected by demolition or construction works.

It is recommended that vibrations at the structure be measured and limited as the hospital is classified as a 'Critical area' in accordance with 'Environmental Noise Management, Assessing Vibration: a technical guideline', by the Department of Environment and Conservation NSW, 2006.

The maximum weighted root mean squared (rms) value for continuous and impulsive vibration accelerations should be limited to:

- a preferred value of 0.0050 m/s^2 vertically and 0.0036 m/s^2 horizontally, and
- a maximum value of 0.010 m/s^2 vertically and 0.0072 m/s^2 horizontally.

There may be cases where sensitive equipment or delicate tasks require more stringent criteria, therefore the hospital should be consulted to ensure that these typical limits for critical operating theatres are acceptable.

Bosch 1B Building

The Bosch 1B Building is a four-storey brick structure with no significant signs of damage. Access to internal rooms of the building is security controlled, therefore only the external structure was inspected. Due to the close proximity to the Blackburn building, a dilapidation inspection should be completed on the Bosch 1B structure prior to commencement of works.

Vibration levels in the structure will be reduced significantly by disconnecting the Blackburn building from the Bosch 1B building prior to demolition or construction works commencing on the main structure. Vibrations will be damped by a greater amount when forces are travelling through the natural clay layer rather than through reinforced concrete. The pedestrian bridges are recommended to be saw cut and lifted down to ground level via crane.

It is recommended that vibrations at the structure be measured and limited as the building is classified as an 'Educational institution'. The maximum weighted root mean squared (rms) value for continuous vibration accelerations should be limited to:

- a preferred value of 0.020 m/s^2 vertically and 0.014 m/s^2 horizontally and
- a maximum value of 0.040 m/s^2 vertically and 0.028 m/s^2 horizontally.

The limit for impulsive vibrations should be limited to:

- a preferred value of 0.64 m/s^2 vertically and 0.46 m/s^2 horizontally, and
- a maximum value of 1.28 m/s^2 vertically and 0.92 m/s^2 horizontally.

The university should be consulted to ensure that no sensitive operations occur within the structure which would be adversely affected by vibrations.

R.P.A.H Chapel

The R.P.A.H Chapel is a single storey brick structure which is connected to the Blackburn building with an underground tunnel. Construction of the chapel was completed in 1955. The structure of the chapel appears to be damaged due to differential settlement. The internal and external faces of the structure have numerous diagonal cracks which have propagated between bricks. Cracks have

opened by as much as 10 mm, typically between door or window frames and the roof. Due to the close proximity to the Blackburn building, a dilapidation inspection should be completed on the chapel prior to commencement of works.

Vibration levels in the structure will be reduced significantly by disconnecting the Blackburn building from the chapel prior to demolition or construction works commencing on the main structure. Vibrations will be damped by a greater amount when forces are travelling through the natural clay layer rather than through reinforced concrete. The tunnel should be disconnected via saw cutting to create a physical gap between the structures.

It is recommended that vibrations at the structure be measured and limited as the building is classified as a 'Place of Worship'. The maximum weighted root mean squared (rms) value for continuous and impulsive vibration accelerations should be limited to the same values as the Bosch 1B building.

The existing damage to the chapel is more severe on the side where the tunnel runs beneath the road to the Blackburn building. Differential movement due to excavation may further exacerbate the damage to the structure, therefore the geotechnical design of such an excavation should consider expected differential movement. Closure of the road would be ideal during construction works to limit deflection. Measurements of significant cracks are recommended before, during and after works to document and assess the damage.

5.3. Structural Recommendations

A vibration monitoring program is recommended during demolition and construction works. The underlying clay strata is expected to transmit only small amounts or vibration compared to rock or concrete structures. The pedestrian bridges should be removed prior to any further demolition of the Blackburn building. The tunnel to the chapel should also be disconnected to leave the maximum physical gap that can be achieved. Surcharges caused by the existing structures should be considered in the methodology for disconnecting the tunnel.

Vibration sensors (transducers) should be installed at the closest edges of the R.P.A.H main building, the R.P.A.H chapel and the Bosch 1B building. Alerts should be set to the values recommended within this report, or more stringent values recommended by the university or the hospital. Where large masses are required to be dropped from heights it is recommended that initially smaller impacts are trialed to assess the effect on vibrations to the adjacent buildings. It is expected that concrete elements will be able to be dropped from the top floor, however the use of a designated drop zone is recommended. The drop zone is recommended to be at the east side of the structure, to increase the clear distance to both the hospital and the chapel.

It is also recommended that differential movement at the face of the chapel be surveyed and crack widths be documented. Dilapidation inspections will be completed at a later date as a part of this scope. It is recommended that the dilapidation inspections include the external face of the R.P.A.H. main structure, the Bosch 1B building, and the R.P.A.H chapel.

6. Safety in Design

Coffey's input to date has included provision of geotechnical design advice in accordance with industry practice, relevant Codes of Practice and Standards. There remain design and construction risks associated with unforeseen ground conditions, variations in actual conditions to those adopted for design, and implementation of the design during construction and maintenance that should be considered by you in conjunction with your designer and other parties. The guidance for effective safe design outcomes is provided in the model Codes of Practice for Safe Design of Structures and Safe Design, Manufacture Import and Supply of Plant. These codes were developed with the close

involvement of Consult Australia, the industry association for professional services firms in the built environment sector.

Coffey is happy to contribute in addressing the Safe Design requirements for this project and can meet with you, your designers and any other relevant party to confirm that geotechnical aspects are satisfactorily addressed in the Safe Design process in collaboration with those who have expertise in construction safety.

7. Closure

Subsurface conditions can be complex, vary over relatively short distances and over time. The inferred geotechnical model and recommendations in this report are based on limited subsurface investigations at discrete locations. The engineering logs describe subsurface conditions only at the investigation locations.

Additional investigations may be required to support detailed design due to factors such as scope limitations and changes to the nature of the project. A geotechnical engineer should be engaged to assist with detailed design and/or to review designs. During construction a geotechnical engineer should verify that conditions exposed are consistent with design assumptions.

The attached document entitled “Important Information about Your Coffey Report” forms an integral part of this report and presents additional information about the uses and limitations of the report.

Important information about your **Coffey** Report

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

Your report is based on project specific criteria

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

Subsurface conditions can change

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

Interpretation of factual data

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

Your report will only give preliminary recommendations

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

Your report is prepared for specific purposes and persons

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

Interpretation by other design professionals

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

Important information about your **Coffey** Report

Data should not be separated from the report*

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

Geoenvironmental concerns are not at issue

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

Rely on Coffey for additional assistance

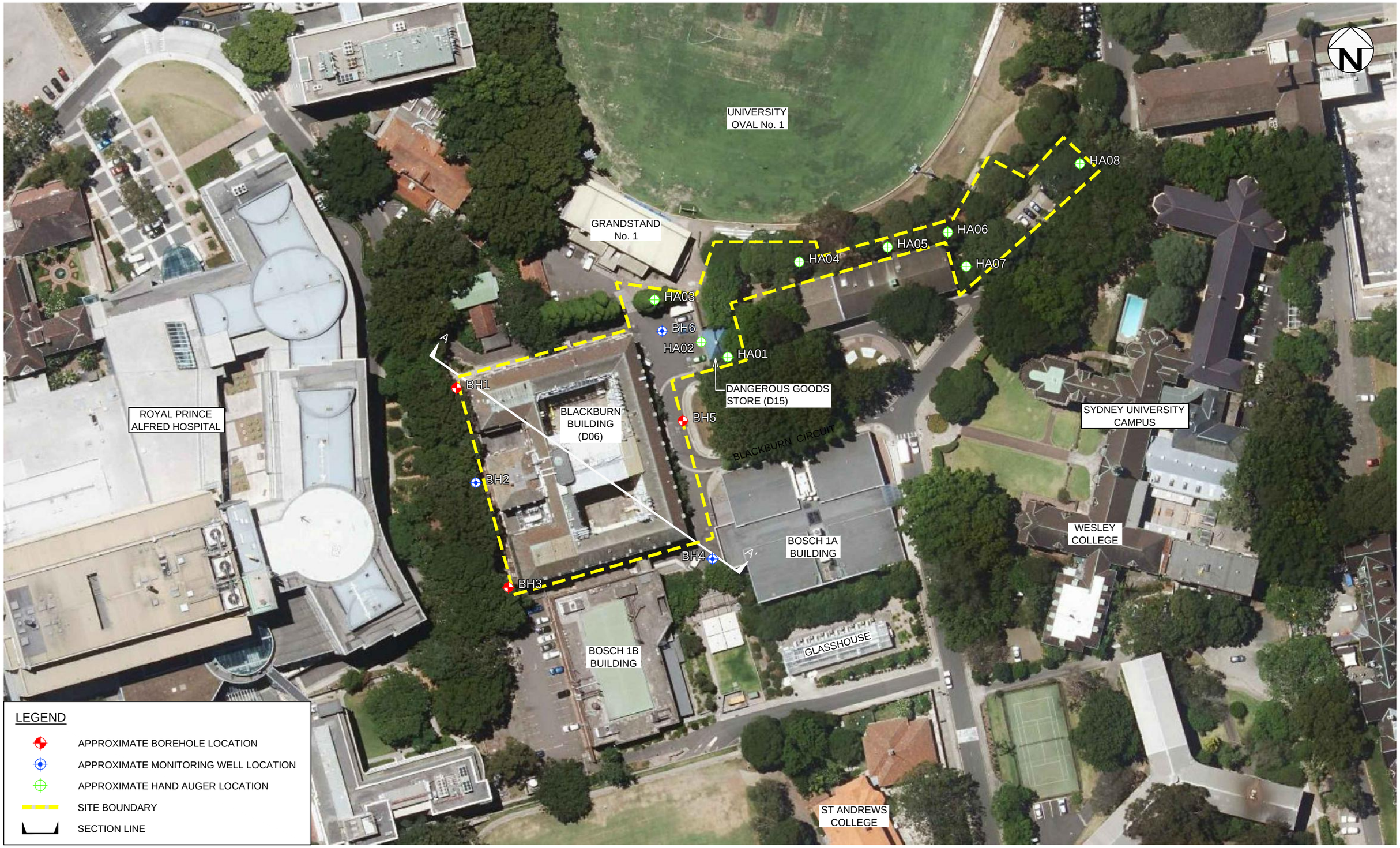
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As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

Responsibility

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

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

Figures



LEGEND

- APPROXIMATE BOREHOLE LOCATION
- APPROXIMATE MONITORING WELL LOCATION
- APPROXIMATE HAND AUGER LOCATION
- SITE BOUNDARY
- SECTION LINE

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	DS	RT	10/01/17

10 0 10 30 50

Scale (metres) 1:1000

drawn	DS / AW
approved	RT
date	10 / 01 / 17
scale	AS SHOWN
original size	A3

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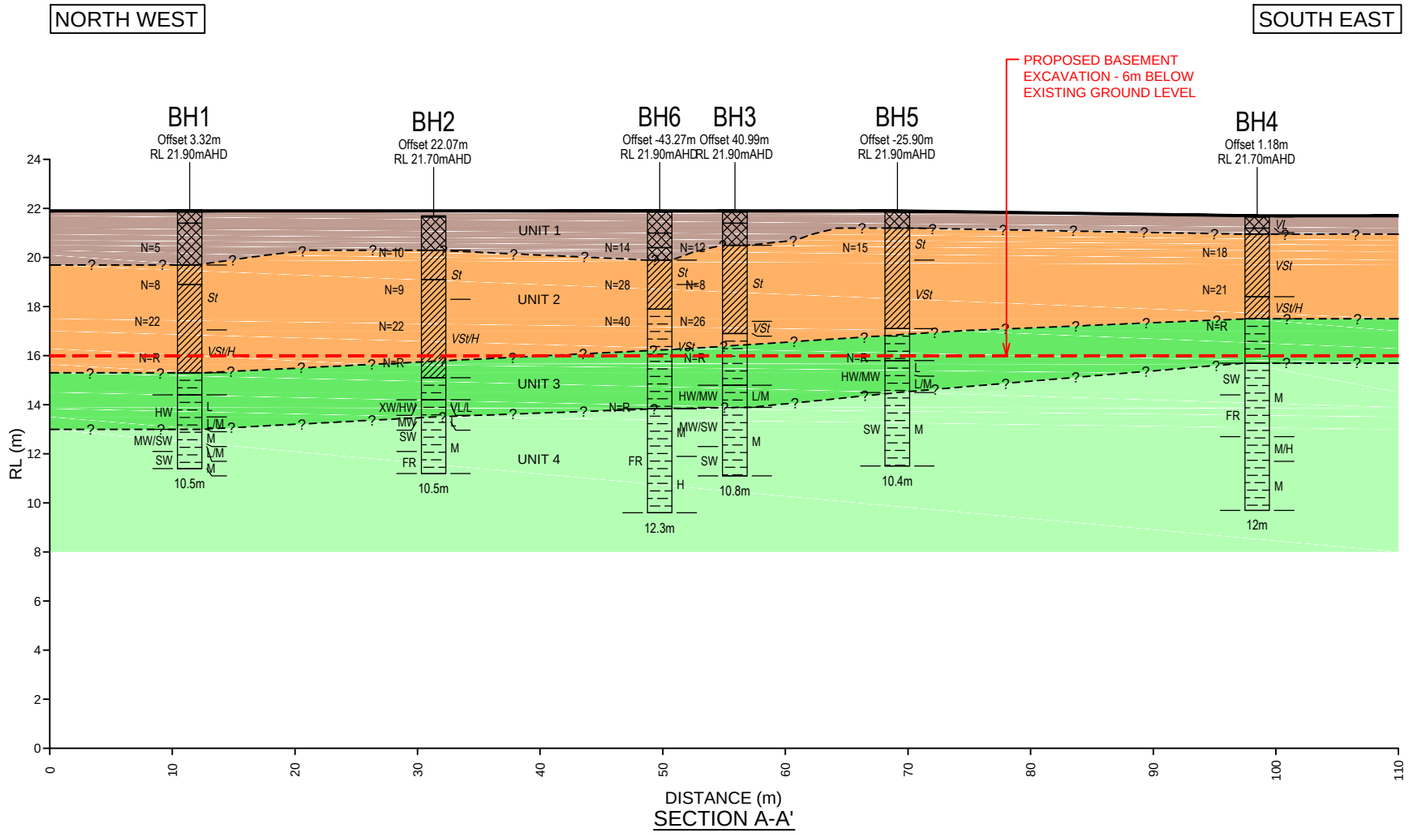
client: LEND LEASE BUILDING PTY LTD

project: USYD HEALTH PRECINCT
UNIVERSITY OF SYDNEY - CAMPERDOWN CAMPUS
CAMPERDOWN, NSW

title: INVESTIGATION LOCATION PLAN

project no: GEOTLCOV25283AF-AD | figure no: FIGURE 1 | rev: A

PLOT DATE: 11/01/2017 9:11:52 AM DWG FILE: F:\GEOTECHNICS\1.PROJECTS\GEOTLCOV25283AF USYD HEALTH PRECINCT\CAD\GEOTLCOV25283AF-AD.DWG



SECTION A-A'

LEGEND

- ASPHALT
- FILL
- CLAY
- SHALE
- EXISTING GROUND SURFACE
- INFERRED GEOLOGICAL BOUNDARY
- BASEMENT LEVEL
- XW — ROCK WEATHERING
- N=17 — STANDARD PENETRATION TEST RESULT

UNIT LEGEND

- UNIT 1 - FILL
- UNIT 2 - RESIDUAL SOIL
- UNIT 3 - SHALE, VERY LOW TO LOW STRENGTH (CLASS V/IV)
- UNIT 4 - SHALE, MEDIUM TO HIGH STRENGTH (CLASS III)

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	DS	RT	10/01/17

Horizontal Scale (metres) 1:500

Vertical Scale (metres) 1:250

drawn	DS / AW
approved	RT
date	10 / 01 / 17
scale	AS SHOWN
original size	A3

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A TETRA TECH COMPANY

client: LEND LEASE BUILDING PTY LTD

project: USYD HEALTH PRECINCT
UNIVERSITY OF SYDNEY - CAMPERDOWN CAMPUS
CAMPERDOWN, NSW

title: SECTION A-A'

project no: GEOTLCOV25283AF-AD | figure no: FIGURE 2 | rev: A

Appendix A – Engineering borehole logs and explanation sheets

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Engineering Log - Borehole

Borehole ID.	**BH1**
sheet:	1 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **21 Nov 2016**
principal:	date completed: **21 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,080.70; N: 6,248,674.03 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter :

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA			E					**ASPHALT**: 50mm.	D			**ROAD SURFACE**
								FILL: Clayey Gravelly SAND: fine to coarse grained, brown-yellow, gravel is sub-rounded to sub-angular, clay is fine to medium.	<Wp			**FILL** PID = 12.4ppm
			E					**FILL: Gravelly Sandy CLAY**: medium plasticity, brown-red to dark brown, sand is fine to coarse grained, gravel is sub-rounded to sub-angular.				PID = 24.8ppm
			E	21	1.0							PID = 11.7ppm
CASING			SPT 2, 2, 3 N*=5	20	2.0							PID = 10.4ppm
			E				CI-CH	**CLAY**: medium to high plasticity, brown with red mottling, with sub-rounded to sub-angular ironstone gravel pieces.	~Wp	St		**RESIDUAL SOIL**
			SPT 3, 3, 5 N*=8	19	3.0		CH	**CLAY**: high plasticity, red-brown with grey mottling, with some ironstone gravel pieces sub-rounded to sun-angular.	>Wp			
AD/T				18	4.0							
			SPT 5, 8, 14 N*=22	17	5.0			4.85 m: becoming grey-pale grey with red mottling		VSt / H		
				16	6.0							
			SPT 8, 30/100mm N*=R	15	7.0			**SHALE**: grey-pale grey, extremely weathered, very low strength.				**WEATHERED BEDROCK**
				14				Borehole BH1 continued as cored hole				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Cored Borehole

Borehole ID.	***BH1***
sheet:	2 of 3
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***21 Nov 2016***
principal:	date completed: ***21 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SM***
location: ***Blackburn Building, University of Sydney - Camperdown Campus***	checked by: ***DS***

position: E: 332,080.70; N: 6,248,674.03 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		21	1.0								
		20	2.0								
		19	3.0								
		18	4.0								
		17	5.0								
		16	6.0								
		15	7.0		started coring at 7.50m						
NMLC		14			**SHALE**: grey-dark grey, distinctly laminated at 0°-10°.	HW		a=0.20	60%		PT, IR, SO, CN High fractured zone SM, Clay, 10 mm SM, Clay/shale, 10 mm

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

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

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

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

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

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

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stain
VN veneer
CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH1**
sheet:	3 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **21 Nov 2016**
principal:	date completed: **21 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,080.70; N: 6,248,674.03 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) — angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted — drilling fluid: — hole diameter : — vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC		13	9.0		**SHALE**: grey-dark grey, distinctly laminated at 0°-10°. *(continued)*	HW		d=0.11			PT, PL, CO - Clay SM, Clay, 20 mm JT, 70°, PL, SO, CN SM, Clay, 10 mm
						MW / SW		a=0.79 d=0.39	60%		SM, Clay, 60 mm JT, 60°, PL, SO, CN PT, IR, SO, CN Clay, 60 mm
		12	10.0			SW		a=1.20 d=0.64 a=1.19 d=1.02			Defects are: PT, 0 - 10°, PL, SO, CN, unless otherwise described
		11	11.0		Borehole BH1 terminated at 10.50 m						
		10	12.0								
		9	13.0								
		8	14.0								
		7	15.0								
		6									

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

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

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

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

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

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

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stain
VN veneer
CO coating

BH1 7.50 - 10.50 m

drawn	**AW**
approved	**DS**
date	**8/12/2016**
scale	**N.T.S.**
original size	**A4**

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client: Lend Lease Building Pty Ltd

project: USYD Health Precinct
Blackburn Building, University of Sydney - Camperdown Campus

title: **CORE PHOTOGRAPH**
BH1

project no: GEOTLCOV25283AF | fig no: **FIGURE 1** | rev:

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Engineering Log - Borehole

Borehole ID.	**BH2**
sheet:	1 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **15 Nov 2016**
principal:	date completed: **15 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,086.19; N: 6,248,647.26 (MGA94 Zone 56) surface elevation: 21.70 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter :

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA			E					**ASPHALT**: 50mm.	<Wp			**ROAD SURFACE**
								FILL: Sandy Gravelly CLAY: medium to high plasticity, brown-grey-red, gravel is sub-rouded to sub-angular, sand is fine to coarse grained.				**FILL** PID = 11.8ppm
			E	21								PID = 17.2ppm
			E		1.0							PID = 16.5ppm
CASING			SPT 3, 4, 6 N*=10	20			CI-CH	**CLAY**: medium to high plasticity, red-grey mottling, with ironstone gravel.	<Wp	St		**RESIDUAL SOIL** PID = 8.9ppm
			E		2.0							
				19			CH	**CLAY**: high plasticity, grey-dark grey.	>Wp			
			SPT 3, 3, 6 N*=9		3.0							
				18				3.4 m: red-brown with grey mottling		VSt / H		
					4.0							
AD/T			SPT 6, 10, 12 N*=22	17								
					5.0							
				16								
			SPT 30 HB N*=R		6.0							
				15				**SHALE**: grey-dark grey with red mottling, extremely weathered, very low strength.				**WEATHERED BEDROCK**
					7.0							
				14				Borehole BH2 continued as cored hole				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Cored Borehole

Borehole ID.	***BH2***
sheet:	2 of 3
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***15 Nov 2016***
principal:	date completed: ***15 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SM***
location: ***Blackburn Building, University of Sydney - Camperdown Campus***	checked by: ***DS***

position: E: 332,086.19; N: 6,248,647.26 (MGA94 Zone 56) surface elevation: 21.70 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : vane id.:

drilling information				material substance					rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		21	1.0								
		20	2.0								
		19	3.0								
		18	4.0								
		17	5.0								
		16	6.0								
		15	7.0								
					started coring at 7.50m						
NMLC		14			**SHALE**: grey-dark grey to pale grey, red within upper 100mm, distinctly laminated at 0°-10°.	XW / HW MW		a=0.22	78%		PT, ST, SO, CN SM, Clay, 30 mm

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

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

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

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

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

*W replaced with A for alteration

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

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

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

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

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

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Engineering Log - Cored Borehole

Borehole ID.	**BH2**
sheet:	3 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **15 Nov 2016**
principal:	date completed: **15 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,086.19; N: 6,248,647.26 (MGA94 Zone 56) surface elevation: 21.70 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC		13	9.0		**SHALE**: grey-dark grey to pale grey, red within upper 100mm, distinctly laminated at 0°-10°. *(continued)*	MW		d=0.15			SM, Clay, 30 mm JT, 60°, PL, SO, CN SM, Clay, 10 mm SM, Clay, 24 mm PT, PL, CO - Clay
						SW	O	a=0.74 d=0.51	78%		
		12	10.0			FR	O	a=0.70 d=0.55			PT, PL, CO - Clay
							X	a=1.15 d=0.71			Defects are: PT, 0 - 10°, PL, SO, CN, unless otherwise described
		11	11.0		Borehole BH2 terminated at 10.50 m						
		10	12.0								
		9	13.0								
		8	14.0								
		7	15.0								
		6									

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

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

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

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

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

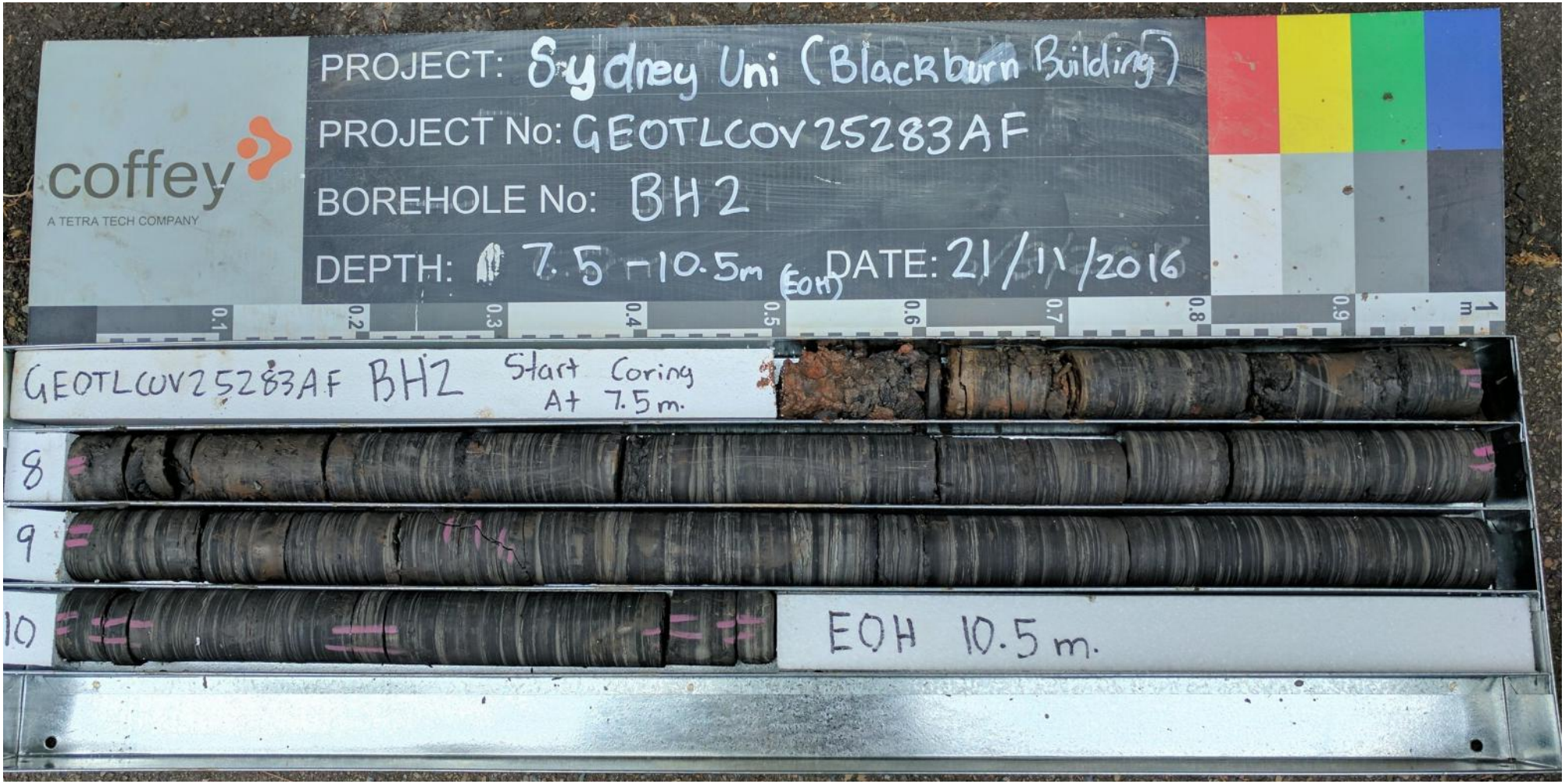
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stain
VN veneer
CO coating



BH2 7.50 - 10.50 m

drawn	**AW**
approved	**DS**
date	**8/12/2016**
scale	**N.T.S.**
original size	**A4**

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client: Lend Lease Building Pty Ltd

project: USYD Health Precinct
Blackburn Building, University of Sydney - Camperdown Campus

title: **CORE PHOTOGRAPH**
BH2

project no: GEOTLCOV25283AF | fig no: **FIGURE 1** | rev:

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Piezometer Installation Log

Hole ID.	**BH2**
sheet:	1 of 1
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **15 Nov 2016**
principal:	date completed: **15 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,086.19; N: 6,248,647.26 (MGA94 Zone 56) surface elevation: 21.70 m (AHD) angle from horizontal: 90°

equipment type: Hydropower Scout, Truck mounted drilling fluid: hole diameter :

drilling information | **material substance** | **piezometer construction details**

bore construction license:
drilling company:
driller:
driller's permit no.:

method & support	water	RL (m)	depth (m)	graphic log	material name
HA		20	1		**ROAD SURFACE**
					FILL
CASING					**RESIDUAL SOIL**
			2		
		18	3		
AD/T			4		
		16	5		
			6		
			7		**WEATHERED BEDROCK**
NMLC		14	8		
			9		
		12	10		
		10	11		

BH2

Cuttings

3.50 m

Bentonite

4.50 m

Sand

10.50 m

method & support
see engineering log for details

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

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

ID	type	installation date	stickup (m)	tip depth (m)	water level (m)	Relative Levels (AHD) stickup	tip	water level
BH2	standpipe piezo.			10.50 m			11.20	

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Engineering Log - Borehole

Borehole ID.	**BH3**
sheet:	1 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **21 Nov 2016**
principal:	date completed: **22 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,095.41; N: 6,248,617.64 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter :

drilling information						material substance							
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetro-meter (kPa) 100 200 300 400	structure and additional observations
HA			E					**ASPHALT**: 50mm.	D			**ROAD SURFACE**
								FILL: Gravelly SAND: fine to coarse grained, brown-yellow, with some gravel sub-rounded to sub-angular, sand is fine to coarse grained.				**FILL** PID = 14.8ppm
			E						M			PID = 17.2ppm
				21				**FILL: Sandy CLAY**: low to medium plasticity, brown-yellow, sand is fine to coarse grained. some gravel, sub-rounded to sub-angular.				
			E		1.0							PID = 18.6ppm
			SPT 3, 6, 6 N*=12	20	2.0		CI-CH	**CLAY**: medium to high plasticity, red-brown with grey mottling, trace of gravel, sub-rounded to sub-angular.	>Wp	St		**RESIDUAL SOIL** PID = 6.9ppm E Sample from 1.4-1.6m
			SPT 3, 3, 5 N*=8	19	3.0							
				18	4.0			4.5 m: becoming shaley clay		VSt		
CASING			SPT 8, 10, 16 N*=26	17	5.0			**SHALE**: red-brown with grey mottling, extremely weathered, very low strength.				**WEATHERED BEDROCK**
AD/T				16	6.0							
			SPT 30 HB N*=R	15	7.0							
				14				Borehole BH3 continued as cored hole				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Cored Borehole

Borehole ID.	***BH3***
sheet:	2 of 3
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***21 Nov 2016***
principal:	date completed: ***22 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SM***
location: ***Blackburn Building, University of Sydney - Camperdown Campus***	checked by: ***DS***

position: E: 332,095.41; N: 6,248,617.64 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : vane id.:

drilling information				material substance						rock mass defects		
method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		21	1.0								
		20	2.0								
		19	3.0								
		18	4.0								
		17	5.0								
		16	6.0								
		15	7.0		started coring at 7.10m						
NMLC		14			**SHALE**: grey-pale grey, distinctly laminated at 0°-10°.	HW / MW		a=0.31 d=0.16	78%		SM, Clay, 30 mm JT, 50°, PL, SO, CN PT, PL, SO, CN

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

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

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

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

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

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

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stain
VN veneer
CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH3**
sheet:	3 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **21 Nov 2016**
principal:	date completed: **22 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,095.41; N: 6,248,617.64 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC		13	9.0		**SHALE**: grey-pale grey, distinctly laminated at 0°-10°. *(continued)*	MW / SW		a=0.71 d=0.26			SM, Clay, 10 mm SM, Clay, 20 mm
		12	10.0			SW		a=1.08 d=0.45	79%		SM, Clay, 10 mm SM, Clay, 10 mm
		11	11.0		Borehole BH3 terminated at 10.80 m			a=1.13 d=0.53			Defects are: PT, 0 - 10°, PL, SO, CN, unless otherwise described
		10	12.0								
		9	13.0								
		8	14.0								
		7	15.0								
		6									

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

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

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

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

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

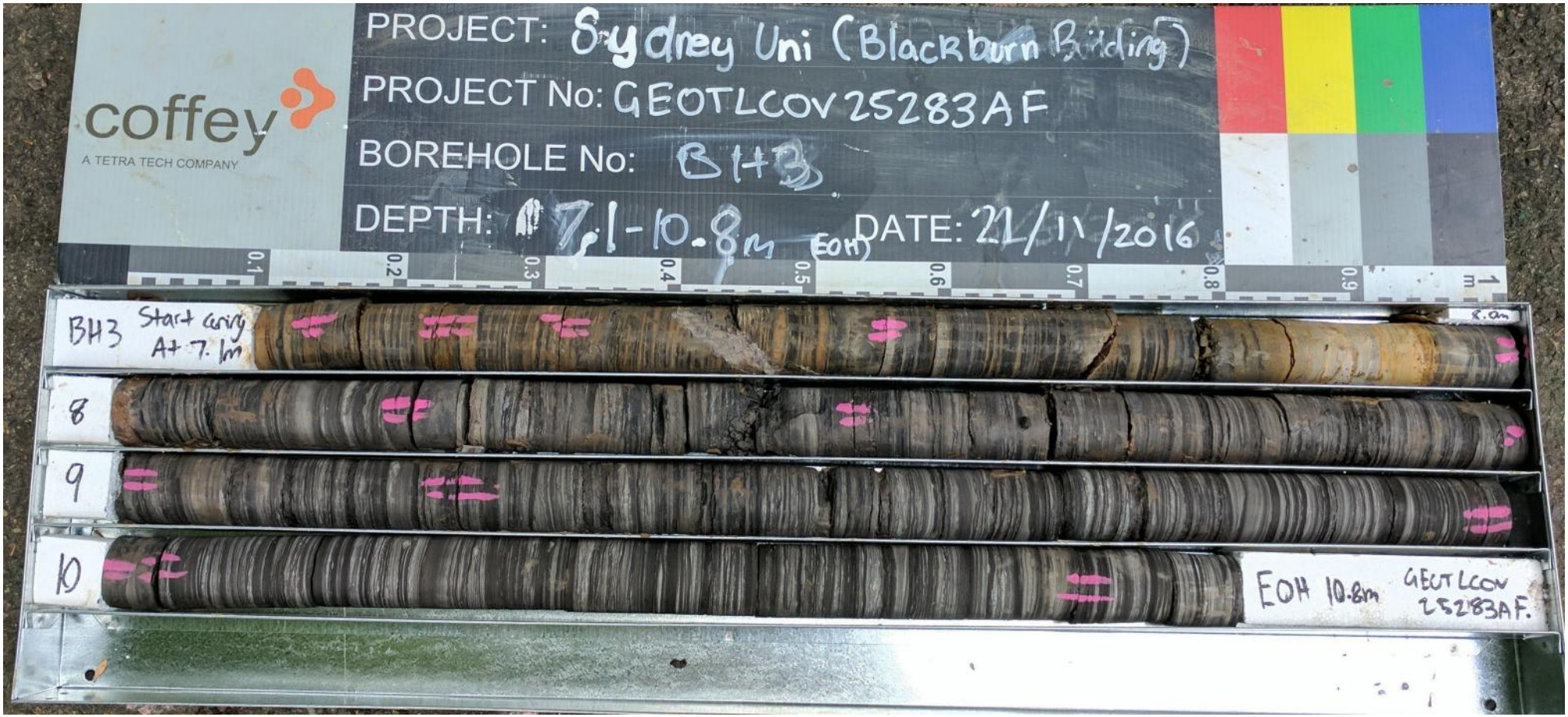
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stain
VN veneer
CO coating



BH3 7.10 - 10.80 m

drawn	**AW**
approved	**DS**
date	**8/12/2016**
scale	**N.T.S.**
original size	**A4**

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client: Lend Lease Building Pty Ltd

project: USYD Health Precinct
Blackburn Building, University of Sydney - Camperdown Campus

title: **CORE PHOTOGRAPH**
BH3

project no: GEOTLCOV25283AF | fig no: **FIGURE 1** | rev:

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Engineering Log - Borehole

Borehole ID.	**BH4**
sheet:	1 of 3
project no.	**GEOTLCOV25283AF**
date started:	**15 Nov 2016**
date completed:	**15 Nov 2016**
logged by:	**SM**
checked by:	**DS**

client: ***Lend Lease Building Pty Ltd***

principal:

project: ***USYD Health Precinct***

location: ***Blackburn Building, University of Sydney - Camperdown Campus***

position: E: 332,153.15; N: 6,248,625.70 (MGA94 Zone 56) surface elevation: 21.70 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA			E					**ASPHALT**: 50mm.	D	VL		**ROAD SURFACE**
								FILL: Gravelly SAND: fine to coarse grained, grey-pale grey, gravel is sub-rounded to sub-angular, trace low to medium plasticity clay.				PID = 8.8ppm
			E	21				**FILL: Sandy CLAY**: low to medium plasticity, grey-brown, sand is fine to coarse grained.				**FILL** PID = ??ppm
							CL-CI		<Wp	VSt		
			E		1.0			**CLAY**: low to medium plasticity, grey with red-brown mottling, with ironstone gravel.				**RESIDUAL SOIL** PID = 20.5ppm
			SPT 3, 7, 11 N*=18	20				1.5 m: becoming red mottled grey				
					2.0			2.1 m: becoming grey, mottled red				
				19				2.8 m: becoming medium to high plasticity				
AD/T			SPT 7, 9, 12 N*=21		3.0							
				18			CI-CH	**CLAY**: medium to high plasticity, grey, pale grey.	>Wp	VSt / H		
					4.0							
								SHALE: grey-dark grey, extremely weathered, with clay lenses, very low strength.				**WEATHERED BEDROCK**
			SPT 10, 12, 30/70mm N*=R	17	5.0							
				16								
					6.0			Borehole BH4 continued as cored hole				
				15								
					7.0							
				14								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Cored Borehole

Borehole ID.	***BH4***
sheet:	2 of 3
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***15 Nov 2016***
principal:	date completed: ***15 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SM***
location: ***Blackburn Building, University of Sydney - Camperdown Campus***	checked by: ***DS***

position: E: 332,153.15; N: 6,248,625.70 (MGA94 Zone 56) surface elevation: 21.70 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : 100 mm vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		21	1.0								
		20	2.0								
		19	3.0								
		18	4.0								
		17	5.0								
		16	6.0		started coring at 6.00m						
NMLC		15	7.0		**SHALE**: grey-dark grey, distinctly laminated at 0°-10°.	SW FR		a=1.34 d=0.76 a=0.34 d=0.51	92%		SM, Clay, 50 mm PT, PL, CO - Clay PT, PL, CO - Clay PT, PL, CO - Clay SM, Clay, 20 mm SM, Clay, 40 mm PT, 0 - 10°, PL, CO - Clay
		14									

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

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

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

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

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

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

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stain
VN veneer
CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH4**
sheet:	3 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **15 Nov 2016**
principal:	date completed: **15 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,153.15; N: 6,248,625.70 (MGA94 Zone 56) surface elevation: 21.70 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : 100 mm vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC		13	9.0		**SHALE**: grey-dark grey, distinctly laminated at 0°-10°. *(continued)*	FR		a=0.89 d=0.39	92%		
		12						a=1.33 d=0.67			JT, 65°, PL, CO - CN
		11	10.0					a=2.57 d=1.07			JT, 75°, PL, SO, CN Multiple fractures
		10	11.0								Defects are: PT, 0 - 10°, PL, SO, CN, unless otherwise described
			12.0		Borehole BH4 terminated at 12.00 m			a=1.56 d=1.03			
		9	13.0								
		8	14.0								
		7	15.0								
		6									

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

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

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

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

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

*W replaced with A for alteration

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

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

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

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

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

BH4 6.00 - 10.00 m

drawn	**AW**
approved	**DS**
date	**8/12/2016**
scale	**N.T.S.**
original size	**A4**

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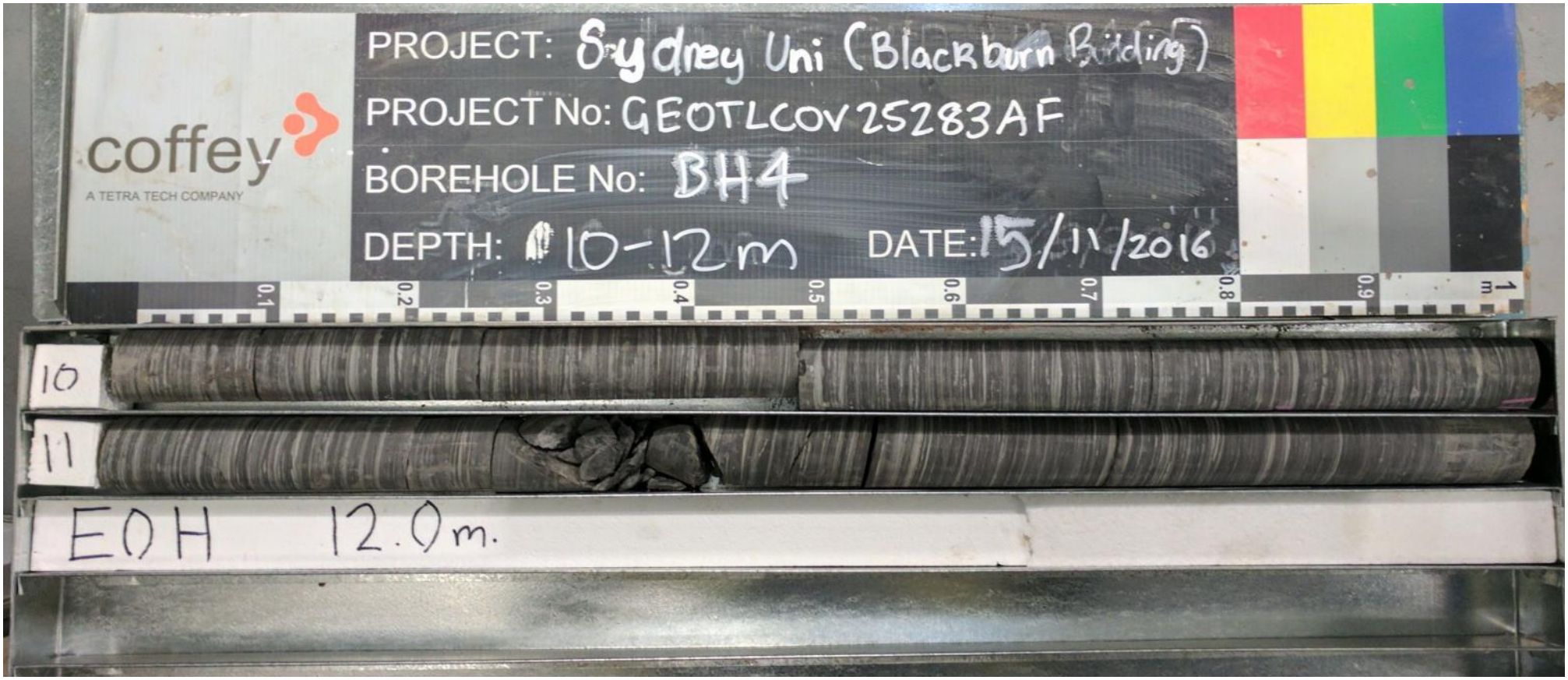
client: Lend Lease Building Pty Ltd

project: USYD Health Precinct
Blackburn Building, University of Sydney - Camperdown Campus

title: **CORE PHOTOGRAPH**
BH4

project no: GEOTLCOV25283AF | fig no: **FIGURE 1** | rev:



BH4 10.00 - 12.00 m

drawn	**AW**
approved	**DS**
date	**8/12/2016**
scale	**N.T.S.**
original size	**A4**

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client:	Lend Lease Building Pty Ltd
project:	USYD Health Precinct Blackburn Building, University of Sydney - Camperdown Campus
title:	**CORE PHOTOGRAPH** **BH4**
project no: GEOTLCOV25283AF	fig no: **FIGURE 2** rev:

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Piezometer Installation Log

Hole ID.	***BH4***
sheet:	1 of 1
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***15 Nov 2016***
principal:	date completed: ***15 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SM***
location: ***Blackburn Building, University of Sydney - Camperdown Campus***	checked by: ***DS***

position: E: 332,153.15; N: 6,248,625.70 (MGA94 Zone 56) surface elevation: 21.70 m (AHD) angle from horizontal: 90°

equipment type: Hydropower Scout, Truck mounted drilling fluid: hole diameter : 100 mm

drilling information | **material substance** | **piezometer construction details**

method & support	water	RL (m)	depth (m)	graphic log	material name
HA		20	1		ROAD SURFACE
					FILL
					RESIDUAL SOIL
			2		
			3		
		18	4		WEATHERED BEDROCK
			5		
AD/T		16	6		
			7		
		14	8		
NMLC			9		
		12	10		
			11		
		10			

bore construction license:
drilling company:
driller:
driller's permit no.:

BH4

Cuttings

2.00 m

Bentonite

3.00 m

Sand

12.00 m

method & support
see engineering log for details

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

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

ID	type	installation date	stickup (m)	tip depth (m)	water level (m)	Relative Levels (AHD) stickup	tip	water level
BH4	standpipe piezo.			12.00 m			9.70	

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Engineering Log - Borehole

Borehole ID.	**BH5**
sheet:	1 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **22 Nov 2016**
principal:	date completed: **22 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,144.72; N: 6,248,664.74 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted drilling fluid: hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA			E					**ASPHALT**: 50mm.	D			**ROAD SURFACE**
								FILL: Gravelly SAND: fine to coarse grained, brown-grey, gravel is sub-rounded to sub-angular.				**FILL**
			E				CH	**CLAY**: high plasticity, red-brown with grey mottling, with some ironstone gravel pieces.	>Wp	St		**RESIDUAL SOIL**
			E	21	1.0			1.4 m: becoming grey-pale grey with red mottling				
			SPT 4, 6, 9 N*=15	20	2.0			2.0 m: becoming red brown with grey mottling		VSt		
AD/T				19	3.0							
				18	4.0							
CASING				17	5.0			**SHALE**: grey-pale grey with red mottling, extremely weathered, very low strength.				**WEATHERED BEDROCK**
			SPT 30/90mm HB N*=R	16	6.0			Borehole BH5 continued as cored hole				
				15	7.0							
				14								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Cored Borehole

Borehole ID.	***BH5***
sheet:	2 of 3
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***22 Nov 2016***
principal:	date completed: ***22 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SM***
location: ***Blackburn Building, University of Sydney - Camperdown Campus***	checked by: ***DS***

position: E: 332,144.72; N: 6,248,664.74 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) — angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted — drilling fluid: — hole diameter : 100 mm — vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		21	1.0								
		20	2.0								
		19	3.0								
		18	4.0								
		17	5.0								
		16	6.0		started coring at 6.10m						
NMLC		15	7.0		**SHALE**: grey and red-brown, distinctly laminated at 0°-10°.	HW / MW		a=0.36 d=0.11	93%		
		14			7.35 m: becoming grey-pale grey	SW		a=0.51 d=0.26			

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

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

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

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

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

*W replaced with A for alteration

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

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

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

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

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

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Engineering Log - Cored Borehole

Borehole ID.	**BH5**
sheet:	3 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **22 Nov 2016**
principal:	date completed: **22 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,144.72; N: 6,248,664.74 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) — angle from horizontal: 90°

drill model: Hydropower Scout, Truck mounted — drilling fluid: — hole diameter : 100 mm — vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
NMLC		13	9.0		**SHALE**: grey and red-brown, distinctly laminated at 0°-10°. *(continued)*	SW		a=0.76 d=0.39			Defects are: PT, 0 - 10°, PL, SO, CN, unless otherwise described
		12	10.0					a=1.18 d=0.77			
								a=1.24 d=0.94			
		11	11.0		Borehole BH5 terminated at 10.40 m						
		10	12.0								
		9	13.0								
		8	14.0								
		7	15.0								
		6									

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

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

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

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

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

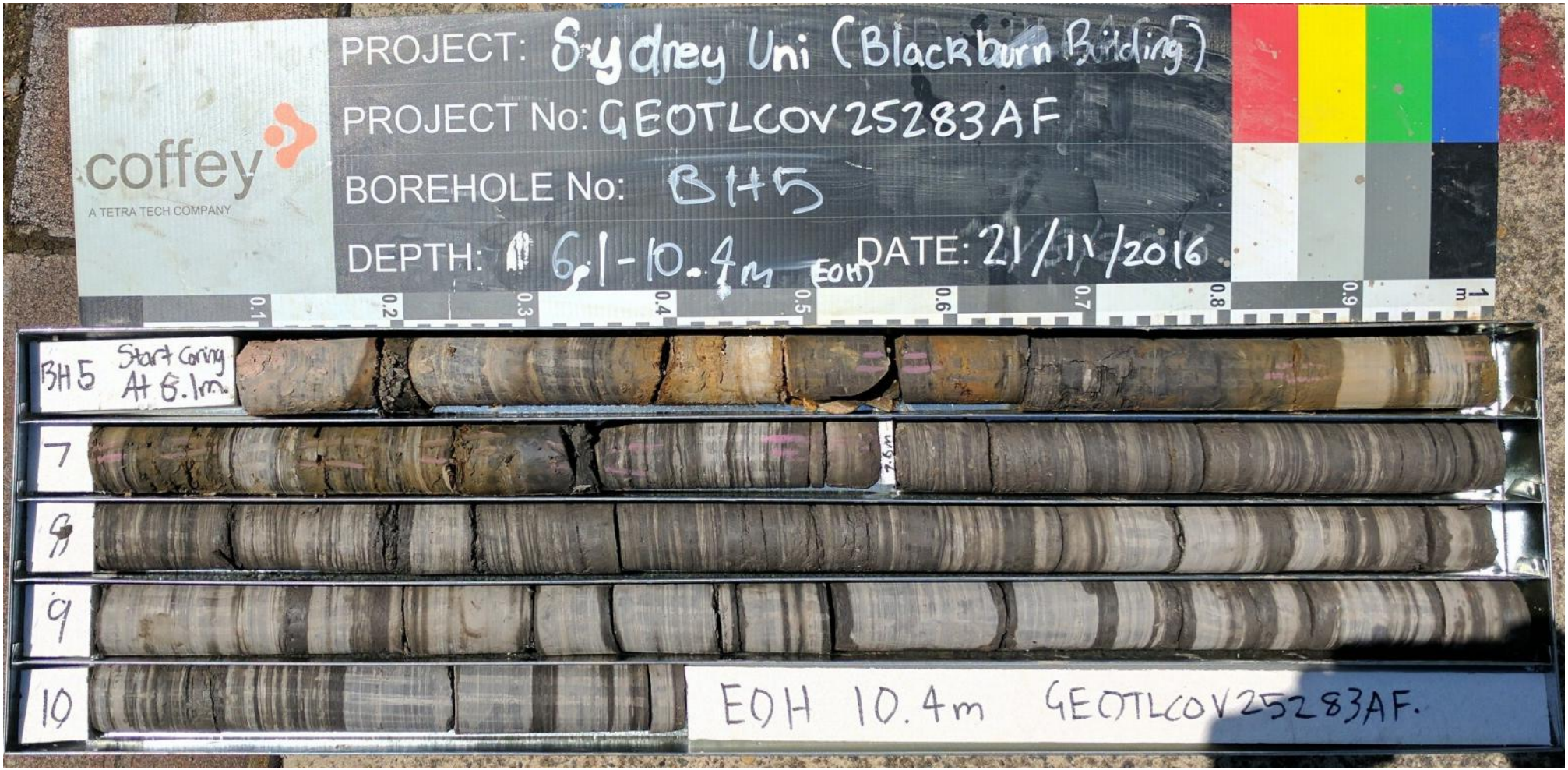
strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

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

coating
CN clean
SN stain
VN veneer
CO coating



BH5 6.10 - 10.40 m

drawn	**AW**
approved	**DS**
date	**8/12/2016**
scale	**N.T.S.**
original size	**A4**

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client:	Lend Lease Building Pty Ltd
project:	USYD Health Precinct Blackburn Building, University of Sydney - Camperdown Campus
title:	**CORE PHOTOGRAPH** **BH5**
project no: GEOTLCOV25283AF	fig no: **FIGURE 1** rev:

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Engineering Log - Borehole

Borehole ID.	**BH6**
sheet:	1 of 3
project no.	**GEOTLCOV25283AF**
client:	***Lend Lease Building Pty Ltd***
date started:	***14 Nov 2016***
principal:	
date completed:	***14 Nov 2016***
project:	***USYD Health Precinct***
logged by:	***SM***
location:	***Blackburn Building, University of Sydney - Camperdown Campus***
checked by:	***DS***

position: E: 332,138.86; N: 6,248,690.09 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

drill model: Commacchio 205, Track mounted drilling fluid: hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA			E					**ASPHALT**: 50mm.	D			**ROAD SURFACE**
								FILL: Gravelly SAND: fine to coarse grained, brown-dark brown, gravel is sub-rounded to sub-angular, with coarse to medium clay.				**FILL** PID = 11.2ppm PID = 10.8ppm
			E	21								
			E		1.0			**FILL: Sandy CLAY**: medium plasticity, brown-dark brown, sand is fine to coarse, with some gravel sub-rounded to sub-angular.	<Wp			PID = 13.1ppm
			SPT 4, 6, 8 N*=14	20				**FILL: CLAY**: medium plasticity, brown with red mottling, with trace of sand fine to medium.				PID = 8.1ppm
					2.0		CI-CH	**CLAY**: medium to high plasticity, brown-red, with some ironstone gravel.	<Wp	St		**RESIDUAL SOIL** PID = 9.8ppm
				19	3.0				>Wp	VSt		
			SPT 9, 12, 16 N*=28	18								
					4.0			**SHALE**: high plasticity, red-brown, extremely weathered, with clay lenses, very low strength.				
AD/T			SPT 9, 17, 23 N*=40	17	5.0			4.9 m: becoming grey-pale grey, very low to low strength, highly to moderately weathered				
				16	6.0							
				15	7.0							
				14								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Borehole

Borehole ID.	**BH6**
sheet:	2 of 3
project no.	**GEOTLCOV25283AF**
date started:	**14 Nov 2016**
date completed:	**14 Nov 2016**
logged by:	**SM**
checked by:	**DS**

client: ***Lend Lease Building Pty Ltd***

principal:

project: ***USYD Health Precinct***

location: ***Blackburn Building, University of Sydney - Camperdown Campus***

position: E: 332,138.86; N: 6,248,690.09 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

drill model: Commacchio 205, Track mounted drilling fluid: hole diameter : 100 mm

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
			SPT 20/90mm HB N*=R					Borehole BH6 continued as cored hole				
				13	9.0							
				12	10.0							
				11	11.0							
				10	12.0							
				9	13.0							
				8	14.0							
				7	15.0							
				6								

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED GEOTLCOV25283AF.GPJ <<DrawingFile>> 09/12/2016 16:15

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Cored Borehole

Borehole ID.	**BH6**
sheet:	3 of 3
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **14 Nov 2016**
principal:	date completed: **14 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,138.86; N: 6,248,690.09 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) — angle from horizontal: 90°

drill model: Commacchio 205, Track mounted — drilling fluid: — hole diameter : 100 mm — vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description: ROCK TYPE: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
NMLC		13	9.0		started coring at 8.06m							
					SHALE: dark grey, pale grey, distinctly laminated at 0°-10°.	FR		a=0.40 d=0.10	28%		CS, PL, SO, CN JT, 75°, PL, SO, CN Multiple fractures JT, 80°, PL, SO, CN	
		12	10.0					a=0.71 d=0.24			SM, PL, Shale, 20 mm	
								a=1.27 d=0.39	44%		JT, 60°, CU, SO, CN SM, Shale, 10 mm Multiple drill breaking	
		11	11.0					a=1.69 d=0.76	67%		PT, CU, SO, CN JT, 70 - 90°, PL, SO, CN	
		10	12.0					a=1.47 d=0.83				
		9	13.0		Borehole BH6 terminated at 12.30 m							
		8	14.0									
		7	15.0									
		6										

Defects are: PT, 0 - 10°, PL, SO, CN, unless otherwise described

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

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

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

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

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

*W replaced with A for alteration

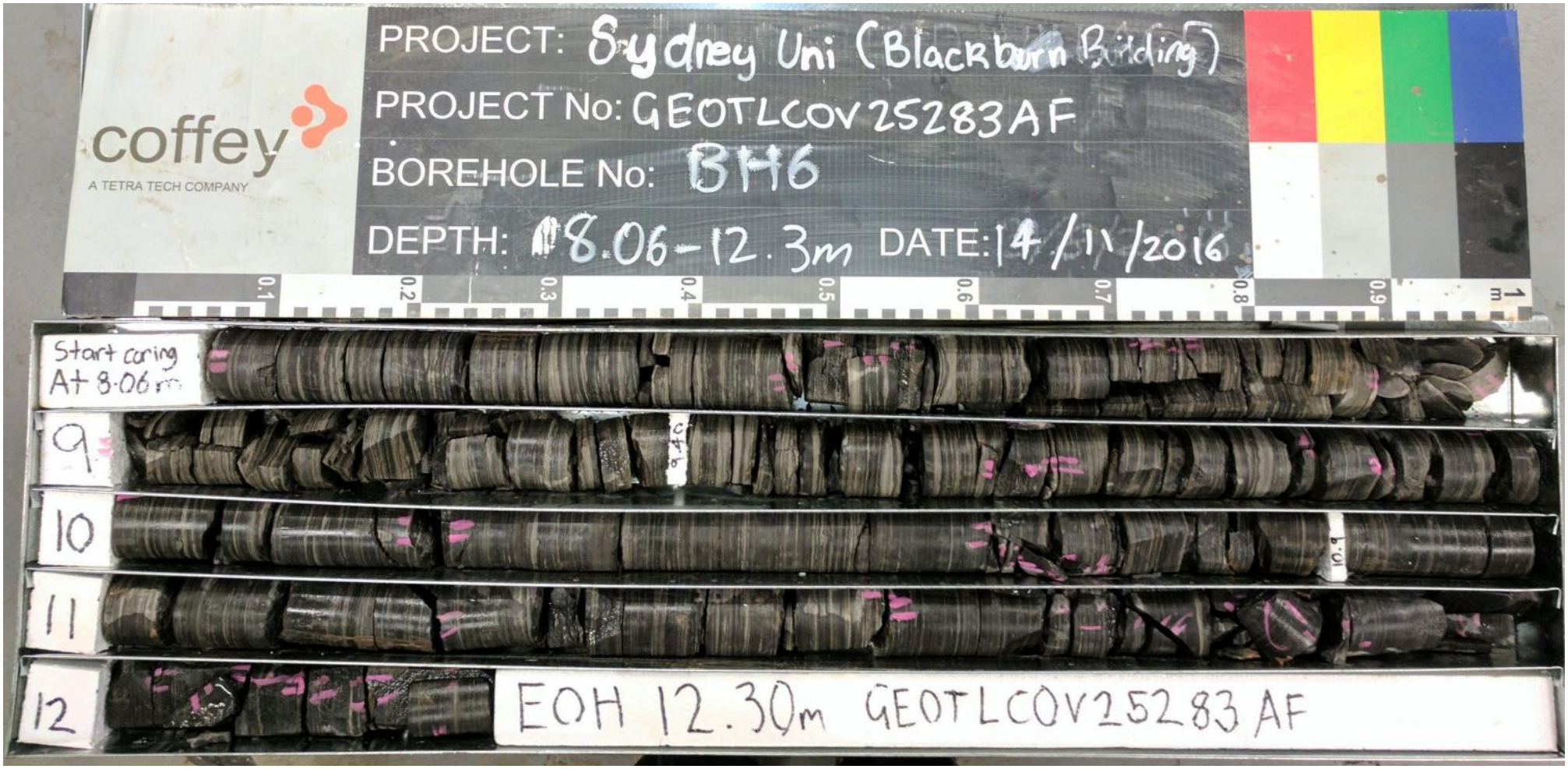
strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

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

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

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



BH6 8.06 - 12.30 m

drawn	**AW**
approved	**DS**
date	**8/12/2016**
scale	**N.T.S.**
original size	**A4**

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client: Lend Lease Building Pty Ltd

project: USYD Health Precinct
Blackburn Building, University of Sydney - Camperdown Campus

title: **CORE PHOTOGRAPH**
BH6

project no: GEOTLCOV25283AF | fig no: **FIGURE 1** | rev:

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Piezometer Installation Log

Hole ID.	**BH6**
sheet:	1 of 1
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **14 Nov 2016**
principal:	date completed: **14 Nov 2016**
project: **USYD Health Precinct**	logged by: **SM**
location: **Blackburn Building, University of Sydney - Camperdown Campus**	checked by: **DS**

position: E: 332,138.86; N: 6,248,690.09 (MGA94 Zone 56) surface elevation: 21.90 m (AHD) angle from horizontal: 90°

equipment type: Commacchio 205, Track mounted drilling fluid: hole diameter : 100 mm

drilling information | **material substance** | **piezometer construction details**

method & support	water	RL (m)	depth (m)	graphic log	material name
HA		20	1		**ROAD SURFACE**
					FILL
			2		**RESIDUAL SOIL**
AD/T		18	3		
			4		
		16	5		
			6		
		14	7		
			8		
NMLC		12	9		
			10		
		10	11		
			12		
		8	13		
			14		
		6	15		

BH6

bore construction license:
drilling company:
driller:
driller's permit no.:

Cuttings

3.00 m

Bentonite

4.00 m

Sand

12.00 m

method & support
see engineering log for details

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

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

ID	type	installation date	stickup (m)	tip depth (m)	water level (m)	Relative Levels (AHD) stickup	tip	water level
BH6	standpipe piezo.			12.00 m			9.90	

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Engineering Log - Borehole

Borehole ID.	***HA01***
sheet:	1 of 1
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***24 Nov 2016***
principal:	date completed: ***24 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SB***
location: ***Near Oval 1 - University of Sydney - Camperdown Campus***	checked by: ***DS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°
drill model: | drilling fluid: | hole diameter :

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA N			E					**CONCRETE**: 130mm.				**ROAD SURFACE**
			E		0.5		CL	**FILL: Gravelly SAND**: medium to coarse grained, dark brown, gravel is sub-angular. **CLAY**: low plasticity, dark brown to dark red, orange.	<Wp	St		**FILL** No odour or ACM observed PID = 3.2ppm (DUP01) **RESIDUAL SOIL** No odour or ACM observed PID = 2.1ppm
					1.0 1.5			Borehole HA01 terminated at 0.7 m Target depth Natural material encountered				

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
HA hand auger

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3
no resistance ranging to refusal

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

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

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

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Engineering Log - Borehole

Borehole ID.	***HA02***
sheet:	1 of 1
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***24 Nov 2016***
principal:	date completed: ***24 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SB***
location: ***Near Oval 1 - University of Sydney - Camperdown Campus***	checked by: ***DS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter :

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA N			E					**ASPHALT**: 25mm.				**ROAD SURFACE**
								FILL: Gravelly SAND: medium to coarse grained, dark brown/grey, medium grained sub-angular gravel, clay traces, crushed concrete fines, sub-angular sandstone pieces.	M			**FILL** No odour or ACM observed PID = 2.0ppm
							CL	**CLAY**: dark brown/orange/red, grading to pale brown colour.	<Wp	St		**RESIDUAL SOIL** No odour or ACM observed PID = 3.3ppm
			E		0.5							
					1.0			Borehole HA02 terminated at 0.7 m Target depth Natural material encountered at 0.3m				
					1.5							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Borehole

Borehole ID.	***HA03***
sheet:	1 of 1
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***22 Nov 2016***
principal:	date completed: ***22 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SB***
location: ***Near Oval 1 - University of Sydney - Camperdown Campus***	checked by: ***DS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter :

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA, N			E					**PAVER**: 30mm.				**ROAD SURFACE**
								FILL: Silty CLAY: brown, black, red.	M			**FILL** Slight HC odour - some light green staining, no ACM observed PID = 2.7ppm
							CH	**Silty CLAY**: orange/pale brown.	<Wp	St		**RESIDUAL SOIL**
			E									Ash layer, no odour or ACM observed PID = 2.0ppm
					0.5		CH	**Silty CLAY**: pale brown, ash layer observed.				
								Borehole HA03 terminated at 0.7 m Natural material				
					1.0							
					1.5							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Borehole

Borehole ID.	***HA04***
sheet:	1 of 1
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***22 Nov 2016***
principal:	date completed: ***22 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SB***
location: ***Near Oval 1 - University of Sydney - Camperdown Campus***	checked by: ***DS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°
drill model: | drilling fluid: | hole diameter :

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA N			E					**PAVER**: 40mm.				**ROAD SURFACE**
								FILL: Gravelly SAND: medium to coarse grained, grey/pale brown, sub-angular gravels.	D			**FILL** No odour or ACM observed PID = 1.5ppm
								FILL: Silty CLAY: dark brown to pale brown, medium to coarse grained. 0.3 m: with some paving sand	<Wp			
			E		0.5							No odour or ACM observed PID = 1.2ppm
								Silty CLAY: low plasticity, black, orange.		St		**RESIDUAL SOIL**
			E									No odour or ACM observed PID = 0.6ppm
					1.0			Borehole HA04 terminated at 1.0 m Target depth Natural material				
					1.5							

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
HA hand auger

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

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

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

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

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Engineering Log - Borehole

Borehole ID.	***HA05***
sheet:	1 of 1
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***22 Nov 2016***
principal:	date completed: ***22 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SB***
location: ***Near Oval 1 - University of Sydney - Camperdown Campus***	checked by: ***DS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°

drill model: | drilling fluid: | hole diameter :

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA / N			E					**TOPSOIL**: with grass roots.	D			**TOPSOIL** No odour or ACM observed PID = 1.6ppm
								FILL: Silty CLAY: low plasticity, pale to dark brown, with medium grained sub-angular gravel.				**FILL**
								FILL: Silty CLAY: low plasticity, red brown, with organics and rootlets, grading to black.	D - M			
			E		0.5							No odour or ACM observed PID = 0.5ppm
								Borehole HA05 terminated at 0.6 m Refusal on tree root				
					1.0							
					1.5							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- HA hand auger

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

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

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

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

consistency / relative density

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

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Engineering Log - Borehole

Borehole ID.	**HA06**
sheet:	1 of 1
project no.	**GEOTLCOV25283AF**
client: **Lend Lease Building Pty Ltd**	date started: **22 Nov 2016**
principal:	date completed: **22 Nov 2016**
project: **USYD Health Precinct**	logged by: **SB**
location: **Near Oval 1 - University of Sydney - Camperdown Campus**	checked by: **DS**

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°
drill model: | drilling fluid: | hole diameter :

drilling information						material substance						
method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA N			E					**TOPSOIL**: with grass.	D			**TOPSOIL** No odour or ACM observed PID = 1.3ppm
							CL	**FILL: Silty CLAY**: low plasticity, brown to pale brown, with some fine grained sub-angular gravel, with some plastic and rootlets.				**FILL**
							CL	**FILL: Silty CLAY**: low plasticity, brown to yellow, with some fine to medium grained sub-angular gravel, with some rootlets.				
			E		0.5							No odour or ACM observed PID = 2.8ppm
			E					0.9 m: with some brick fragments				No odour or ACM observed PID = 3.1ppm
					1.0			Borehole HA06 terminated at 1.0 m Target depth				
					1.5							

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
HA hand auger

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3
no resistance ranging to refusal

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

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

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

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Engineering Log - Borehole

Borehole ID.	***HA07***
sheet:	1 of 1
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***24 Nov 2016***
principal:	date completed: ***24 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SB***
location: ***Near Oval 1 - University of Sydney - Camperdown Campus***	checked by: ***DS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°
drill model: | drilling fluid: | hole diameter :

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA N			E					**TOPSOIL**: with grass.	D			**TOPSOIL**
								FILL: SILTY SAND: fine grained, dark brown to black, with rootlets, organics and wood chip fragments.	M			**FILL** No odour or ACM observed PID = 4.3ppm
			E		0.5			**FILL: Sandy CLAY**: low plasticity, light brown, fine to medium grained sand, trace of grey/red clays, trace crushed concrete.				No odour or ACM observed PID = 1.3ppm
							CL	**Sandy CLAY**: low plasticity, light brown.				**RESIDUAL SOIL**
			E									No odour or ACM observed PID = 6.6ppm
					1.0			Borehole HA07 terminated at 1.0 m Target depth				
					1.5							

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
HA hand auger

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3
no resistance ranging to refusal

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

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

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

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Engineering Log - Borehole

Borehole ID.	***HA08***
sheet:	1 of 1
project no.	***GEOTLCOV25283AF***
client: ***Lend Lease Building Pty Ltd***	date started: ***24 Nov 2016***
principal:	date completed: ***24 Nov 2016***
project: ***USYD Health Precinct***	logged by: ***SB***
location: ***Near Oval 1 - University of Sydney - Camperdown Campus***	checked by: ***DS***

position: Not Specified | surface elevation: Not Specified | angle from horizontal: 90°
drill model: | drilling fluid: | hole diameter :

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
HA N								**TOPSOIL**: with grass and wood chips.	M			**TOPSOIL**
			E					**FILL: SILTY SAND**: fine grained, dark brown to black, with rootlets, organics and wood traces.				**FILL** No odour or ACM observed PID = 4.7ppm
			E		0.5		CL	**Sandy CLAY**: low plasticity, pale brown, fine to medium grained sand.	<Wp	St		**RESIDUAL SOIL** No odour or ACM observed PID = 5.0ppm
			E				CL	**CLAY**: low plasticity, white grey red.				PID = 4.2ppm
					1.0			Borehole HA08 terminated at 1.0 m Target depth				
					1.5							

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method
AD auger drilling*
AS auger screwing*
HA hand auger
W washbore
HA hand auger

* bit shown by suffix
e.g. AD/T
B blank bit
T TC bit
V V bit

support
M mud
C casing
N nil

penetration
1 2 3 no resistance ranging to refusal

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

samples & field tests
B bulk disturbed sample
D disturbed sample
E environmental sample
SS split spoon sample
U## undisturbed sample ##mm diameter
HP hand penetrometer (kPa)
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
VS vane shear; peak/remouded (kPa)
R refusal
HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
D dry
M moist
W wet
Wp plastic limit
Wl liquid limit

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

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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

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

CLASSIFICATION SYMBOL & SOIL NAME

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

PARTICLE SIZE DESCRIPTIVE TERMS

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

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

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

DENSITY OF GRANULAR SOILS

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

MINOR COMPONENTS

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

SOIL STRUCTURE

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

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

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

TRANSPORTED SOILS

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

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Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

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

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

COMMON DEFECTS IN SOIL

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

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

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Rock Description Explanation Sheet (1 of 2)

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

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

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

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

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

Notes on Weathering:

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

ROCK SUBSTANCE STRENGTH TERMS

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

Notes on Rock Substance Strength:

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

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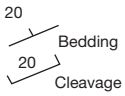
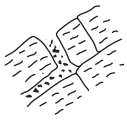
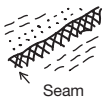
Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES

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

DEFECT SHAPE TERMS

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

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

ROUGHNESS TERMS

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

COATING TERMS

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

BLOCK SHAPE TERMS

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

Notes on Defects:

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

Appendix B – Laboratory Test Results

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 9352 5000

Report No: SYDN16S-07749-1
Issue No: 1

Material Test Report

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00023AA
Project Name:	754-GEOTLCOV25283AF - 754 USYD Health Precinct
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Lachlan Smith
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 5/12/2016

Sample Details

Sample ID:	SYDN16S-07749
Client Sample:	1
Date Sampled:	22/11/2016
Source:	Borehole
Material:	Existing
Specification:	AS Grading
Sampling Method:	Submitted by client
Project Location:	Sydney University, Blackburn Building.
Sample Location:	BH3 4.5m-4.95m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	15.1	
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	16.0	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	49	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	26	
Plasticity Index (%)	AS 1289.3.3.1	23	

Particle Size Distribution

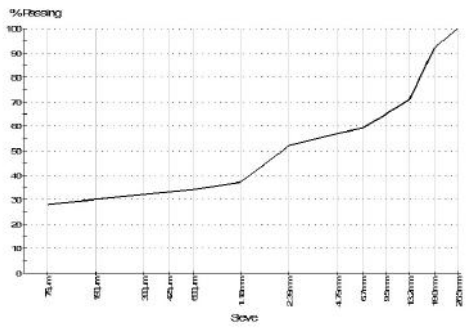
Method: AS 1289.3.6.1

Date Tested: 1/12/2016

Note: Sample Washed

Sieve Size	% Passing	Limits
26.5mm	100	
19.0mm	92	
13.2mm	71	
9.5mm	65	
6.7mm	59	
4.75mm	57	
2.36mm	52	
1.18mm	37	
600µm	34	
425µm	33	
300µm	32	
150µm	30	
75µm	28	

Chart



Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 9352 5000

Report No: SYDN16S-07750-1
Issue No: 1

Material Test Report

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00023AA
Project Name:	754-GEOTLCOV25283AF - 754 USYD Health Precinct
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Lachlan Smith
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 5/12/2016

Sample Details

Sample ID:	SYDN16S-07750
Client Sample:	2
Date Sampled:	22/11/2016
Source:	Borehole
Material:	Existing
Specification:	AS Grading
Sampling Method:	Submitted by client
Project Location:	Sydney University, Blackburn Building.
Sample Location:	BH4: 1.5 - 1.95m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	16.9	
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	6.5	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	43	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	24	
Plasticity Index (%)	AS 1289.3.3.1	19	

Particle Size Distribution

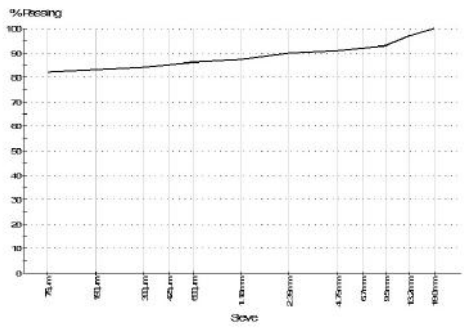
Method: AS 1289.3.6.1

Date Tested: 1/12/2016

Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	97	
9.5mm	93	
6.7mm	92	
4.75mm	91	
2.36mm	90	
1.18mm	87	
600µm	86	
425µm	85	
300µm	84	
150µm	83	
75µm	82	

Chart



Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 9352 5000

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Material Test Report

Report No: SYDN16S-07751-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00023AA
Project Name:	754-GEOTLCOV25283AF - 754 USYD Health Precinct
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Lachlan Smith
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 5/12/2016

Sample Details

Sample ID:	SYDN16S-07751
Client Sample:	3
Date Sampled:	22/11/2016
Source:	Borehole
Material:	Existing
Specification:	AS Grading
Sampling Method:	Submitted by client
Project Location:	Sydney University, Blackburn Building.
Sample Location:	HA03 0.6m-0.7m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	30.4	
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.5	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	43	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	24	
Plasticity Index (%)	AS 1289.3.3.1	19	

Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 9352 5000

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Material Test Report

Report No: SYDN16S-07752-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00023AA
Project Name:	754-GEOTLCOV25283AF - 754 USYD Health Precinct
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Lachlan Smith
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 5/12/2016

Sample Details

Sample ID:	SYDN16S-07752
Client Sample:	4
Date Sampled:	22/11/2016
Source:	Borehole
Material:	Existing
Specification:	AS Grading
Sampling Method:	Submitted by client
Project Location:	Sydney University, Blackburn Building.
Sample Location:	HA04 0.9m-1.0m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	16.4	
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.0	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	33	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	21	
Plasticity Index (%)	AS 1289.3.3.1	12	

Comments

N/A

Sydney Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
31 Hope Street
Melrose Park NSW 2114

Phone: +61 (2) 9352 5000

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Material Test Report

Report No: SYDN16S-07753-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Chatswood) Level 19, 799 Pacific Highway Chatswood NSW 2067
Principal:	
Project No.:	754-SYDN00023AA
Project Name:	754-GEOTLCOV25283AF - 754 USYD Health Precinct
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Lachlan Smith
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 5/12/2016

Sample Details

Sample ID:	SYDN16S-07753
Client Sample:	5
Date Sampled:	22/11/2016
Source:	Borehole
Material:	Existing
Specification:	AS Grading
Sampling Method:	Submitted by client
Project Location:	Sydney University, Blackburn Building.
Sample Location:	HA06 0.3m-0.4m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.4	
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	1.5	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	29	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	25	
Plasticity Index (%)	AS 1289.3.3.1	4	

Comments

N/A

eurofins | mgt

Certificate of Analysis

Coffey Geotechnics Pty Ltd Chatswood
Level 18, Tower B, Citadel Tower 799 Pacific Highway
Chatswood
NSW 2067

NATA Accredited
Accreditation Number 1261
Site Number 18217

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

Attention: **Alex Ructtinger**

Report **524268-S**
Project name USYD HEALTH(CONTAMINATION)
Project ID GEOTLCOV25283AF
Received Date Nov 17, 2016

Client Sample ID			**BH4_1_0.0-0.2m**	**BH4_2_0.5m**	**BH2_1_0-0.2**	**BH2_2_0.5**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S16-No16921**	**S16-No16922**	**S16-No16926**	**S16-No16927**
Date Sampled			**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	80	62	83	73
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	1.8	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	2.0	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	2.3	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	0.7	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	1.3	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	1.3	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	1.2	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	1.1	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	1.0	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	1.0	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	4.1	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	0.8	< 0.5	< 0.5	< 0.5

Client Sample ID			BH4_1_0.0-0.2m	BH4_2_0.5m	BH2_1_0-0.2	BH2_2_0.5
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S16-No16921**	**S16-No16922**	**S16-No16926**	**S16-No16927**
Date Sampled			**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	3.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	3.3	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	19.8	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	93	100	93	91
p-Terphenyl-d14 (surr.)	1	%	101	108	103	100
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
4.4'-DDD	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
4.4'-DDE	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
4.4'-DDT	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
a-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Aldrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
b-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
d-BHC	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Dieldrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan I	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan II	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endosulfan sulphate	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin aldehyde	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Endrin ketone	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
g-BHC (Lindane)	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Heptachlor	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Heptachlor epoxide	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Hexachlorobenzene	0.05	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05
Methoxychlor	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
Toxaphene	1	mg/kg	< 1	< 1	< 1	< 1
Dibutylchlorendate (surr.)	1	%	82	85	90	92
Tetrachloro-m-xylene (surr.)	1	%	89	101	102	99
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
Semivolatile Organics						
2-Methyl-4.6-dinitrophenol	5	mg/kg	-	< 5	-	-
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	-	< 0.5	-	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	-	0.6	-	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	-	1.2	-	-
1-Chloronaphthalene	0.5	mg/kg	-	< 0.5	-	-
1-Naphthylamine	0.5	mg/kg	-	< 0.5	-	-
1.2-Dichlorobenzene	0.5	mg/kg	-	< 0.5	-	-
1.2.3-Trichlorobenzene	0.5	mg/kg	-	< 0.5	-	-
1.2.3.4-Tetrachlorobenzene	0.5	mg/kg	-	< 0.5	-	-
1.2.3.5-Tetrachlorobenzene	0.5	mg/kg	-	< 0.5	-	-
1.2.4-Trichlorobenzene	0.5	mg/kg	-	< 0.5	-	-
1.2.4.5-Tetrachlorobenzene	0.5	mg/kg	-	< 0.5	-	-
1.3-Dichlorobenzene	0.5	mg/kg	-	< 0.5	-	-
1.3.5-Trichlorobenzene	0.5	mg/kg	-	< 0.5	-	-

Client Sample ID			BH4_1_0.0-0.2m	BH4_2_0.5m	BH2_1_0-0.2	BH2_2_0.5
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S16-No16921**	**S16-No16922**	**S16-No16926**	**S16-No16927**
Date Sampled			**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**
Test/Reference	LOR	Unit				
Semivolatile Organics						
1.4-Dichlorobenzene	0.5	mg/kg	-	< 0.5	-	-
2-Chloronaphthalene	0.5	mg/kg	-	< 0.5	-	-
2-Chlorophenol	0.5	mg/kg	-	< 0.5	-	-
2-Methylnaphthalene	0.5	mg/kg	-	< 0.5	-	-
2-Methylphenol (o-Cresol)	0.2	mg/kg	-	< 0.2	-	-
2-Naphthylamine	0.5	mg/kg	-	< 0.5	-	-
2-Nitroaniline	1	mg/kg	-	< 1	-	-
2-Nitrophenol	1	mg/kg	-	< 1	-	-
2-Picoline	0.5	mg/kg	-	< 0.5	-	-
2.3.4.6-Tetrachlorophenol	0.5	mg/kg	-	< 0.5	-	-
2.4-Dichlorophenol	0.5	mg/kg	-	< 0.5	-	-
2.4-Dimethylphenol	0.5	mg/kg	-	< 0.5	-	-
2.4-Dinitrophenol	5	mg/kg	-	< 5	-	-
2.4-Dinitrotoluene	1	mg/kg	-	< 1	-	-
2.4.5-Trichlorophenol	1	mg/kg	-	< 1	-	-
2.4.6-Trichlorophenol	1.0	mg/kg	-	< 1	-	-
2.6-Dichlorophenol	0.5	mg/kg	-	< 0.5	-	-
2.6-Dinitrotoluene	1	mg/kg	-	< 1	-	-
3&4-Methylphenol (m&p-Cresol)	0.4	mg/kg	-	< 0.4	-	-
3-Methylcholanthrene	0.5	mg/kg	-	< 0.5	-	-
3.3'-Dichlorobenzidine	0.5	mg/kg	-	< 0.5	-	-
4-Aminobiphenyl	0.5	mg/kg	-	< 0.5	-	-
4-Bromophenyl phenyl ether	0.5	mg/kg	-	< 0.5	-	-
4-Chloro-3-methylphenol	1.0	mg/kg	-	< 1	-	-
4-Chlorophenyl phenyl ether	0.5	mg/kg	-	< 0.5	-	-
4-Nitrophenol	5	mg/kg	-	< 5	-	-
4.4'-DDD	0.5	mg/kg	-	< 0.5	-	-
4.4'-DDE	0.5	mg/kg	-	< 0.5	-	-
4.4'-DDT	1	mg/kg	-	< 1	-	-
7.12-Dimethylbenz(a)anthracene	0.5	mg/kg	-	< 0.5	-	-
a-BHC	0.5	mg/kg	-	< 0.5	-	-
Acenaphthene	0.5	mg/kg	-	< 0.5	-	-
Acenaphthylene	0.5	mg/kg	-	< 0.5	-	-
Acetophenone	0.5	mg/kg	-	< 0.5	-	-
Aldrin	0.5	mg/kg	-	< 0.5	-	-
Aniline	0.5	mg/kg	-	< 0.5	-	-
Anthracene	0.5	mg/kg	-	< 0.5	-	-
b-BHC	0.5	mg/kg	-	< 0.5	-	-
Benz(a)anthracene	0.5	mg/kg	-	< 0.5	-	-
Benzo(a)pyrene	0.5	mg/kg	-	< 0.5	-	-
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	-	< 0.5	-	-
Benzo(g.h.i)perylene	0.5	mg/kg	-	< 0.5	-	-
Benzo(k)fluoranthene	0.5	mg/kg	-	< 0.5	-	-
Benzyl chloride	0.5	mg/kg	-	< 0.5	-	-
Bis(2-chloroethoxy)methane	0.5	mg/kg	-	< 0.5	-	-
Bis(2-chloroisopropyl)ether	0.5	mg/kg	-	< 0.5	-	-
Bis(2-ethylhexyl)phthalate	5	mg/kg	-	< 5	-	-
Butyl benzyl phthalate	0.5	mg/kg	-	< 0.5	-	-
Chrysene	0.5	mg/kg	-	< 0.5	-	-

Client Sample ID			BH4_1_0.0-0.2m	BH4_2_0.5m	BH2_1_0-0.2	BH2_2_0.5
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S16-No16921**	**S16-No16922**	**S16-No16926**	**S16-No16927**
Date Sampled			**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**
Test/Reference	LOR	Unit				
Semivolatile Organics						
d-BHC	0.5	mg/kg	-	< 0.5	-	-
Di-n-butyl phthalate	0.5	mg/kg	-	< 0.5	-	-
Di-n-octyl phthalate	0.5	mg/kg	-	< 0.5	-	-
Dibenz(a.h)anthracene	0.5	mg/kg	-	< 0.5	-	-
Dibenz(a.j)acridine	0.5	mg/kg	-	< 0.5	-	-
Dibenzofuran	0.5	mg/kg	-	< 0.5	-	-
Dieldrin	0.5	mg/kg	-	< 0.5	-	-
Diethyl phthalate	0.5	mg/kg	-	< 0.5	-	-
Dimethyl phthalate	0.5	mg/kg	-	< 0.5	-	-
Dimethylaminoazobenzene	0.5	mg/kg	-	< 0.5	-	-
Diphenylamine	0.5	mg/kg	-	< 0.5	-	-
Endosulfan I	0.5	mg/kg	-	< 0.5	-	-
Endosulfan II	0.5	mg/kg	-	< 0.5	-	-
Endosulfan sulphate	0.5	mg/kg	-	< 0.5	-	-
Endrin	0.5	mg/kg	-	< 0.5	-	-
Endrin aldehyde	0.5	mg/kg	-	< 0.5	-	-
Endrin ketone	0.5	mg/kg	-	< 0.5	-	-
Fluoranthene	0.5	mg/kg	-	< 0.5	-	-
Fluorene	0.5	mg/kg	-	< 0.5	-	-
g-BHC (Lindane)	0.5	mg/kg	-	< 0.5	-	-
Heptachlor	0.5	mg/kg	-	< 0.5	-	-
Heptachlor epoxide	0.5	mg/kg	-	< 0.5	-	-
Hexachlorobenzene	0.5	mg/kg	-	< 0.5	-	-
Hexachlorobutadiene	0.5	mg/kg	-	< 0.5	-	-
Hexachlorocyclopentadiene	1	mg/kg	-	< 1	-	-
Hexachloroethane	0.5	mg/kg	-	< 0.5	-	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	-	< 0.5	-	-
Methoxychlor	0.5	mg/kg	-	< 0.5	-	-
N-Nitrosodibutylamine	0.5	mg/kg	-	< 0.5	-	-
N-Nitrosodipropylamine	0.5	mg/kg	-	< 0.5	-	-
N-Nitrosopiperidine	0.5	mg/kg	-	< 0.5	-	-
Naphthalene	0.5	mg/kg	-	< 0.5	-	-
Nitrobenzene	0.5	mg/kg	-	< 0.5	-	-
Pentachlorobenzene	0.5	mg/kg	-	< 0.5	-	-
Pentachloronitrobenzene	0.5	mg/kg	-	< 0.5	-	-
Pentachlorophenol	1.0	mg/kg	-	< 1	-	-
Phenanthrene	0.5	mg/kg	-	< 0.5	-	-
Phenol	0.5	mg/kg	-	< 0.5	-	-
Pronamide	0.5	mg/kg	-	< 0.5	-	-
Pyrene	0.5	mg/kg	-	< 0.5	-	-
Trifluralin	0.5	mg/kg	-	< 0.5	-	-
Phenol-d6 (surr.)	1	%	-	70	-	-
Nitrobenzene-d5 (surr.)	1	%	-	89	-	-
2-Fluorobiphenyl (surr.)	1	%	-	100	-	-
2.4.6-Tribromophenol (surr.)	1	%	-		-	-
% Moisture	1	%	6.4	18	19	20

Client Sample ID			BH4_1_0.0-0.2m	BH4_2_0.5m	BH2_1_0-0.2	BH2_2_0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-No16921	S16-No16922	S16-No16926	S16-No16927
Date Sampled			Nov 15, 2016	Nov 15, 2016	Nov 15, 2016	Nov 15, 2016
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	2	mg/kg	< 2	3.2	< 2	< 2
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	8.6	< 5	8.7	< 5
Copper	5	mg/kg	68	11	13	7.8
Lead	5	mg/kg	27	21	30	20
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	56	< 5	< 5	< 5
Zinc	5	mg/kg	63	5.6	12	< 5

Client Sample ID			DUP1	BH2_3	BH6_5	BH4_4
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-No16928	S16-No16929	S16-No16930	S16-No16931
Date Sampled			Nov 15, 2016	Nov 15, 2016	Nov 15, 2016	Nov 15, 2016
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	-	-
TRH C10-C14	20	mg/kg	< 20	< 20	-	-
TRH C15-C28	50	mg/kg	< 50	< 50	-	-
TRH C29-C36	50	mg/kg	< 50	< 50	-	-
TRH C10-36 (Total)	50	mg/kg	< 50	< 50	-	-
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	-	-
Toluene	0.1	mg/kg	< 0.1	< 0.1	-	-
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	-	-
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	-	-
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	-	-
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	-	-
4-Bromofluorobenzene (surr.)	1	%	81	80	-	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	-	-
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	-	-
TRH C6-C10	20	mg/kg	< 20	< 20	-	-
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	-	-
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	-	-
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	-	-
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	-	-
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	-	-
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	-	-
Anthracene	0.5	mg/kg	< 0.5	< 0.5	-	-
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	-	-
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	-	-
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	-	-
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	-	-
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	-	-
Chrysene	0.5	mg/kg	< 0.5	< 0.5	-	-
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	-	-

Client Sample ID			DUP1	BH2_3	BH6_5	BH4_4
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			S16-No16928	S16-No16929	S16-No16930	S16-No16931
Date Sampled			Nov 15, 2016	Nov 15, 2016	Nov 15, 2016	Nov 15, 2016
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	-	-
Fluorene	0.5	mg/kg	< 0.5	< 0.5	-	-
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	-	-
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	-	-
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	-	-
Pyrene	0.5	mg/kg	< 0.5	< 0.5	-	-
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	-	-
2-Fluorobiphenyl (surr.)	1	%	93	100	-	-
p-Terphenyl-d14 (surr.)	1	%	100	110	-	-
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	< 0.1	-	-
4.4'-DDD	0.05	mg/kg	< 0.05	< 0.05	-	-
4.4'-DDE	0.05	mg/kg	< 0.05	< 0.05	-	-
4.4'-DDT	0.05	mg/kg	< 0.05	< 0.05	-	-
a-BHC	0.05	mg/kg	< 0.05	< 0.05	-	-
Aldrin	0.05	mg/kg	< 0.05	< 0.05	-	-
b-BHC	0.05	mg/kg	< 0.05	< 0.05	-	-
d-BHC	0.05	mg/kg	< 0.05	< 0.05	-	-
Dieldrin	0.05	mg/kg	< 0.05	< 0.05	-	-
Endosulfan I	0.05	mg/kg	< 0.05	< 0.05	-	-
Endosulfan II	0.05	mg/kg	< 0.05	< 0.05	-	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	< 0.05	-	-
Endrin	0.05	mg/kg	< 0.05	< 0.05	-	-
Endrin aldehyde	0.05	mg/kg	< 0.05	< 0.05	-	-
Endrin ketone	0.05	mg/kg	< 0.05	< 0.05	-	-
g-BHC (Lindane)	0.05	mg/kg	< 0.05	< 0.05	-	-
Heptachlor	0.05	mg/kg	< 0.05	< 0.05	-	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	< 0.05	-	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	< 0.05	-	-
Methoxychlor	0.2	mg/kg	< 0.2	< 0.2	-	-
Toxaphene	1	mg/kg	< 1	< 1	-	-
Dibutylchlorendate (surr.)	1	%	120	123	-	-
Tetrachloro-m-xylene (surr.)	1	%	100	93	-	-
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
TRH >C10-C16	50	mg/kg	< 50	< 50	-	-
TRH >C16-C34	100	mg/kg	< 100	< 100	-	-
TRH >C34-C40	100	mg/kg	< 100	< 100	-	-
Chloride	10	mg/kg	-	-	39	14
pH (1:5 Aqueous extract)	0.1	pH Units	-	-	4.4	5.3
Sulphate as SO4 (1:5 aqueous extract)	10	mg/kg	-	-	250	170
% Moisture	1	%	19	18	21	15
Heavy Metals						
Arsenic	2	mg/kg	2.2	< 2	-	-
Cadmium	0.4	mg/kg	< 0.4	< 0.4	-	-
Chromium	5	mg/kg	9.5	15	-	-
Copper	5	mg/kg	10	20	-	-
Lead	5	mg/kg	26	41	-	-
Mercury	0.1	mg/kg	< 0.1	< 0.1	-	-

Client Sample ID			DUP1	BH2_3	BH6_5	BH4_4
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S16-No16928**	**S16-No16929**	**S16-No16930**	**S16-No16931**
Date Sampled			**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**	**Nov 15, 2016**
Test/Reference	LOR	Unit				
Heavy Metals						
Nickel	5	mg/kg	< 5	7.8	-	-
Zinc	5	mg/kg	5.4	22	-	-

Client Sample ID			BH2_5	BH2_6
Sample Matrix			**Soil**	**Soil**
Eurofins | mgt Sample No.			**S16-No16932**	**S16-No16933**
Date Sampled			**Nov 15, 2016**	**Nov 15, 2016**
Test/Reference	LOR	Unit		
Chloride	10	mg/kg	< 10	32
pH (1:5 Aqueous extract)	0.1	pH Units	4.5	4.4
Sulphate as SO4 (1:5 aqueous extract)	10	mg/kg	100	150
% Moisture	1	%	21	20

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Sydney	Nov 22, 2016	14 Day
- Method: TRH C6-C36 - LTM-ORG-2010			
BTEX	Sydney	Nov 21, 2016	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Nov 21, 2016	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Eurofins | mgt Suite B4			
Polycyclic Aromatic Hydrocarbons	Sydney	Nov 22, 2016	14 Day
- Method: E007 Polyaromatic Hydrocarbons (PAH)			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Sydney	Nov 21, 2016	14 Day
- Method: TRH C6-C40 - LTM-ORG-2010			
Organochlorine Pesticides	Sydney	Nov 22, 2016	14 Day
- Method: E013 Organochlorine Pesticides (OC)			
Semivolatile Organics	Sydney	Nov 22, 2016	14 Day
- Method: USEPA 8270 Semivolatile Organics			
Chloride	Sydney	Nov 22, 2016	28 Day
- Method: E033 /E045 /E047 Chloride			
pH (1:5 Aqueous extract)	Sydney	Nov 22, 2016	7 Day
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate as SO4 (1:5 aqueous extract)	Sydney	Nov 22, 2016	28 Day
- Method: APHA 4500-SO4 Sulfate by FIA			
Metals M8	Sydney	Nov 21, 2016	28 Day
- Method: LTM-MET-3040_R0 TOTAL AND DISSOLVED METALS AND MERCURY IN WATERS BY ICP-MS			
% Moisture	Sydney	Nov 18, 2016	14 Day
- Method: LTM-GEN-7080 Moisture			

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Company Name: Coffey Geotechnics Pty Ltd Chatswood
Address: Level 18, Tower B, Citadel Tower 799 Pacific Highway
Chatswood
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Project Name: USYD HEALTH(CONTAMINATION)
Project ID: GEOTLCOV25283AF

Order No.:
Report #: 524268
Phone: +61 2 9406 1000
Fax: +61 2 9406 1002

Received: Nov 17, 2016 2:05 PM
Due: Nov 24, 2016
Priority: 5 Day
Contact Name: Alex Ructtinger

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Asbestos Absence /Presence	Chloride	HOLD	pH (1:5 Aqueous extract)	Sulphate as SO4 (1:5 aqueous extract)	Organochlorine Pesticides	Metals M8	Moisture Set	Semivolatile Organics	Eurofins | mgt Suite B4	BTEX and Volatile TRH
Melbourne Laboratory - NATA Site # 1254 & 14271																
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794																
Perth Laboratory - NATA Site # 18217																
External Laboratory																
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**											
1	BH4_1_0.0-0.2m	Nov 15, 2016	9:00AM	Soil	S16-No16921	X					X	X	X		X	
2	BH4_2_0.5m	Nov 15, 2016	9:15AM	Soil	S16-No16922	X					X	X	X	X	X	
3	RB1 DAY2	Nov 15, 2016	12:00PM	Water	S16-No16923						X	X			X	
4	TB	Nov 15, 2016	7:00AM	Water	S16-No16924											X
5	TS	Nov 15, 2016	7:00AM	Water	S16-No16925											X
6	BH2_1_0-0.2	Nov 15, 2016	3:30PM	Soil	S16-No16926	X					X	X	X		X	
7	BH2_2_0.5	Nov 15, 2016	3:40PM	Soil	S16-No16927	X					X	X	X		X	
8	DUP1	Nov 15, 2016	3:45PM	Soil	S16-No16928						X	X	X		X	
9	BH2_3	Nov 15, 2016	3:50PM	Soil	S16-No16929						X	X	X		X	

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Sample Detail						Asbestos Absence /Presence	Chloride	HOLD	pH (1:5 Aqueous extract)	Sulphate as SO4 (1:5 aqueous extract)	Organochlorine Pesticides	Metals M8	Moisture Set	Semivolatile Organics	Eurofins | mgt Suite B4	BTEX and Volatile TRH
Melbourne Laboratory - NATA Site # 1254 & 14271																
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794																
Perth Laboratory - NATA Site # 18217																
10	BH6_5	Nov 15, 2016		Soil	S16-No16930		X		X	X			X			
11	BH4_4	Nov 15, 2016		Soil	S16-No16931		X		X	X			X			
12	BH2_5	Nov 15, 2016		Soil	S16-No16932		X		X	X			X			
13	BH2_6	Nov 15, 2016		Soil	S16-No16933		X		X	X			X			
14	BH4_3	Nov 15, 2016	9:30AM	Soil	S16-No16934			X								
15	BH2_4	Nov 15, 2016	4:00PM	Soil	S16-No16935			X								
16	BH1_3_1m	Nov 15, 2016	4:00PM	Soil	S16-No16948			X								
Test Counts						4	4	3	4	4	7	7	10	1	7	2