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SPECIALISTS MANAGING THE EARTH

# GEOTECHNICAL INVESTIGATION AND PRELIMINARY CONTAMINATION ASSESSMENT
# PROPOSED ADDITIONS TO BLACKTOWN HOSPITAL
# BLACKTOWN, NSW

Health Infrastructure, NSW

GEOTLCOV24207AB-AB
10 May 2011

**Coffey Geotechnics Pty Ltd** ABN 93 056 929 483
8/12 Mars Road Lane Cove West NSW 2066 Australia
PO Box 125 North Ryde NSW 1670 Australia
T (+61) (2) 9911 1000 F (+61) (2) 9911 1001 coffey.com

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

10 May 2011

Health Infrastructure, NSW
C/- Robert Bird Group
Level 5, 9 Castlereagh Street,
Sydney, NSW 2000

**Attention: Jason Langer**

Dear Sir

**RE: Geotechnical Investigation and Preliminary Contamination Assessment, Proposed Additions, Blacktown Hospital, NSW- Final Report**

Coffey Geotechnics Pty Ltd (Coffey) is pleased to present the final report for the geotechnical investigation and contamination assessment undertaken for the proposed additions to Blacktown Hospital, NSW.

Should you have any queries or comments regarding this report please do not hesitate to contact Sara Somasundaram or the undersigned on (02) 9911 1000.

For and on behalf of Coffey Geotechnics Pty Ltd

**Peter Waddell**

Principal Engineer

Distribution: Original held by Coffey Geotechnics Pty Ltd
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3 hard copies and electronic copy to Robert Bird Group Pty Ltd

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# 1 INTRODUCTION

This report presents the results of a geotechnical investigation and contamination assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) on behalf of Health Infrastructure, NSW (the Principal) and Robert Bird Group (RBG, Principal's representative) for the proposed additions to Blacktown Hospital, NSW.

The Investigation was undertaken in general accordance with the scope of works presented in our initial proposal; reference GEOTLCOV24207AA-AA, dated 31 January 2011, and our revised proposal; reference GEOTLCOV24207AA-AB, dated 8 February 2011.

It is understood that the project is currently at an early planning stage and that the results of this investigation will be used to further refine the proposed development and to assist with civil/structural design.

The following documents were referred to by Coffey in preparation of this report:

- "Geotechnical Investigation Brief" document revision 3 – Blacktown Hospital (RBG Job ref:10684 dated 19 January 2011)
- "Geotechnical Desktop Study for Proposed Redevelopment of Blacktown Hospital" (issued to the Principal) by Jeffery and Katauskas Pty Ltd on 2 November 2011).

Based on the above documents the proposed redevelopment is likely to comprise:

- Provision of access from Blacktown road and reconfiguration of internal accesses and entry/exit points.
- Construction of new hospital buildings on the southern side of the existing main hospital building (i.e. at the location of existing car parks). These buildings are expected to be up to 4 stories high and are to be undertaken in two stages.
- Construction of new multi-storey car parks to the south of proposed buildings.
- Demolition of some existing buildings at the location of proposed multi storey car parks
- A potential underground tunnel link between main hospital building and proposed building.

Coffey Understands that the Stage 1 and Stage 2 developments will comprise above ground structures only with no excavation of basements. It is noted from the brief supplied to us that the developments are likely to be founded on high level pad footings in rock and piles to stiff clay or rock. Raft foundations are mentioned as an option dependent upon subsurface conditions.

Proposed investigation locations were identified by RBG with basic layout drawings supplied to us as part of the brief.

The objectives of the geotechnical investigation are to assess subsurface conditions and to provide comments and recommendations on geotechnical aspects as set out in the brief

The environmental component of the work aims to provide a preliminary contamination assessment of the site.

# 2 SITE INFORMATION

## 2.1 Published Geology

The Penrith 1:100,000 Geological Sheet indicates that the sites are underlain by Bringelly Shale of the Wianamatta Group. The Bringelly Shale is described as shale, carbonaceous claystone, claystone, laminate, fine to medium grained lithic sandstone, rare coal and tuff.

## 2.2 Site description

The site is located at the Blacktown Hospital Campus located south of Blacktown Road occupying ground gently sloping down towards the north/northwest. The site is bound to the north and east by Blacktown Road and to the south by Bungarribee Road. The areas of proposed development are located to the south of the existing Main Hospital Building on an area currently occupied by car parks at grade as shown in Figure 1.

## 2.3 Hydrogeology

A search for registered groundwater bores within a 500m radius of the site was undertaken using the NSW Natural Resources Atlas (NSW-NRA, http://nratlas.nsw.gov.au) on 11 November 2010 as part of a Stage 1 Site Contamination Assessment (Coffey, 2010). Records for four registered groundwater bores were found. A summary of groundwater bores is presented below:

- One bore located approximately 500m northwest of the site is reported to be used for waste disposal purposes; and
- Three bores located approximately 400m northeast of the site are reported to be used for monitoring purposes.

Based on data provided in the groundwater bore search results, it is estimated that groundwater beneath the site would lie at a depth of between about 3m and 11m below ground surface (bgs) and is considered likely to flow in a broadly north and/or easterly direction.

## 2.4 Acid Sulfate Soils

Based on the published acid sulfate soils risk maps, the site is located in an area not known to contain acid sulfate soils.

## 2.5 Previous Investigations

### 2.5.1 Geotechnical Reports

Several geotechnical investigations have been undertaken by Jeffery and Katauskas Pty Ltd (J&K) at Blacktown Hospital pertaining to various previous developments. A summary of these previous works were presented in a Geotechnical Desktop Study Report authored by J&K (reference: 24416SBrpt dated 2 November 2010).

The Geotechnical Desk Study Report summarised the findings of geotechnical investigations undertaken for the following previous developments at the Blacktown Hospital Campus:

- Clinical School Building;

- Main Hospital Building;
- Birthing Centre Building; and
- Ambulance Station Building.

A total of 40 boreholes were drilled to varying depths within the Blacktown Hospital site, based on collation of this data, subsurface conditions were found to comprise areas of fill overlying residual silty clays of medium plasticity and stiff to hard consistencies, grading into weathered shale and sandstone rock.

The depth to the surface of the rock in the area of the proposed new development to the south of the existing Main Hospital Building was interpreted to be in the order of 2m to 6m depth.

The shale and sandstone was reported to be extremely weathered and extremely low strength on contact and improving with depth with many defects and extremely low strength bands throughout.

Groundwater was encountered in some of the boreholes and interpreted to occur mainly along the soil/rock interface and through joints in the rock.

### 2.5.2 Contamination Reports

Coffey Environments Pty Ltd previously undertook a Stage 1 Preliminary Site Contamination Assessment for the site (Ref: ENAURHOD04072AA-R01). The assessment included a site walkover and a review of available site history information.

Based on findings from the assessment, it was concluded that there is a low to medium likelihood of contamination existing on the portions of the site where the proposed development zones are located in Master Plan Option 3 (Woods Bagot, 2010) from past and present activities.

## 3 POTENTIAL CONTAMINATING ACTIVITIES & AREAS OF CONCERN

Based on information presented in the Stage 1 assessment, the areas of environmental concern (AEC) and contaminants of potential concern (COPC) with respect to the subject investigation area are listed in Table 3.1.

**Table 3.1: Areas of Environmental Concern and Contaminants of Potential Concern**

| Area of Environmental Concern | Contaminants of Potential Concern |
|---|---|
| Historical 20,000L UST (location unknown) | TPH, BTEX, PAH and lead |
| Fill material | TPH, BTEX, PAH, metals, PCB, OCP, OPP and asbestos |
| Previous hospital footprint and demolition | Asbestos, lead, OCP and OPP |

# 4 METHOD OF INVESTIGATION

## 4.1 Geotechnical Fieldwork

The fieldwork for this investigation was conducted between the 15 and 22 February 2011, and comprised the following:

- Twelve boreholes (BH1 to BH11) drilled using a truck mounted drilling rig; and
- Two test pits (TPB1 and TPB2) excavated using a Yanmar 5 tonne excavator.

Figure 1 shows the approximate borehole and test pit locations.

A Coffey Engineer or Geologist was present throughout the fieldwork to conduct;

- Geotechnical sampling and testing, record test results and log materials encountered;
- Environmental sampling/testing;
- Liaison with Principal's representatives and contractors;
- Implementation of the Site Specific Health, Safety and Environmental Management Plans.

### 4.1.1 Borehole Drilling

The boreholes were drilled using a Hydrapower Scout truck mounted drilling rig. Each borehole was advanced using solid flight augers with a tungsten carbide (TC) drill bit until refusal on rock at depths between 3.2m and 8.2m, with the exception of BH4a which was terminated at a refusal depth of 1.1m on concrete.

Standard Penetration Testing (SPT) was carried out at selected depth intervals to assess soil strength and obtain samples for logging purposes. Environmental samples were also collected at selected depth intervals in each borehole.

Following TC bit refusal on rock the boreholes were cored using a triple tube core barrel to a depth of about 10m.

Groundwater inflows and soil moisture observed during drilling in soil were recorded. Groundwater observations were not possible in the cored sections of the boreholes during drilling as water was used as a drilling fluid. All remaining boreholes were backfilled with cuttings to 0.1m below ground level, and the pavement repaired at surface with bitumen.

Borehole and test pit locations were marked on the site survey plan supplied by the client and approximate interpreted reduced levels noted on the logs.

### 4.1.2 Test Pitting

The test pits were excavated using a Yanmar 5 Tonne Excavator with a toothless 1800mm mud bucket attachment, until termination in weathered shale at depths of 2.4m and 3m respectively. Environmental samples and bulk samples were collected at selected depth intervals.

## 4.2 Geotechnical Laboratory Testing

Soil samples obtained during the investigation were taken to our NATA registered laboratory. The following tests were carried out on selected samples:

- Standard Compaction and 4 days soaked California Bearing Ratio (CBR)
- Atterberg Limits 4 point
- Moisture Content
- Soil Aggressivity for buried steel and concrete structures (ph, Sulphate and Chloride)

## 4.3 Environmental Laboratory Testing

Environmental samples were taken from the geotechnical boreholes. The geotechnical boreholes provided a broad coverage of the general investigation area and the areas of environmental concern.

A total of 20 primary soil samples were collected from the site and submitted for laboratory analysis for one or more of the following contaminants of potential concern:

- total petroleum hydrocarbons (TPH);
- benzene, toluene, ethylbenzene, total xylenes (BTEX);
- polycyclic aromatic hydrocarbons (PAH);
- organochloine pesticides (OCP);
- polychlorinated biphenyls (PCB);
- heavy metals; and
- asbestos.

Soil samples collected from a decontaminated split spoon sampler and were transferred to laboratory supplied sample containers for chemical analysis. Where samples were submitted for asbestos analysis, a portion of the soil sample was placed in a zip-lock bag for analysis. The sample containers/bags clearly identified the site details, sampling location and sample depth. The samples were transferred to an ice chilled cooler.

A portion of the sample was placed inside an additional sealed plastic bag for screening for the presence of volatile organic compounds (VOCs) using a Photoionisation Detector (PID) calibrated to 100ppm isobutylene calibration gas.

The PID readings, together with other field observations, were used to assess which samples should be analysed for volatile contaminants (BTEX and TPH $C_6$-$C_9$). The field screening results are included on the borehole logs.

One intra-laboratory duplicate soil sample, one inter-laboratory duplicate soil sample, one wash blank, one trip blank and one trip spike were collected from the site during fieldwork for quality control/quality assurance (QA/QC) purposes and analysed for the contaminants of potential concern.

The samples were dispatched to NATA accredited laboratories (SGS Australia as the primary laboratory) under chain of custody control.

# 5 RESULTS OF INVESTIGATION

## 5.1 Subsurface Conditions

Engineering borehole logs from the current investigation are presented in Appendix A, together with Explanation Sheets defining the terms and symbols adopted in the borehole log preparation and photographs of the rock core recovered during the investigation.

The site is underlain be a variable thickness of fill overlying residual soils and shale or sandstone bedrock. In some locations relatively deep sand and gravel fill was encountered (BH5 and BH6). Such deep fill deposits may be associated with existing services or old infilled service trenches. In other locations clay fill was encountered which may be associated with levelling of the site during construction of the car parking area or backfilling associated with services trenches. At one borehole location (BH4a) concrete was encountered that may be associated with an old building footing or other buried structure.

Based on the information obtained from the boreholes, three cross sections have been drawn through the site and are presented in Figures 2, 3 and 4. Two geotechnical models have been developed, pertaining to developments immediately south of the Main Hospital Building (Table 5.1) and another for the area in the vicinity of existing Child Care Centre (Table 5.2).

**TABLE 5.1: Interpreted Subsurface Conditions – Area South of Main Hospital Building (BH1 to BH11)**

| Unit | Material / Origin | Depth to Top of Unit (m) | Thickness of Unit (m) | Top of Unit (mAHD) | Description |
|---|---|---|---|---|---|
| 1 | Fill | 0 | 0.5 to 3.8 | 61.2 to 64.75 | Variable deposits of Sand, Gravel and Clay |
| 2 | Residual Soil | 0.5 to 3.8 | 0.1 to 4.2 | 57.8 to 61.3 | Clay: medium and high plasticity, firm to hard, pale grey to reddish brown with ironstone gravels |
| 3a | Class V and IV Shale and Class V and IV Sandstone (1) | 3.1 to 6.6 | 0.8 to 4.4 | 54.8 to 59.75 | Shale with interbedded Sandstone: pale to dark grey and reddish brown, extremely to moderately weathered, very low to medium strength |

| Unit | Material / Origin | Depth to Top of Unit (m) | Thickness of Unit (m) | Top of Unit (mAHD) | Description |
|---|---|---|---|---|---|
| 3b | Class III Shale and Class III Sandstone or better(1) | 5.3 to >10m | Not Proven | <51.34 to 56.5 | Shale with interbedded Sandstone: pale to dark grey, reddish brown, slightly weathered, medium to high strength |

(1) Rock classified in accordance with Pells et al (1998) "Foundations on Sandstone and Shale in the Sydney Region" Aust. Geomech. Jnl, Dec 1998.

**TABLE 5.2: Interpreted Subsurface Conditions in the Vicinity of Childcare (TPB1 and TPB2)**

| Unit | Material / Origin | Depth to Top of Unit (m) | Thickness of Unit (m) | Top of Unit (mAHD) | Description |
|---|---|---|---|---|---|
| 1 | Fill | 0 | 0.6 to 1.6 | 56.85 to 57.3 | Topsoil / Clay and Sandy Clay |
| 2 | Residual Soil | 1.0 to 1.6 | 0.8 | 55.7 to 56.25 | Clay: Medium and high plasticity, hard, pale grey to reddish brown with ironstone and shale gravel |
| 3a | Class V Shale(1) | 1.8 to 2.4 | Not Proven | 54.9 to 55.05 | Shale: pale grey to reddish brown, extremely weathered, very low to low strength |

(1) Rock classified in accordance with Pells et al (1998) "Foundations on Sandstone and Shale in the Sydney Region" Aust. Geomech. Jnl, Dec 1998.

The depths and layer thicknesses in Tables 5.1 and 5.2 are based on the subsurface conditions at the borehole locations and may not be representative of all areas of the site.

## 5.2 Laboratory Test Results

### 5.2.1 Geotechnical Testing

Soil samples were transported to our NATA registered laboratory for storage and testing. The following soil tests were carried out on soil samples obtained during the field work.

- Moisture Content tests
- Atterberg limit tests
- Shrink / Swell Tests
- pH, sulphate & chloride content tests
- California Bearing Ratio tests; and

In addition, axial and diametral point load index strength testing was carried out on the rock cores, with the test results presented on the individual borehole engineering logs in Appendix A and in Appendix B. Detailed laboratory test results are presented in Appendix B and a summary is presented in Table nos. 5.3 to 5.5, given below:

**TABLE 5.3: Summary of Moisture Content, Atterberg Limits and Soil Aggressivity Tests**

| Borehole No. | Depth (m) BGL | pH | Soluble Sulfate ($SO4^{2-}$) (mg/kg) | Chloride ($Cl^-$) (mg/kg) | Moisture Content (%) | Atterberg Limits | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | LL (%) | PL (%) | PI (%) |
| BH1 | 2.0 – 2.45 | 10.1 | 90 | 430 | 19 | - | - | - |
| BH1 | 2.55 – 2.90 | - | - | - | 20 | 51 | 18 | 33 |
| BH2 | 2.0 – 2.50 | - | - | - | 17 | 50 | 20 | 30 |
| BH3 | 5.0 – 5.45 | 9.7 | 380 | 940 | 16 | - | - | - |
| BH4 | 2.0-2.45 | - | - | - | 20 | 46 | 16 | 30 |
| BH5 | 2.0 – 2.45 | 11.0 | 250 | 30 | 9 | - | - | - |
| BH6 | 2.0 – 2.45 | 9.0 | 270 | 30 | 8 | - | - | - |
| BH9 | 2.0 – 2.45 | - | - | - | 19 | 47 | 16 | 31 |
| BH9 | 3.5 – 3.95 | 6.4 | 250 | 260 | 14 | 45 | 19 | 26 |
| BH10 | 2.0 – 2.45 | 7.0 | 190 | 180 | 9 | - | - | - |
| BH10 | 3.0 – 3.45 | - | - | - | 18 | 59 | 18 | 41 |
| BH11 | 0.5 – 0.95 | 6.9 | 580 | 40 | 14 | - | - | - |

**TABLE 5.4: Summary of CBR Test Results**

| Borehole No. | Depth | Maximum Dry Density | Optimum Moisture Content | 4 day Soaked CBR % |
|---|---|---|---|---|
| **TPB1** | 0.5-0.7 | 1.75 | 17.9 | 1 |
| **TPB2** | 1.5-1.7 | 1.82 | 15.5 | 1.5 |

**TABLE 5.5: Summary of Shrink Swell Test Results**

| Borehole No. | Depth | Swell on Saturation % | Shrink on Drying % | Shrink Swell Index $I_{ss}$ |
|---|---|---|---|---|
| BH1 | 2.55-2.90 | 2 | 6.8 | 4.3 |

Based on laboratory test results as summarized in Table 5.3, the soils could be classified as “mildly aggressive to non aggressive” according to AS 2159-2009 for concrete and as “non aggressive” for steel.

## 5.3 Environmental Testing

### 5.3.1 Environmental Soil Assessment Criteria

For assessing whether the soil is contaminated, the criteria presented in the following references are generally the primary criteria used in NSW when setting acceptance criteria for chemical contaminants in soil:

- Guidelines for the NSW Auditor Scheme (Second Edition) (NSW DEC, 2006); and
- *Guidelines for Assessing Service Station Sites* (NSW EPA, 1994).

For assessing contamination levels in soil in urban settings, the *Guidelines for the NSW Site Auditor Scheme* (NSW DEC, 2006) present health based investigation levels (HILs) for different land uses (e.g. industrial/commercial, residential, recreational etc.). These HIL settings are, however, not generally applicable for hospital sites and there is currently no clear guidance as to the most appropriate guideline value for comparison purposes.

This notwithstanding, based on the understanding that the site is intended for ongoing hospital usage, Coffey has adopted a conservative approach and used the HIL for residential land use with gardens and accessible soils, and the provisional phytoxicity-based investigation levels, for preliminary screening of the soil.

NSW DEC (2006) guidelines do not provide levels for volatile petroleum hydrocarbon compounds. The *Guidelines for Assessing Service Station Sites* (NSW EPA, 1994) provide an indication of acceptable

levels for sensitive land use for petroleum hydrocarbons compounds. The NSW DECC has advised that these guidelines should also be used without multiplication for less sensitive land uses. For semi-volatile petroleum hydrocarbons (C16–C35 and >C35) investigation levels are provided in the NSW DEC (2006) Guidelines, however, these are based on the NEPC (1999) health-based investigation levels, which require the laboratory analysis to unequivocally differentiate between aromatic and aliphatic compounds. The relevant values in NSW EPA service station guidelines will be applied in the first instance as broad criteria to assess TPH concentrations. If TPH impacts are identified in soil, then aromatic/aliphatic investigation levels from NSW DEC (2006) may be utilised to assess the aromatic/aliphatic speciation of TPH if considered necessary.

Currently there are no set guidelines in NSW for the assessment of asbestos in soils. A criterion of "no asbestos detected" will be adopted as a screening level for assessing soil asbestos analytical results.

A summary of the adopted soil acceptance criteria is presented in Table 5.6.

**Table 5.6: Summary of Soil Contamination Assessment Criteria**

| Analyte | Health-based Investigation Levels (HILs) (mg/kg)[1] HIL A | Sensitive Land Use (mg/kg)[2] | Provisional Phytotoxicity-based Investigation Levels (mg/kg)[1] | Adopted Soil Assessment Criteria (mg/kg) |
|---|---|---|---|---|
| **METALS / METALLOIDS** | | | | |
| Arsenic (total) | 100 | - | 20 | 20 |
| Cadmium | 20 | - | 3 | 3 |
| Chromium (III) | 12,000 | - | 400 | 400 |
| Copper | 1,000 | - | 100 | 100 |
| Lead | 300 | - | 600 | 300 |
| Mercury (inorganic) | 15 | - | 1 | 1 |
| Nickel | 600 | - | 60 | 60 |
| Zinc | 7,000 | - | 200 | 200 |
| **ORGANICS** | | | | |
| Total PAHs | 20 | - | - | 20 |
| Benzo(a)pyrene | 1 | - | - | 1 |
| Aldrin + Dieldrin | 10 | - | - | 10 |
| Chlordane | 50 | - | - | 50 |
| DDT+DDD+DDE | 200 | - | - | 200 |
| Heptachlor | 10 | - | - | 10 |
| Total PCB | 10 | - | - | 10 |
| TPH $C_6$-$C_9$ | - | 65 | - | 65 |
| TPH $C_{10}$-$C_{40}$ | - | 1,000 | - | 1,000 |
| Benzene | - | 1 | - | 1 |

| Analyte | Health-based Investigation Levels (HILs) (mg/kg)[1] HIL A | Sensitive Land Use (mg/kg)[2] | Provisional Phytotoxicity-based Investigation Levels (mg/kg)[1] | Adopted Soil Assessment Criteria (mg/kg) |
|---|---|---|---|---|
| Toluene | - | 50 | - | 1.4 |
| Ethylbenzene | - | 130 | - | 3.1 |
| Xylenes | - | 25 | - | 14 |
| Asbestos | - | - | | No Asbestos Detected |

1. NSW DEC (2006) *Guidelines for the NSW Site Auditor Scheme* (2nd Edition).
2. NSW EPA (1994) *Guidelines for Assessing Service Station Sites*.

### 5.3.2 Field Observations and Screening

No visual or olfactory evidence of significant contamination (i.e. odours or staining) was identified during field work.

Screening of soil samples collected from the site reported PID readings between 0.2ppm and 7.5ppm, which suggests a low potential for the presence of volatile hydrocarbons in these samples.

### 5.3.3 Analytical Results

The results of the laboratory analysis of the environmental soil samples collected from the site indicated the following:

- The samples analysed reported concentrations of TPH $C_6$-$C_9$ and BTEX less than the laboratory limit of reporting (LOR);
- The samples analysed reported concentrations of TPH C10-C36 less than the adopted assessment criteria;
- The samples analysed reported concentrations of PAH, OCP and PCB less than the laboratory LOR;
- The samples analysed reported concentrations of heavy metals less than the adopted health-based assessment criteria, however samples BH1 (0.1-0.5), BH2 (0.1-0.3) and its duplicate DUP1, BH3(0.1-0.3), BH4 (0.1-0.3) and BH9 (0.1-0.3) reported nickel concentrations between 69mg/kg and 100mg/kg) which exceeds the phytoxicity investigation levels; and
- Asbestos was not detected in the samples analysed.

Detailed laboratory test results are presented in Appendix C.

### 5.3.4 Quality Assurance / Quality Control

Field and laboratory analytical results have been reviewed to assess their suitability for use for the purpose of this assessment. Based on the review, the data is considered suitable for the purpose of this assessment without qualification or adjustment.

The data validation report is attached in Appendix D.

# 6 DISCUSSION AND RECOMMENDATIONS

## 6.1 Excavation Conditions

### 6.1.1 Excavatability

Coffey is not aware of any proposed basement excavations. However, excavations into the hillside may be required depending on building levels and the potential underground tunnel link that is being considered would also require bulk excavation. Excavation in Units 1 and 2 should be possible using conventional earthmoving equipment such as tracked loaders and hydraulic excavators. During or following periods of high rainfall, groundwater may be encountered near the soil/rock interface and at higher levels in the soil profile.

Where excavations extend into the bedrock, it is expected that very low strength or fractured shale/sandstone should be able to be excavated using conventional earthmoving plant such as hydraulic excavators fitted with a rock bucket and dozers fitted with rippers. At depths where the rock is expected to be medium to high strength, ripping or the use of rock hammers and rock saws may be required.

Rock excavations can result in noise and vibrations that affect adjacent structures, particularly if hydraulic impact breakers are used. Selection of excavation plant will need to be carefully considered by the contractor as part of construction planning together with the preparation of a vibration monitoring plan if excavations are to be carried out in close proximity to existing structures. Rock saws may be required to reduce the lateral transmission of vibrations.

Excavation contractors should be required to consider the borehole logs and core photographs and make their own interpretation of the capacity and productivity of specific plant.

### 6.1.2 Bulk Excavation Support Requirements

We recommend temporary unsupported batter slopes of 2H:1V for excavations on Unit 1 and 1.5H:1V for excavations on Units 2 and 3a (provided excavation is above the groundwater table and surcharge loads are kept well clear of the crest of batters). If there is insufficient room to form temporary batters, or if excavations encounter groundwater, then retention system will be required. Further advice on retention systems is provided in Section 7.2. For permanent battters 2H:1V or flatter slopes are recommended.

As for Unit 3b (class III shale or better) vertical excavations should be practicable provided support is provided in the form of rock bolts, mesh and shotcrete, where required. An experienced geotechnical engineer or engineering geologist should be engaged to assess the rock faces after each 1.5m depth of excavation to assess support needs.

Where rock bolts are required to provide permanent support they should be galvanised and double encapsulated in grout and a polyethylene sheath. Proprietary systems such as “CT bolts” or equivalent have been accepted as having a design life of up to 100 years when double encapsulated.

### 6.1.3 Traffic on Soils

Field (SPT) and laboratory testings on Unit 1 and 2 soils indicate that a minimum 300mm thick working platform of road base may be needed where construction plants such are trucks are to travel above Unit

1 and Unit 2. Where heavy plants such as piling rigs or mobile cranes are to traffic the site, specific analysis of working platform requirements will be required to assess working platform thickness.

### 6.1.4 Groundwater

No groundwater inflow was observed during auger drilling up to depths ranging 3m to 7m, except in BH5, where ground water was observed at 1.8m below ground level in a sandy layer (likely to be localised due to events such as recent rains or leaking services.). Water level monitoring was not possible during rock coring as water was used as drilling fluid in the drilling process. Previous investigations report water observations in some boreholes at depths ranging between 2m to 3.7m and suggest that they are mainly along soil/rock interface and through joints in rock. It is anticipated that high groundwater levels would be limited to prolonged periods of high rainfall or localised events such as failures of service lines.

We do not anticipate major groundwater inflows during excavations however; ground water seepages are likely due to high rainfall events, local drainage conditions etc and provision should be made for pumping form sumps. The risk of the development causing adverse impacts on adjacent sites due to changes in groundwater is assessed as low.

## 6.2 Retention Systems

### 6.2.1 Possible Systems and Limitations

Though the site lies in a relatively elevated location with low permanent groundwater table levels, short term build up of hydrostatic pressures could occur during prolonged wet periods or due to broken services, hence the possibility of hydrostatic pressures that could extend to the ground surface should be considered in the design of retention systems.

Surcharges due to equipment, stockpiles or other loadings behind the wall should also be considered in the design.

Retention systems that could be considered include:

- Sheet Pile Walls;
- Soldier Pile Walls
- Contiguous Piled Walls.

Sheet piles driven to the weathered rock could provide temporary support for excavations. A cast insitu concrete wall would be required to provide a permanent retention system. Noise and vibration issues as well as drivability through residual soil (Unit 2) need to be considered.

Soldier pile walls using steel or bored piles with shotcrete infilled panels (laggings) could also be considered.

Contiguous piles could be adopted, however with such a system gaps between the piles may allow soil to fall into the excavation destabilising the ground behind the piles and risking undermining of adjacent structures. Careful construction procedures would be a required with allowance for progressive grouting of gaps between piles for this system to provide effective temporary and permanent support.

### 6.2.2 Design Parameters for Shoring and Earth Retaining Structures

For the design of retaining walls a triangular earth pressure distribution can be adopted to calculate earth pressures for relatively flexible shoring systems such as cantilevered walls or walls supported by a single row of props or anchors. The horizontal earth pressure profile may be calculated using the following formula:

$$p = K (\gamma' z + p_s)$$

where $p$ = lateral earth pressure (kPa)

$K$ = earth pressure coefficient, to be selected depending considering the amount of movement that can be tolerated.

$\gamma'$ = effective unit weight ($kN/m^3$)

$z$ = depth below top of excavation (m)

$H$ = height of excavation at base of excavation (m)

$p_s$ = design uniform surcharge pressure at ground level

Flexible shoring systems such as cantilevered walls should be avoided where there is a risk of movements damaging structures or services adjacent to an excavation.

Design of braced shoring or permanent retaining structures walls, which are constrained at several levels, can be based on a trapezoidal earth pressure distribution. Where retention of a multi-layered material profile is required, modification of the distribution (including the definition of H) will be necessary.

***Table 7.1: Trapezoidal Pressure Distribution***

| Depth (m) | Horizontal Pressure (kPa) |
|---|---|
| 0 | $K.p_s$ |
| 0.25 H | $K (0.8.\gamma'.H + p_s)$ |
| 0.75 H | $K (0.8.\gamma'.H + p_s)$ |
| H | $K.p_s$ |

In addition to lateral earth pressures and surcharge loads, consideration should be given to the possibility of a hydrostatic pressure due to build-up of water behind the wall (e.g. from broken services) unless permanent subsurface drainage can be provided.

Table 7.2 provides retaining wall design parameters:

**Table 7.2: Earth Pressure Coefficients for Retaining Wall Design**

| Geotechnical Unit | Active Earth Pressure Coefficient ($k_a$[1]) | At Rest Earth Pressure Coefficient ($K_0$) | Passive Earth Pressure Coefficient $K_p$ | Bulk Density ($kN/m^3$) | Drained Cohesion, c' (kPa)[3] | Effective Friction, $\phi$' ($^o$) | Drained Elastic Modulus E'(MPa) |
|---|---|---|---|---|---|---|---|
| Unit 1 | 0.33 | 0.5 | 3.0 | 19 | 0 | 30 | 10 |
| Unit 2 | 0.36 | 0.53 | 2.8 | 19 | 5 | 28 | 20 |
| Unit 3a[2] | 0.33 | 0.5 | 3.0 | 22 | 10 | 30 | 120 |

Notes:

1. Assumes no wall friction

2. Values of better quality rock are variable and dependant on global effects of defects. Variability also occurs due to the in situ stress environment and geometry of the excavation. For design parameters, use should be made of the cohesion and friction angle parameters.

The earth pressure coefficients in Table 7.2 assume horizontal ground surface at the crest and toe of the retaining wall. If this is not the case then the coefficient should be modified or surcharges added, as necessary. Care will be required when compacting fill adjacent to retaining walls to avoid lateral pressures that exceed tabulated values.

Based on concept plan drawings, adjacent structures may be located within the nominal zone of influence of the excavation (a line extending at a gradient of 1H:1V upwards from the base of the proposed excavation). The excavation system will need to be designed to support the footing surcharge loads.

The amount of movement that will be experienced by a retaining wall will depend on various factors including the earth pressures that exist, groundwater conditions and the excavation and construction sequence, including the tensioning sequence of anchors. Detailed soil structure interaction analysis should be carried out if movement sensitive structures are located within close proximity to the retaining wall. In particular, if movement sensitive services are located close to the excavation the design should consider the need to limit movements. In such situations the earth pressures calculated using coefficients in Table 7.2 may need to be modified to assess the impact on predicted movements.

## 6.3 Foundation Options

There is a variable depth of fill across the site probably as a result of buried services, demolition of previous buildings and site levelling works during car park construction. We recommend piled foundations for multi storey building development where relatively high building loads and differential movement tolerances are tight, with the piles founded on bedrock.

For lightly loaded structures it may be possible to adopt shallow foundation such as a stiffened raft, however, additional investigations would be required as there is no well defined pattern to the distribution of fill. Unless records are available to confirm that fill has been placed and compacted to an engineering specification it should be treated as uncontrolled and should not be used to support

building loads. If assessed to be suitable for reuse, existing fill could be excavated and recompacted to form a foundation for raft slabs. Fill should be compacted to at least 98% Standard Compaction at moisture content within 2% of Standard Optimum Moisture Content.

### 6.3.1 Shrink Swell Potential

In areas where existing fill occurs a site classification of 'P' as defined in AS2870-2011 should be adopted. If the fill is excavated and recompacted it may be possible to found a raft slab on the fill. Reclassification of the site would depend on the nature and thickness of the compacted fill and should foundation recommendations should be developed based on AS2870-2011.

Where residual soils are relatively shallow and would form the bearing stratum for a raft a classification of other than 'P' could be adopted. Raft foundations could be adopted for buildings with similar scale and building loads to residential structures, based on the guidelines in AS2870-2011. Based on a shrink swell test on a sample of residual soil from BH1 sites underlain by residual soils can be classified as 'H1' as defined in AS2870-2011.

### 6.3.2 Pad Footings

For pad or strip footings bearing on stiff residual soil we recommend an allowable bearing pressure of 150kPa. However, pad footings on residual soil should only be adopted for structures that are not susceptible to damage from shrink swell movements. For pad footings founded on units 3a and 3b, ultimate bearing pressures of 2MPa and 10MPa are recommended, respectively. A geotechnical strength reduction factor $\phi_{g1}$ of 0.5 should be adopted. Settlements of these footings should be assessed adopting an elastic modulus of 100MPa and 500MPa for Units 3a and 3b, respectively.

A geotechnical engineer should observe pad footing excavations (and undertake dynamic cone penetration tests if founding layer is residual soil) to confirm that a competent bearing stratum exists.

### 6.3.3 Piled Foundations

Where a piled foundation is required the piles should penetrate the fill and residual soil layers and found within Unit 3a and 3b bedrock.

Open bored piles may be feasible but would require temporary liners when penetrating granular materials such as the sand fill encountered at some locations. In clay fill or clay residual soils open bored piles may still require temporary liners if groundwater seepage occurs as seepage will tend to soften the pile shaft if left open.

Continuous flight auger (CFA) piles should be practicable and do not require temporary casing. However, a high capacity CFA piling rig will be required to socket the piles into the bedrock if significant loads are to be carried in shaft adhesion or to take advantage of the parameters for the better quality Unit 3b rock. Advice should be sought from specialist CFA piling contractors regarding the length of socket in the Unit 3b that can be achieved with their piling rigs.

For the limit state design of piles the geotechnical parameters provided in Table 6.1, below, can be adopted.

**Table 6.1: Recommended Limit State Design Parameters for Piles on Rock**

| Geotechnical Unit (1) | Ultimate End Bearing (MPa) (2) | Ultimate Shaft Adhesion (kPa) (3) | Elastic Modulus (MPa) (4) |
|---|---|---|---|
| Unit 2 – Residual Soil | - | 30 | 30 |
| Unit 3a – Class IV and V Shale and Class V and IV Sandstone | 3 | 100 | 100 |
| Unit 3b – Class III Shale and Class III Sandstone | 15[5] | 500 | 500 |

(1) Rock classified in accordance with Pells et al (1998) "Foundations on Sandstone and Shale in the Sydney Region" Aust. Geomech. Jnl, Dec 1998.
(2) Assumes a minimum embedment of at least 0.3m into the relevant bearing stratum.
(3) Shaft adhesion should be ignored unless the pile has a minimum socket length of 3 pile diameters.
(4) Serviceability should be assessed using the tabulated modulus value to check that settlements are within tolerable limits.
(5) To adopt this value further assessment of rock quality will be required as discussed below.

We recommend a geotechnical strength reduction factor, $\Phi_g$, of 0.7 for footings bearing on rock where a suitable program of verification is undertaken. If piles are required to resist uplift the shaft adhesion a $\Phi_g$ of 0.6 should be adopted and the values in Table 8 should be multiplied by 0.6 and a cone pull out check should be carried out assuming a cone angle of $70^{0.}$

Where ultimate end bearing pressures of greater than 6.5MPa are adopted we recommend that additional cored boreholes be drilled at column locations to assess the uniformity and quality of the bearing stratum. The number of additional boreholes will be dependent on the piling layout. Cores may be required at 25% to 50% of pile locations to assess provide adequate information for the assessment of rock quality to justify the upper end of the recommended ultimate end bearing values.

A geotechnical engineer should be engaged to review piling records to confirm that piles have penetrated to the appropriate rock class. Pile dynamic integrity testing should be carried out particularly, if CFA piles are adopted. At least 5% of all piles should be subjected to integrity testing.

The base of open bored piles and pad footings should be clean of loose debris and water. Continuous flight auger piles should be carefully controlled to avoid spoil falling off the auger and fouling the base of the pile.

## 6.4 Pavement Design

Laboratory testing of two bulk disturbed samples indicate the 4 day soaked CBR values to be 1% and 1.5% for plastic clays. Previous investigations report CBR values ranging between 0.5% and 3%.

Subgrade improvement in the form of excavation and replacement with better quality material or insitu improvement of the existing subgrade using lime stabilisation or similar techniques should be

undertaken to improve the subgrade conditions for pavements. With replacement or insitu improvement a target CBR of 5% could be achieved depending on the nature technique employed and the depth of treatment.

Where existing fill lies at subgrade level it should be excavated and recompacted, if suitable, or replaced with a good quality material. Fill that is to form the subgrade for pavements should be compacted to at least 100% Standard Compaction at moisture content within 2% of Standard Optimum Moisture Content. If existing fill is deeper than about 1m below final subgrade level it may be possible to leave the fill in place provided it is assessed to be suitable by a geotechnical engineer and proof rolled.

## 6.5 Earthquake Design

We recommend that the site be classified as Class $C_e$ in accordance with the site sub-soil classes defined in AS1170.4-2007 Part 4, Earthquake Actions in Australia. In the event, the entire building footprint is excavated and founded on Unit 3b (i.e. class III shale / Class III Sandstone or better) then the site could be classified as $B_e$.

A hazard factor of 0.08 is suggested based on AS1170.4-2007. Liquefaction potential is considered to be low in view of the limited thicknesses of sandy deposits and low groundwater table level.

## 6.6 Environmental Assessment

The conclusions and recommendations presented below are based on the limited scope of works carried out on-site as part of the preliminary environmental assessment.

The results of the laboratory analysis indicate that concentrations of chemical contaminants within the subsurface are less than the adopted health-based assessment criteria and that no asbestos fibres were detected.

Based on the results of the limited environmental assessment, there is no evidence at the borehole locations to suggest contamination conditions exceeding human health criteria that may present significant limitations to the proposed hospital development. Although several samples reported concentrations of nickel exceeding the phytotoxicity investigation levels, these guidelines are generally used as a screening guide only and are typically subject to specific plant and soil types.

With respect to waste classification, the chemicals of potential concern analysed were generally detected below the General Solid Waste (CT1) criteria with the exception of a number of exceedances for nickel. For preliminary planning purposes, it appears that a majority of the fill and natural soils would likely meet the General Solid Waste criteria (for fill) and VENM classification (for natural soils), subject to further assessment including leachability testing based on the toxicity characteristics leaching procedure (TCLP).

Coffey notes that the Stage 1 assessment identified potential presence of USTs in the investigation area. Boreholes drilled during this investigation however did not provide any visual evidence of underground petroleum infrastructure. As such, there remains uncertainty in relation to the potential presence of USTs. Given the significant potential for contamination associated with USTs, we recommend further assessment of the potential presence of USTs, which may include undertaking a geophysical survey such as Ground Penetrating Radar.

It should be noted that environmental sampling conducted on-site was for the purposes of preliminary assessment at discrete locations to assist with initial development planning and should not be relied on for assessment of overall site suitability.

## 6.7 Construction Risk Register

A preliminary risk register(in format provided by the Client), identifying geotechnical and environmental construction risks is presented in Appendix E. It should be noted that the risk register is prepared based on information available at present and should be reviewed and updated during construction stages.

# 7 LIMITATIONS

The geotechnical model and recommendations in this report are based on a limited number of boreholes. The engineering logs describe subsurface conditions only at the specific borehole locations. Ground conditions can vary over relatively close distances and a geotechnical engineer should be engaged at the construction stage to assess whether site conditions are consistent with design assumptions.

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

For and on behalf of Coffey Geotechnics Pty Ltd

**Peter Waddell**

Principal Engineer

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# 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.

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# Important information about your **Coffey** Report

## Interpretation by other design professionals

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

## Data should not be separated from the report*

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

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

## Geoenvironmental concerns are not at issue

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

## Rely on Coffey for additional assistance

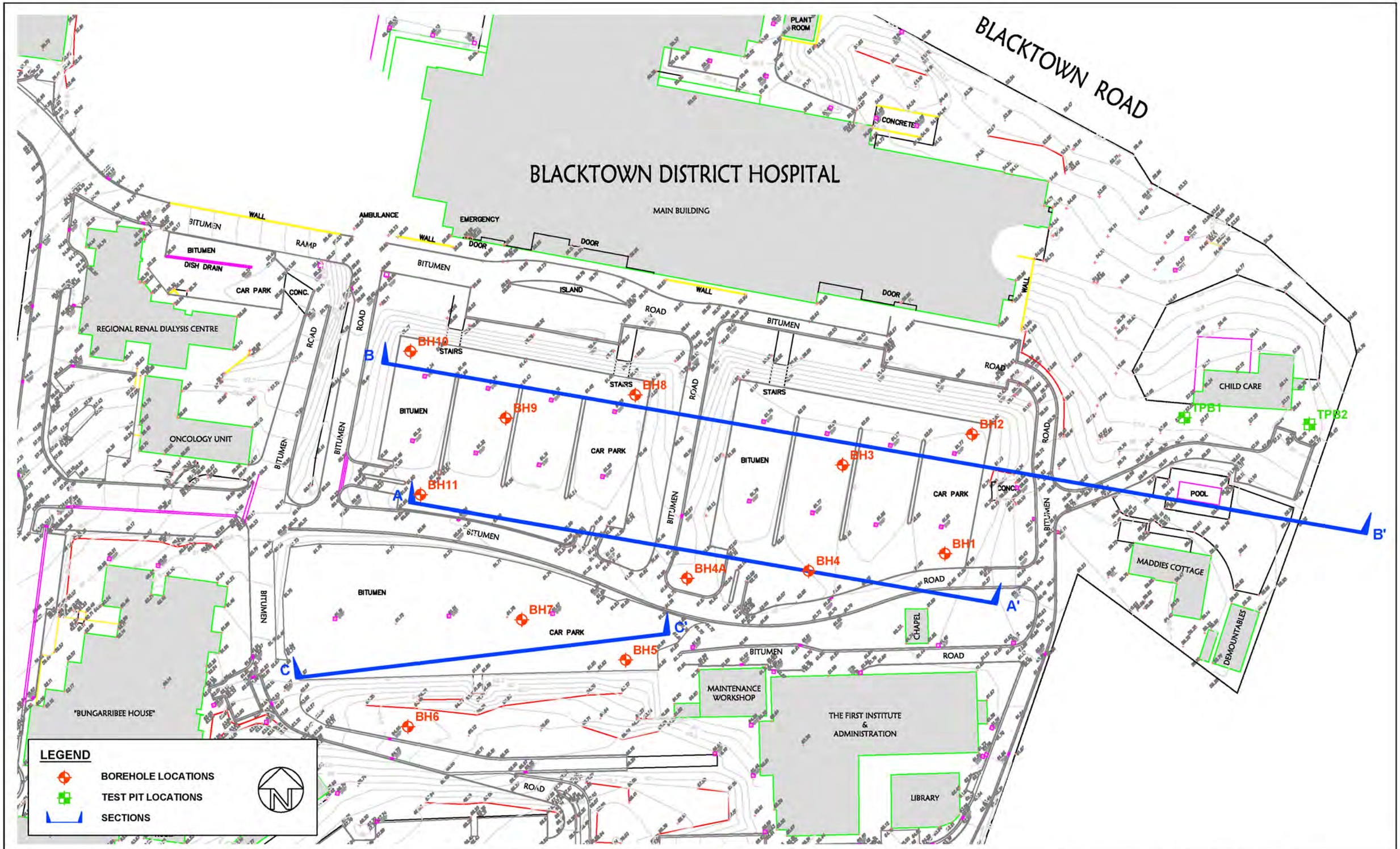
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As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

## Responsibility

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

* 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

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| original size | A3 |

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SPECIALISTS MANAGING THE EARTH

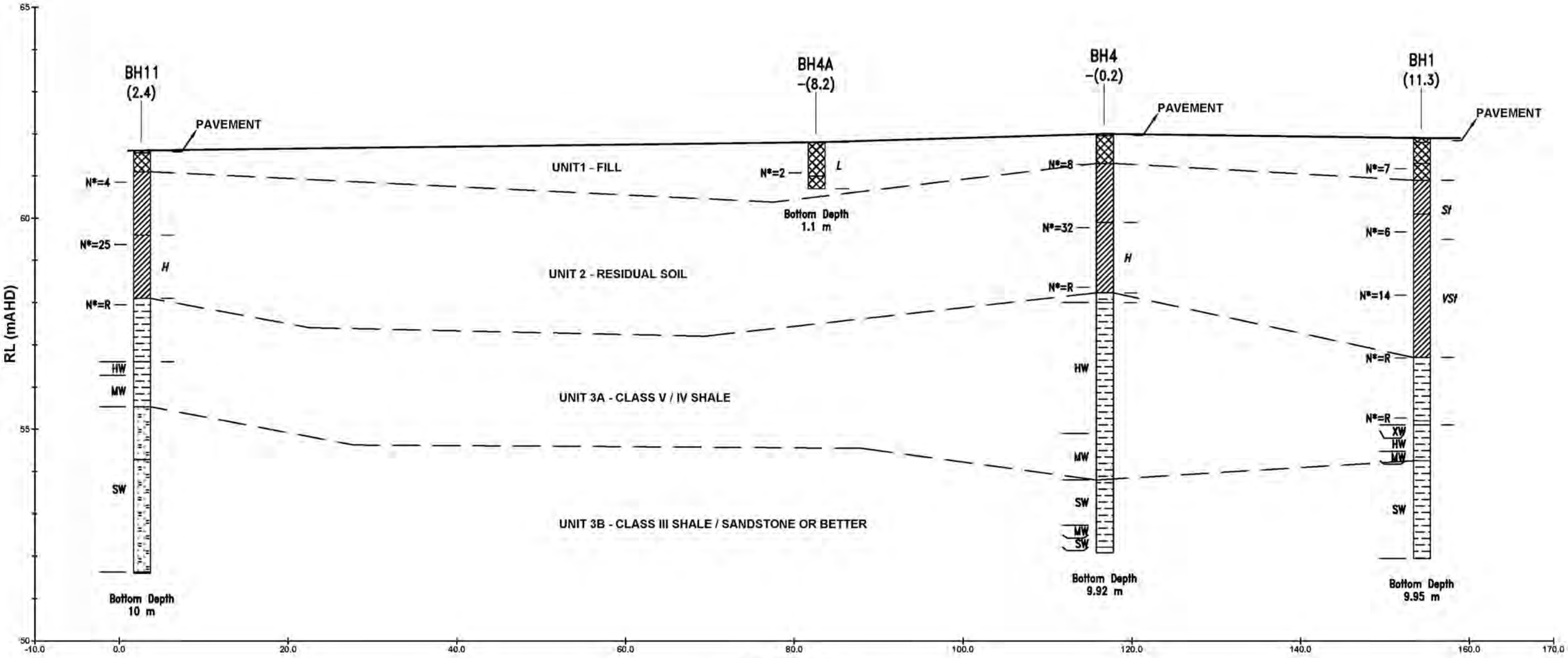
client: HEALTH INFRASTRUCTURE, NSW

project: BLACKTOWN HOSPITAL DEVELOPMENT
BLACKTOWN HOSPITAL, BLACKTOWN, NSW

title: SITE PLAN SHOWING BOREHOLE LOCATIONS AND TEST PITS

project no: GEOTLCOV24207AB

figure no: FIGURE 1




## SECTION-AA'

### LEGEND

- FILL
- CLAY
- SHALE
- INTERBEDDED SHALE & SANDSTONE
- NO CORE
- SANDY CLAY
- SANDSTONE
- IV — ROCK CLASSIFICATION (PELLS ET AL, 1998)
- DX — WEATHERING (SEE EXPLANATION SHEETS)
- qc (MPa) — PIEZOCONE TEST RESULT
- ▼ — WATER LEVEL
- N*=17 — STANDARD PENETRATION TEST RESULT

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Vertical Scale (metres) 1:100

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| approved | SS |
| date | 15/03/11 |
| scale | AS SHOWN |
| original size | A3 |

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SPECIALISTS MANAGING THE EARTH

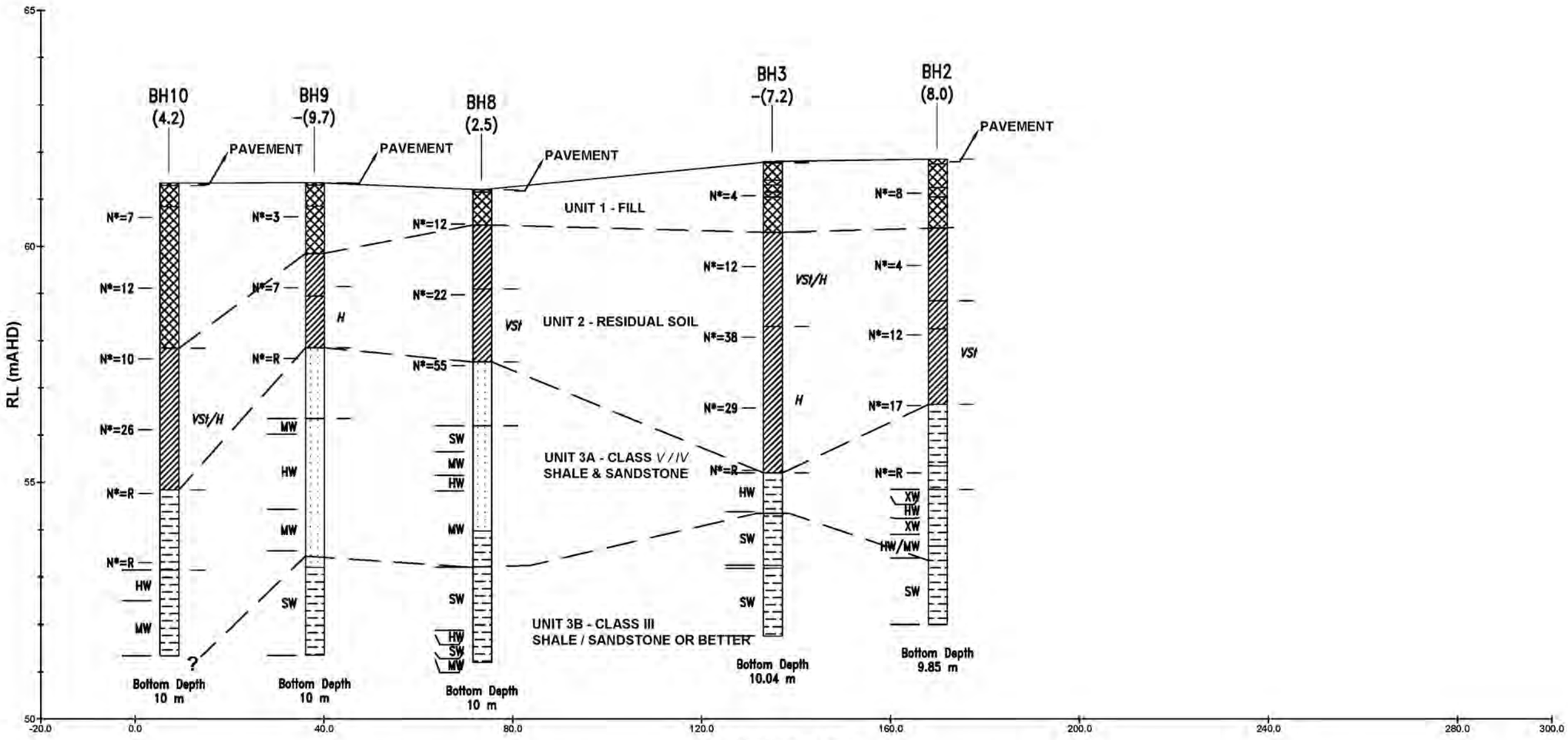
client: HEALTH INFRASTRUCTURE, NSW

project: BLACKTOWN HOSPITAL DEVELOPMENT
BLACKTOWN HOSPITAL, BLACKTOWN, NSW

title: SECTION AA'

project no: GEOTLCOV24207AB

figure no: FIGURE 2




## SECTION-BB'

### LEGEND

- FILL
- CLAY
- SHALE
- INTERBEDDED SHALE & SANDSTONE
- NO CORE
- SANDY CLAY
- SANDSTONE

| | |
|---|---|
| /V | ROCK CLASSIFICATION (PELLS ET AL, 1998) |
| DX | WEATHERING (SEE EXPLANATION SHEETS) |
| qc (MPa) | PIEZOCONE TEST RESULT |
| ▼ | WATER LEVEL |
| N*=17 | STANDARD PENETRATION TEST RESULT |

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Vertical Scale (metres) 1:100

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| date | 15/03/11 |
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| original size | A3 |

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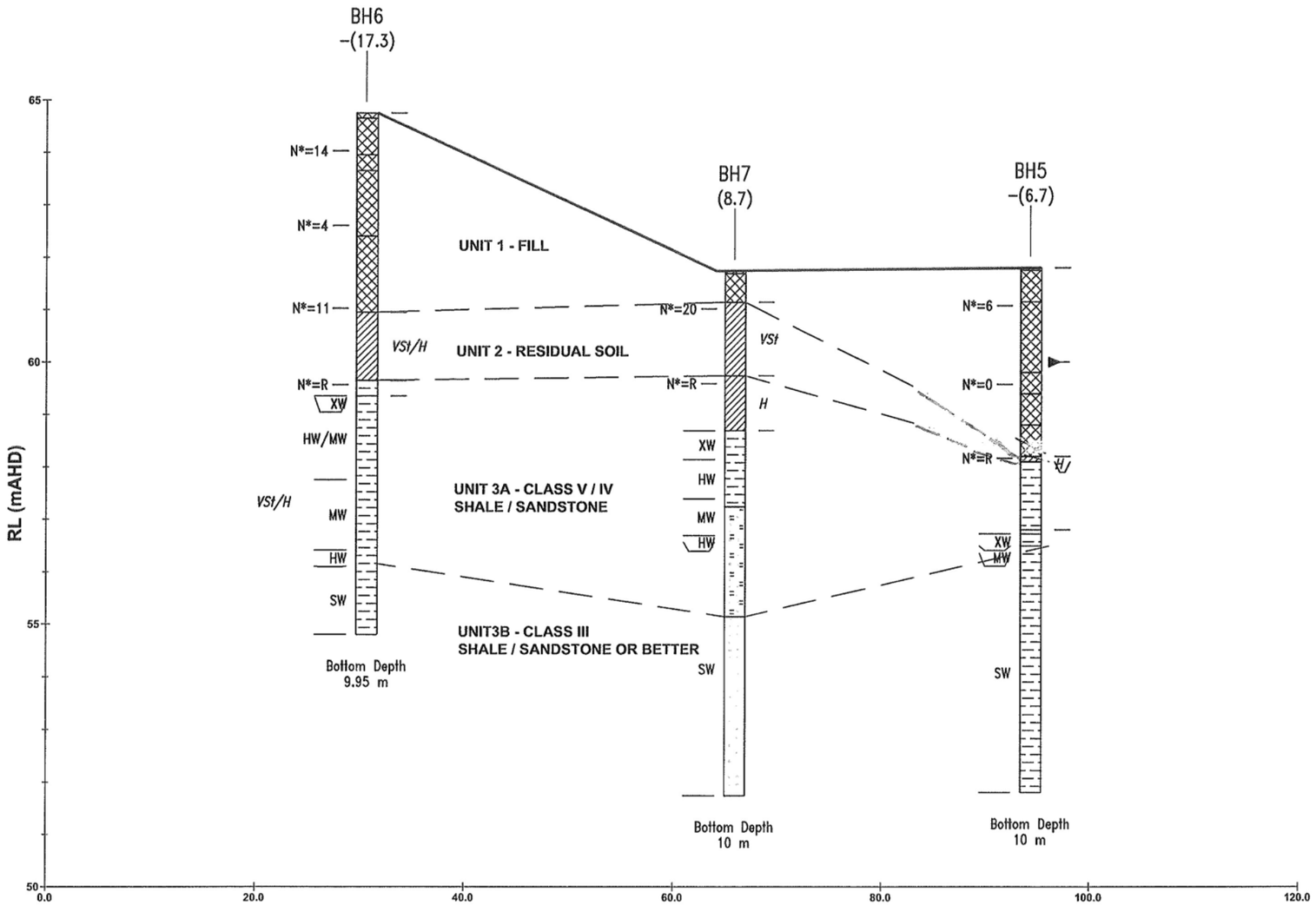
client: HEALTH INFRASTRUCTURE, NSW

project: BLACKTOWN HOSPITAL DEVELOPMENT
BLACKTOWN HOSPITAL, BLACKTOWN, NSW

title: SECTION BB'

project no: GEOTLCOV24207AB

figure no: FIGURE 3




## SECTION-CC'

LEGEND

| | | | |
|---|---|---|---|
| FILL | NO CORE | /V | ROCK CLASSIFICATION (PELLS ET AL, 1998) |
| CLAY | SANDY CLAY | DX | WEATHERING (SEE EXPLANATION SHEETS) |
| SHALE | SANDSTONE | qc (MPa) | PIEZOCONE TEST RESULT |
| INTERBEDDED SHALE & SANDSTONE | | ▼ | WATER LEVEL |
| | | N*=17 | STANDARD PENETRATION TEST RESULT |

| revision | description | drawn | approved | date |
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Vertical Scale (metres) 1:100

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SPECIALISTS MANAGING THE EARTH

client: HEALTH INFRASTRUCTURE, NSW

project: BLACKTOWN HOSPITAL DEVELOPMENT
BLACKTOWN HOSPITAL, BLACKTOWN, NSW

title: SECTION CC'

project no: GEOTLCOV24207AB

figure no: FIGURE 4

# Appendix A

**Engineering Borehole Logs, Core Photographs and Explanation Sheets**

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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%<br>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%<br>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 2.0 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 2.0 mm | CLEAN SANDS (Little or no fines) | Wide range in grain sizes and substantial amounts of all intermediate sizes missing | | | 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%.

## 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 roch 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, $I_S50$ (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 (Is50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

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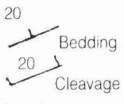
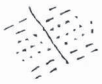
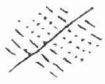
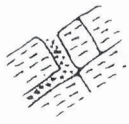
# **Rock Description** Explanation Sheet (2 of 2)

| COMMON DEFECTS IN ROCK MASSES<br>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.

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# Engineering Log - Borehole

| | |
|---|---|
| Borehole No. | ***BH1*** |
| Sheet | 1 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***15.2.2011*** |
| Principal: | |
| Date completed: | ***15.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***DB/SS*** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| drill model and mounting: | Hydrapower Scout Truck | Easting: | 307226 | slope: | -90° | R.L. Surface: | 61.9 |
| hole diameter: | 125 mm | Northing | 6260677 | bearing: | | datum: | AHD |

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E + D | | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: Gravelly SAND:** Fine to coarse grained, brown, fine to medium gravel, angular, trace of clay. | | | | FILL<br>0.1-0.5m PID=1.2ppm |
| | | | | SPT 20,5,2 N*=7 | 61 | 1 | | | **FILL: Gravelly SAND:** Fine to coarse grained, pale brown, fine to medium gravel, angular, trace of clay. | | | | 0.5-0.95m PID=1.6ppm |
| | | | | D | | | | CL/CH | **CLAY:** Medium to high plasticity, brown, trace of fine angular shale and fine subrounded ironstone gravel. | D/M | VSt/St | | RESIDUAL SOIL |
| | | | | | 60 | 2 | | CL | **CLAY:** Medium plasticity, pale grey/red brown, trace of fine rounded ironstone gravel and roots. | | VSt | | |
| | | | | SPT 1,2,4 N*=6 | | | | | | | | | 2.0-2.45m PID=1.1ppm |
| | | | | $U_{50}$ | 59 | 3 | | | | | H | | |
| | | | | SPT 2,5,9 N*=14 | 58 | 4 | | | Trace of fine grained sand at 3.50m. | | | | |
| | | | | | 57 | 5 | | | | | | | |
| | | | | SPT 4,15 N*=R | | | | | **SHALE:** Extremely weathered, pale grey/red brown, ironstained, estimated low to be very low strength, remoulds to a gravelly clay. | | | | SHALE |
| | | | | | 56 | 6 | | | | | | | |
| | | | | SPT 6 N*=R | | | | | **SHALE:** Highly weathered, dark grey/pale grey, ironstained, estimated low to medium strength. | | | | |
| | | | | | 55 | 7 | | | Borehole BH1 continued as cored hole | | | | |
| | | | | | 54 | 8 | | | | | | | |

BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

Form GEO 5.3 Issue 3 Rev.2

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil
C casing

**penetration**

1 2 3 4 no resistance ranging to refusal

**water**

10/1/98 water level on date shown
water inflow
water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

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# Engineering Log - Cored Borehole

Borehole No. **BH1**

Sheet 2 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***15.2.2011***

Principal:

Date completed: ***15.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***DB/SS***

drill model & mounting: Hydrapower Scout Truck | Easting: 307226 | slope: -90° | R.L. Surface: 61.9

hole diameter: 125 mm | Drilling fluid: | Northing: 6260677 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | | | rock mass defects | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular | general |
| | | | 61 | 1 | | | | | | | | | |
| | | | 60 | 2 | | | | | | | | | |
| | | | 59 | 3 | | | | | | | | | |
| | | | 58 | 4 | | | | | | | | | |
| | | | 57 | 5 | | | | | | | | | |
| | | | 56 | 6 | | | | | | | | | |
| | | | | | | Continued from non-cored borehole | | | D A | | | | |
| NMLC | | | 55 | 7 | | **SHALE:** Pale grey/red brown, iron staining along defects, with some fine grained sandstone laminations between 6.80 to 7.27m. | XW<br>HW<br>MW | | 0 0 | 60 | | XW SM Clay filled, pp=70kPa<br>Highly Fractured Zone, 140mm<br>PT<br>PT<br>Highly Fractured Zone, 70mm<br>Highly Fractured Zone, 80mm<br>Highly Fractured Zone, 70mm<br>PT, 10mm<br>PT | |
| | | | 54 | 8 | | **SHALE:** Grey/dark grey, thinly bedded at 0-5°. | SW | | D A<br>0.22 0.23 | | | | |

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

**core-lift**
casing used; barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material; no core recovered

**water**
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; water pressure test result (lugeons) for depth interval shown (25)

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**coating**
CN clean; SN stained; VN veneer; CO coating

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH1*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***15.2.2011*** |
| Principal: | |
| Date completed: | ***15.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***DB/SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307226 | slope: -90° | R.L. Surface: 61.9

hole diameter: 125 mm | Drilling fluid: | Northing: 6260677 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength (VL L M H VH EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm (30 100 300 1000 3000) | defect description: type, inclination, planarity, roughness, coating, thickness (particular / general) |
| NMLC | | Groundwater Not Monitored | 53 | 9 | | **SHALE:** Grey/dark grey, thinly bedded at 0-5°. *(continued)* | SW | | D 0.33 A 0.39 | 60 | | PT<br>Highly Fractured Zone, 10mm<br>Highly Fractured Zone, 50mm |
| | | | | | | | | | D 0.28 A 0.34 | | | PT, 10°, IR, SO, CN |
| | | | | | | | | | D 0.3 A 0.2 | | | PT, 10°, IR, SO, CLAY VN |
| | | | | | | | | | D 0.2 A 0.3 | 49 | | JT, 80°, PL, RO, CN |
| | | | | | | | | | D 0.3 A 0.3 | | | PT<br>Highly Fractured Zone of Multiple PT, 60mm<br>PT<br>PT<br>PT |
| | | | 52 | 10 | | | | | D 0.3 A 0.3 | 70 | | PT, 130mm<br>PT, 20mm |
| | | | | | | BH1 terminated at 9.95m | | | | | | |
| | | | 51 | 11 | | | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

All defects are PT, 0-5°, PL, RO-SO, CN-Fe SN; unless noted otherwise

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

**core-lift**
casing used
barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material
no core recovered

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

**weathering**
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR irregular

**roughness**
VR very rough
RO rough
SO smooth
SL slickensided

**coating**
CN clean
SN stained
VN veneer
CO coating


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: **Health Infrastructure , NSW** | |
| approved | **SS** | | project: **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** | |
| date | **15/2/2011** | | title: **BOREHOLE PHOTOGRAPH–BH1: 6.80m – 9.95m** | |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH1 1 of 1** |
| original size | **A4** | | | |

coffey geotechnics

# Engineering Log - Borehole

Borehole No. **BH2**
Sheet 1 of 3
Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***
Date started: ***15.2.2011***
Principal:
Date completed: ***16.2.2011***
Project: ***Blacktown Hospital Development***
Logged by: ***VJ***
Borehole Location: ***Blacktown District Hospital Carpark***
Checked by: ***SS***

drill model and mounting: Hydrapower Scout Truck | Easting: 307233 | slope: -90° | R.L. Surface: 61.85
hole diameter: 125 mm | Northing 6260711 | bearing: | datum: AHD

| drilling information | | | | | | | material substance | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
| ADT | | C | | E | | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: Gravelly SAND:** Fine to coarse, brown, gravel is fine to medium, angular, trace of clay. | | | | FILL<br>0.1-0.3m PID=4.0ppm |
| | | | | SPT 6,5,3 N*=8 | 61 | 1 | | | **FILL: Gravelly SAND:** Fine to coarse, pale brown, trace of clay. | | | | 0.5-0.7m PID=5.3ppm |
| | | | | | | | | | **FILL: CLAY:** Medium to high plasticity, pale brown, trace of ironstone gravel. | <Wp | | × | |
| | | | | | 60 | 2 | | CL/CH | **CLAY:** Medium to high plasticity, pale brown mottled red brown/pale grey, with some coarse grained sand, trace of fine angular ironstone gravel. | | F/St | | RESIDUAL SOIL |
| | | | | SPT 1,2,2 N*=4 | | | | | | | | × | 2.0-2.2m PID=6.3ppm |
| | | | | | 59 | 3 | | | | | | × | |
| | | | | | | | | CL | **CLAY:** Medium plasticity, brown/pale brown, with some fine ironstone gravel. | | VSt | | |
| | | | | SPT 2,5,7 N*=12 | 58 | 4 | | CL/CH | **Sandy CLAY:** Medium to high plasticity, pale grey, trace of ironstone gravel and rootlets. | | | × | 3.5-3.7m PID=6.6ppm |
| | | | | | 57 | 5 | | | | | | | 5.0-5.2m PID=7.5ppm |
| | | | | SPT 3,7,10 N*=17 | | | | | **SHALE:** Extremely weathered, pale grey, estimated to be very low strength, remoulds to a gravelly clay | | | | SHALE |
| | | | | | 56 | 6 | | | | | | | |
| | | | | SPT 12,22 N*=R | 55 | 7 | | | **SHALE:** Highly weathered, pale grey, estimated to be very low strength, iron stained. | | | | 6.5-6.8m PID=2.5ppm |
| | | | | | 54 | 8 | | | Borehole BH2 continued as cored hole | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**
M mud N nil
C casing

**penetration**
1 2 3 4 — no resistance ranging to refusal

**water**
10/1/98 water level on date shown
water inflow
water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**
based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

coffey geotechnics

# Engineering Log - Cored Borehole

| | | | |
|---|---|---|---|
| Borehole No. | ***BH2*** | | |
| Sheet | 2 of 3 | | |
| Project No: | ***GEOTLCOV24207AB*** | | |
| Client: | ***Health Infrastructure*** | Date started: | ***15.2.2011*** |
| Principal: | | Date completed: | ***16.2.2011*** |
| Project: | ***Blacktown Hospital Development*** | Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** | Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307233 | slope: -90° | R.L. Surface: 61.85

hole diameter: 125 mm Drilling fluid: | Northing: 6260711 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular | general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 61 | 1 | | | | | | | | | |
| | | | 60 | 2 | | | | | | | | | |
| | | | 59 | 3 | | | | | | | | | |
| | | | 58 | 4 | | | | | | | | | |
| | | | 57 | 5 | | | | | | | | | |
| | | | 56 | 6 | | | | | | | | | |
| | | | 55 | 7 | | Continued from non-cored borehole | | | | | | | |
| NMLC | | | 54 | 8 | | **SHALE:** Pale grey mottled red/brown, iron staining along defects. | XW / HW / XW | | | 40 | | — XW, Clay filled, SN, pp=70kPa<br>— Highly Fractured Zone, 330mm<br>PT, 0°, CU, RO, SN<br>Highly Fractured Zone, 270mm<br>— PT, 0°, CU, RO, SN<br>— PT, 0°, PL, SO, SN | |

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

**core-lift**
casing used
barrel withdrawn

**graphic log/core recovery**
core recovered
- graphic symbols indicate material
no core recovered

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

**weathering**
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

**roughness**
VR very rough
RO rough
SO smooth
SL slickensided

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR irregular

**coating**
CN clean
SN stained
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH2*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***15.2.2011*** |
| Principal: | |
| Date completed: | ***16.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307233 | slope: -90° | R.L. Surface: 61.85

hole diameter: 125 mm | Drilling fluid: | Northing: 6260711 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength (VL L M H VH EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm (30 100 300 1000 3000) | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NMLC | | Groundwater Not Monitored | 53 | 9 | | **SHALE:** Pale grey/dark grey, thinly bedded at 0-5°, with some fine grained sandstone laminations, pale grey. | HW/MW | | D 0.31 A 0.3 | 40 | | PT, 0-5°, PL (Parting every 20-30mm for 210mm) |
| | | | | | | | | | | | | Highly Fractured Zone, 120mm |
| | | | | | | | SW | | D 0.28 A 0.32 | | | |
| | | | | | | | | | D 0.2 | | | PT, 0°, RO |
| | | | | | | | | | D 0.2 A 0.64 | | | PT, 0-5°, RO |
| | | | | | | | | | | | | PT, 0°, RO |
| | | | | | | | | | | | | JT, 80-85°, RO, SN, 210mm |
| | | | | | | | | | | | | PT, 0°, PL |
| | | | 52 | | | | | | D 0.3 | | | |
| | | | | 10 | | BH2 terminated at 9.85m | | | | | | |
| | | | 51 | 11 | | | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

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

**core-lift**
casing used; barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material; no core recovered

**water**
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**coating**
CN clean; SN stained; VN veneer; CO coating


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **16/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH2: 7.00m – 9.85m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH2 1 of 1** |
| original size | **A4** | | | |

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# Engineering Log - Borehole

| | |
|---|---|
| Borehole No. | ***BH3*** |
| Sheet | 1 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: ***Health Infrastructure*** | Date started: ***16.2.2011*** |
| Principal: | Date completed: ***16.2.2011*** |
| Project: ***Blacktown Hospital Development*** | Logged by: ***VJ*** |
| Borehole Location: ***Blacktown District Hospital Carpark*** | Checked by: ***SS*** |

drill model and mounting: Hydrapower Scout Truck | Easting: 307196 | slope: -90° | R.L. Surface: 61.8

hole diameter: 125 mm | Northing 6260702 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa (100 200 300 400) | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E + D | | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | E + D | | | | | **FILL: Sandy GRAVEL:** Fine to medium, angular gravel, dark grey/brown, fine to coarse grained sand. | | | | FILL |
| | | | | SPT 1,2,2 N*=4 | 61 | 1 | | | **FILL: Gravelly SAND:** Fine to medium sand, brown/grey, medium, angular gravel, trace of clay. | | | | 0.10-0.30m PID=1.0ppm |
| | | | | | | | | | **FILL: CLAY:** Low plasticity, brown/grey, trace of medium gravel and roots. | D/M | | | 0.40-0.50m PID=2.8ppm |
| | | | | E + D | | | | | **FILL: SAND:** Medium to coarse sand, brown/grey/white, trace of fine angular gravel. | | | | 0.50-0.75m PID=1.9ppm |
| | | | | | | | | | **FILL: CLAY:** Low to medium plasticity, brown/red brown/grey, with some fine angular gravel. | | | | 1.20-1.30m PID=1.8ppm |
| | | | | | 60 | 2 | | CL/CH | **CLAY:** Medium to high plasticity, pale grey/red brown, with some fine angular ironstone gravel, trace of sand and roots. | <Wp | VSt/H | | RESIDUAL SOIL |
| | | | | SPT 3,5,7 N*=12 | | | | | | | | | 2.00-2.45m PID=1.9ppm |
| | | | | | 59 | 3 | | | | | | | |
| | | | | SPT 7,14,24 N*=38 | 58 | 4 | | CL/CH | **CLAY:** Medium to high plasticity, pale grey mottled red brown, with some fine ironstone gravel. | | H | | 3.50-3.95m PID=2.1ppm |
| | | | | | 57 | 5 | | | | | | | |
| | | | | SPT 5,9,20 N*=29 | | | | | | | | | |
| | | | | | 56 | 6 | | | | | | | |
| | | | | SPT 20/90mm N*=R | 55 | 7 | | | Borehole BH3 continued as cored hole | | | | |
| | | | | | 54 | 8 | | | | | | | |

BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

Form GEO 5.3 Issue 3 Rev.2

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil
C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown
water inflow
water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH3*** |
| Sheet | 2 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***16.2.2011*** |
| Principal: | |
| Date completed: | ***16.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307196 | slope: -90° | R.L. Surface: 61.8

hole diameter: 125 mm | Drilling fluid: | Northing: 6260702 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 61 | 1 | | | | | | | | |
| | | | 60 | 2 | | | | | | | | |
| | | | 59 | 3 | | | | | | | | |
| | | | 58 | 4 | | | | | | | | |
| | | | 57 | 5 | | | | | | | | |
| | | | 56 | 6 | | Continued from non-cored borehole | | | | | | |
| NMLC | | | 55 | 7 | | **SHALE:** Pale brown/pale grey, distinctly bedded 0-5°, with some minor sandstone laminations. At 6.85m becoming grey/pale grey. | HW | | D 0 A 0.06 | 60 | | PT, 0-5°, CU, RO, SN<br>PT, 0-5°, CU, RO, SN<br>PT, 0°, PL, RO, SN<br>JT, 45°, CU, RO, SN<br>Highly Fractured Zone, 70mm<br>Highly Fractured Zone, 50mm<br>JT, 30°, RO, SN<br>PT, 0-5°, CU, SO, SN<br>Highly Fractured Zone, 20mm<br>JT, PL, SO<br>PT, 0-5°, CU, SO, SN |
| | | | 54 | 8 | | | SW | | D 0.17 A 0.12<br>D 0.25 A 0.26 | | | |

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

**core-lift**
casing used; barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material; no core recovered

**water**
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**coating**
CN clean; SN stained; VN veneer; CO coating

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH3*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***16.2.2011*** |
| Principal: | |
| Date completed: | ***16.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307196 | slope: -90° | R.L. Surface: 61.8

hole diameter: 125 mm | Drilling fluid: | Northing: 6260702 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength (VL L M H VH EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm (30 100 300 1000 3000) | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NMLC | | Groundwater Not Monitored | 53 | 9 | | **SHALE:** Pale brown/pale grey, distinctly bedded 0-5°, with some minor sandstone laminations. *(continued)* | SW | M | D 0.43 A 0.5 | 60 | | JT, 10°, CU, SN, SO<br>Highly Fractured Zone, 40mm<br>PT, 0°, RO, CU<br>JT, 45-80°, PL. SO, 100mm<br>PT, 0°, RO, CU<br>Highly Fractured Zone, 70mm |
| | | | | | | **NO CORE:** 0.06m. | SW | | | | | |
| | | | | | | **SHALE:** Grey/pale grey, distinctly bedded at 0°-5°, with some minor sandstone laminations. | | | | | | JT, ST, 75-80°, 15mm<br>PT, 0°, PL |
| | | | 52 | 10 | | | | | D 0.3 A 0.3 | | | PT, 0°, ST |
| | | | | | | | | | D 0.2 A 0.2 | | | PT, 0°, PL |
| | | | | | | BH3 terminated at 10.04m | | | | | | |
| | | | 51 | 11 | | | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

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

**core-lift**
casing used; barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material; no core recovered

**water**
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; water pressure test result (lugeons) for depth interval shown (25)

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

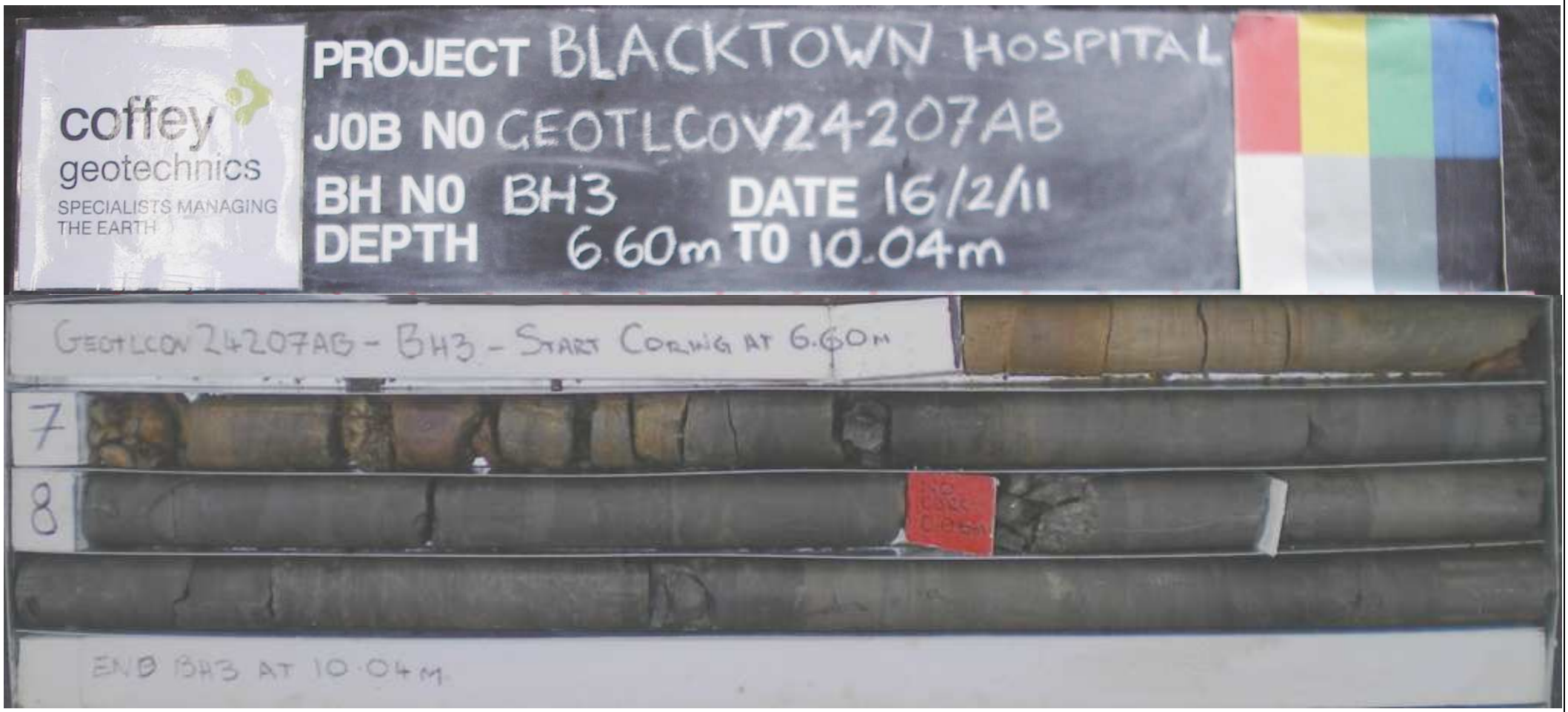
**strength**
VL very low; L low; M medium; H high; VH very high; EH extremely high

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**coating**
CN clean; SN stained; VN veneer; CO coating




| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **16/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH3: 6.60m – 10.04m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH3 1 of 1** |
| original size | **A4** | | | |

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# Engineering Log - Borehole

Borehole No. **BH4**

Sheet 1 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***18.2.2011***

Principal:

Date completed: ***18.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model and mounting: Hydrapower Scout Truck | Easting: 307187 | slope: -90° | R.L. Surface: 62.0

hole diameter: 125 mm | Northing 6260672 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E | | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: SAND:** Fine grained sand, brown, with some fine gravel, trace of clay. | | | | FILL<br>0.1-0.3m PID=0.9ppm<br>0.5-0.6m PID=5.8ppm |
| | | | | SPT 1,2,6 N*=8 | 61 | 1 | | CH | **CLAY:** High plasticity, pale grey, trace of ironstone gravel and rootlets. | <Wp | VSt | × | RESIDUAL SOIL |
| | | | | | 60 | 2 | | | | | | | |
| | | | | SPT 1,13,19 N*=32 | | | | CL | **CLAY:** Medium plasticity, pale grey/red brown, trace of ironstone gravel. | | H | | 2.0-2.1m PID=0.7ppm |
| | | | | | 59 | 3 | | | | | | | |
| | | | | SPT 15 N*=R | | | | | | | | | 3.5-3.6m PID=0.6ppm |
| | | | | | 58 | 4 | | | **SHALE:** Extremely weathered, pale grey/red brown, estimated to be very low strength, remoulds to a gravelly clay. | | | | SHALE |
| | | | | | | | | | Borehole BH4 continued as cored hole | | | | |
| | | | | | 57 | 5 | | | | | | | |
| | | | | | 56 | 6 | | | | | | | |
| | | | | | 55 | 7 | | | | | | | |
| | | | | | 54 | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil

C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown

water inflow

water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH4*** |
| Sheet | 2 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***18.2.2011*** |
| Principal: | |
| Date completed: | ***18.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307187 | slope: -90° | R.L. Surface: 62.0

hole diameter: 125 mm | Drilling fluid: | Northing: 6260672 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | Is(50) MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 61 | 1 | | | | | | | | |
| | | | 60 | 2 | | | | | | | | |
| | | | 59 | 3 | | | | | | | | |
| | | | 58 | 4 | | Continued from non-cored borehole | | | | | | |
| NMLC | | Groundwater Not Monitored | 57 | 5 | | **SHALE:** Grey/red brown, thinly laminated, iron stained. | HW | | D 0.21 A 0.13 | 33 | | PT, 0°, PL, SO, SN<br>JT, 45°, PL, SO, SN, 80mm<br>Highly Fractured Zone, 440mm<br>PT, ST, IR, SN<br>JT, 45-50°, IR, 50mm |
| | | | 56 | 6 | | | | | D 0.08 A 0.18<br>D 0 A 0.03 | | | Highly Fractured Zone, 350mm<br>PT, IR, SN<br>PT, ST, IR<br>PT, 0°, PL, SN<br>PT, ST, SO, SN<br>PT, 0°, PL<br>JT, 75-80°, IR, SN, 100mm<br>PT, 0°, PL, SN<br>Highly Fractured Zone, 500mm<br>JT, 90°, IR, 150mm<br>PT, 0°, PL, RO, SN |
| | | | 55 | 7 | | | MW | | D 0.1 A 0.09<br>D 0.1 A 0.2 | 78 | | JT, 60-70°, PL, SN, 80mm<br>PT, 0°, IR, SN<br>PT, IR, SN<br>JT, 45-50°, PL, 80mm<br>PT, 0°, IR, SN<br>PT, 0°, IR |
| | | | 54 | 8 | | | | | D A | | | JT, 85-90°, SO, 110mm<br>SM, 20mm |

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

**core-lift**
casing used; barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material; no core recovered

**water**
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**coating**
CN clean; SN stained; VN veneer; CO coating

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH4*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***18.2.2011*** |
| Principal: | |
| Date completed: | ***18.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307187 | slope: -90° | R.L. Surface: 62.0

hole diameter: 125 mm | Drilling fluid: | Northing: 6260672 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength (VL L M H VH EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm (30 100 300 1000 3000) | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
| NMLC | | | 53 | 9 | | **SHALE:** Grey/red brown, thinly laminated, iron stained. *(continued)* | MW | | D 0 0.2 | 78 | | PT, 0-5°, PL |
| | | | | | | | SW | | A 0 0.2 | | | SM, 10mm |
| | | | | | | | | | D 0.2 0.3 | | | JT, 45°, PL, SN |
| | | | | | | | | | A 0.2 0.3 | | | JT, 90°, PL, SN, 160mm |
| | | | | | | | | | D 0.2 0.2 | | | PT, 0-5°, PL, SN |
| | | | | | | | | | A 0.2 0 | | | JT, 90°, PL, SO, SN, 150mm |
| | | | | | | | MW | | | | | PT, 0°, PL |
| | | | | | | | | | | | | PT, 0°, IR, SN |
| | | | | | | | SW | | | | | PT, IR, SN |
| | | | | | | | | | D 0.4 0.6 | | | SM, 10mm |
| | | | | | | **NO CORE:** 130mm. | | | A 0.1 0.3 | | | PT, IR, SN |
| | | | 52 | 10 | | BH4 terminated at 9.92m | | | | | | PT, 0-5°, PL, SN |
| | | | 51 | 11 | | | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

**method**

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

**core-lift**

- casing used
- barrel withdrawn

**graphic log/core recovery**

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

**water**

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

**weathering**

| | |
|---|---|
| FR | fresh |
| SW | slightly weathered |
| MW | moderately weathered |
| HW | highly weathered |
| XW | extremely weathered |
| DW | distinctly weathered (covers MW and HW) |

**strength**

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

**defect type**

| | |
|---|---|
| JT | joint |
| PT | parting |
| SM | seam |
| SZ | sheared zone |
| SS | sheared surface |
| CS | crushed seam |

**planarity**

| | |
|---|---|
| PL | planar |
| CU | curved |
| UN | undulating |
| ST | stepped |
| IR | irregular |

**roughness**

| | |
|---|---|
| VR | very rough |
| RO | rough |
| SO | smooth |
| SL | slickensided |

**coating**

| | |
|---|---|
| CN | clean |
| SN | stained |
| VN | veneer |
| CO | coating |


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **18/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH4: 4.00m – 9.92m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH4 1 of 1** |
| original size | **A4** | | | |

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Borehole No. **BH4A**

Sheet 1 of 1

Project No: **GEOTLCOV24207AB**

# Engineering Log - Borehole

Client: ***Health Infrastructure***

Date started: ***16.2.2011***

Principal:

Date completed: ***16.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model and mounting: Hydrapower Scout Truck | Easting: 307152 | slope: -90° | R.L. Surface: 61.8

hole diameter: 125 mm | Northing 6260670 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | N | | E<br>SPT 2,1,1 N*=2 | 61 | 1 | | | **FILL: SAND:** Fine to medium grained, grey, with some fine gravel and roots. | D | L | | FILL<br>0.2-0.3m PID=3.8ppm<br>0.5-0.6m PID = 7.1ppm |
| | | | | | | | | | **FILL: GRAVEL:** Fine to medium, angular, with some medium to coarse grained sand. | | | | |
| | | | | | 60 | 2 | | | Borehole BH4A terminated at 1.1m | | | | End on posible concrete foundation |
| | | | | | 59 | 3 | | | | | | | |
| | | | | | 58 | 4 | | | | | | | |
| | | | | | 57 | 5 | | | | | | | |
| | | | | | 56 | 6 | | | | | | | |
| | | | | | 55 | 7 | | | | | | | |
| | | | | | 54 | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil

C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown

water inflow

water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

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# Engineering Log - Borehole

| | |
|---|---|
| Borehole No. | ***BH5*** |
| Sheet | 1 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***17.2.2011*** |
| Principal: | |
| Date completed: | ***17.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model and mounting: Hydrapower Scout Truck | Easting: 307134 | slope: -90° | R.L. Surface: 61.8

hole diameter: 125 mm | Northing 6260646 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E + D | | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: SAND:** Medium to coarse sand, grey, with some fine to medium gravel, trace of clay. | | | | FILL<br>0.30-0.40m PID=1.8ppm |
| | | | | SPT 3,3,3 N*=6 | 61 | 1 | | | **FILL: SAND:** Fine to medium sand, pale brown. | M | | | |
| | | | | E + D | | | | | | | | | 1.00-1.10m PID=3.9ppm |
| HA | | | | E + D | | | | | | | | | 1.30-1.40m PID=4.2ppm |
| ADT | | | ▶ | | 60 | 2 | | | **FILL: SAND:** Fine to medium sand, pale brown. | W | | | 2.00m: SPT rods sank under own weight. |
| | | | | SPT 0,0,0 N*=0 | | | | | **FILL: Clayey SAND:** Fine to medium sand, grey, low to medium plasticity clay. | | | | |
| | | | | | 59 | 3 | | | **FILL: SAND:** Fine to medium sand, pale brown. | | | | |
| | | | | SPT 10 N*=R | 58 | 4 | | CL/CH | **CLAY:** Medium to high plasticity, pale grey/grey, trace of fine ironstone gravel. | D | H | | 3.50-3.60m PID=4.9ppm<br>RESIDUAL SOIL |
| | | | | | | | | | **SHALE:** Extremely weathered, brown/pale brown/red brown, estimated to be very low strength, remoulds to a gravelly clay. | | | | SHALE |
| | | | | | 57 | 5 | | | | | | | |
| | | | | | | | | | Borehole BH5 continued as cored hole | | | | |
| | | | | | 56 | 6 | | | | | | | |
| | | | | | 55 | 7 | | | | | | | |
| | | | | | 54 | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil
C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown
water inflow
water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

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# Engineering Log - Cored Borehole

Borehole No. **BH5**
Sheet 2 of 3
Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure*** Date started: ***17.2.2011***
Principal: Date completed: ***17.2.2011***
Project: ***Blacktown Hospital Development*** Logged by: ***VJ***
Borehole Location: ***Blacktown District Hospital Carpark*** Checked by: ***SS***

drill model & mounting: Hydrapower Scout Truck | Easting: 307134 | slope: -90° | R.L. Surface: 61.8
hole diameter: 125 mm Drilling fluid: | Northing: 6260646 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
| | | | 61 | 1 | | | | | | | | |
| | | ▼ | 60 | 2 | | | | | | | | |
| | | | 59 | 3 | | | | | | | | |
| | | | 58 | 4 | | | | | | | | |
| | | | 57 | 5 | | Continued from non-cored borehole | | | | | | |
| NMLC | | | 56 | 6 | | **NO CORE:** 0.08m<br>**SHALE:** Brown, thinly bedded, ironstained.<br>**SHALE:** Grey/dark grey, thinly bedded at 0-5°, with some laminations of fine grained sandstone, pale grey. | XW<br>MW<br>SW | | D 0.13 A 0.19<br>D 0.12 A 0.26<br>D 0.1 A 0.22<br>A 0.3 | 70 | | Highly Fractured Zone, 210mm<br>PT<br>JT, 25-30°, PL, 20mm<br>JT, 0-5°, 10mm<br>PT<br>JT, 85-90°, PL, SO, 20mm<br>JT, 10-15°, PL, SO<br>PT, 0°, CU, SO<br>PT<br>PT, CU<br>PT, 0°, IR<br>PT<br>Highly Fractured Zone, 220mm,<br>PT<br>PT<br>PT<br>PT<br>All defects are: PT, 0°-5°, PL, SO-RO, CN-SN |
| | | | 55 | 7 | | | | | | | | |
| | | | 54 | 8 | | | | | | | | |

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

**core-lift**
casing used
barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material
no core recovered

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

**weathering**
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR irregular

**roughness**
VR very rough
RO rough
SO smooth
SL slickensided

**coating**
CN clean
SN stained
VN veneer
CO coating

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH5*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***17.2.2011*** |
| Principal: | |
| Date completed: | ***17.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307134 | slope: -90° | R.L. Surface: 61.8

hole diameter: 125 mm | Drilling fluid: | Northing: 6260646 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength (VL L M H VH EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm (30 100 300 1000 3000) | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
| NMLC | | | 53 | 9 | | **SHALE:** Grey/dark grey, thinly bedded at 0-5°, with some laminations of fine grained sandstone, pale grey. *(continued)* | SW | | D A<br>0.2 0.3<br>D A<br>0.2 0.4<br>D A<br>0.2 0.4<br>D A<br>0 0.3<br>D A<br>0.2 0.1<br>D A<br>0.2 0.3 | 100 | | PT<br>PT<br>PT, 0°, IR<br>PT<br>PT, 0°, IR<br>PT<br>PT |
| | | | 52 | 10 | | | | | | | | |
| | | | 51 | 11 | | BH5 terminated at 10m | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

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

**core-lift**
casing used
barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material
no core recovered

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

**weathering**
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR irregular

**roughness**
VR very rough
RO rough
SO smooth
SL slickensided

**coating**
CN clean
SN stained
VN veneer
CO coating


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **17/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH5: 5.00m – 10.00m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH5 1 of 1** |
| original size | **A4** | | | |

coffey geotechnics

# Engineering Log - Borehole

Borehole No. **BH6**

Sheet 1 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***17.2.2011***

Principal:

Date completed: ***17.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model and mounting: Hydrapower Scout Truck | Easting: 307072 | slope: -90° | R.L. Surface: 64.75

hole diameter: 125 mm | Northing 6260628 | bearing: | datum: AHD

| drilling information | | | | | | | material substance | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
| ADT | | C | | E + D | | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: GRAVEL:** Coarse grained gravel, dark grey, with some medium to coarse sand, trace of clay. | | | | FILL<br>0.10-0.30m PID=3.2ppm<br>0.50-0.60m PID=5.8ppm |
| | | | | SPT 2,5,9 N*=14 | 64 | 1 | | | | | | | |
| | | | | E + D | | | | | **FILL: Clayey SAND:** Fine to medium sand, brown/dark brown, trace of clay and grass cuttings at 0.8m. | | | | 1.10-1.20m PID=5.0ppm |
| | | | | | 63 | 2 | | | **FILL: Gravelly SAND:** Medium to coarse sand, brown/dark grey, fine gravel, with some clay, trace of roots. | | | | |
| | | | | SPT 2,2,2 N*=4 | | | | | | | | | |
| | | | | E + D | | | | | **FILL: SAND:** Fine grained sand, pale brown. | | | | 2.35-2.45m PID=2.3ppm |
| | | | | | 62 | 3 | | | | | | | |
| | | | | SPT 1,1,10 N*=11 | 61 | 4 | | CL/CH | **CLAY:** Medium to high plasticity, brown/dark brown, with some ironstone gravel. | <Wp | VSt/H | | RESIDUAL SOIL |
| | | | | | 60 | 5 | | | | | | | 5.00-5.10m PID=5.8ppm |
| | | | | SPT 7,20 N*=R | | | | | **SHALE:** Extremely weathered, grey, estimated to be very low strength, remoulds to a clay. | | | | SHALE |
| | | | | | 59 | 6 | | | Borehole BH6 continued as cored hole | | | | |
| | | | | | 58 | 7 | | | | | | | |
| | | | | | 57 | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil

C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown

water inflow

water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

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# Engineering Log - Cored Borehole

Borehole No. **BH6**

Sheet 2 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***17.2.2011***

Principal:

Date completed: ***17.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model & mounting: Hydrapower Scout Truck | Easting: 307072 | slope: -90° | R.L. Surface: 64.75

hole diameter: 125 mm Drilling fluid: | Northing: 6260628 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 64 | 1 | | | | | | | | |
| | | | 63 | 2 | | | | | | | | |
| | | | 62 | 3 | | | | | | | | |
| | | | 61 | 4 | | | | | | | | |
| | | | 60 | 5 | | Continued from non-cored borehole | | | | | | |
| NMLC | | Groundwater Not Monitored | 59 | 6 | | **SHALE:** Pale grey/pale brown mottled dark grey, indistinctly bedded at 0-5°, with some laminations of fine grained sandstone, iron staining along defects. | XW / HW/MW | | D 0.03 A 0.17 | 70 | | PT, 80mm<br>PT, 50mm<br>Highly Fractured Zone, 40mm<br>PT, 0°, IR, RO, SN<br>PT<br>PT, 0°, IR, RO, SN<br>PT, 0°, IR, SO, SN<br>PT, 0°, IR, SO, SN |
| | | | 58 | 7 | | | MW | | D 0 A 0<br>D 0 A 0.37 | | | Highly Fractured Zone, 20mm<br>JT, 5-10°, PL, RO, 20mm<br>PT<br>PT<br>PT<br>PT<br>PT |
| | | | 57 | 8 | | | | | D 0.12 A 0.19 | | | JT, 10-15°, PL, SO, SN<br>PT, CU, SO, SN |

All defects are: PT, 0°-5°, PL, RO-SO, SN-CN; unless noted otherwise

**method**

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

**core-lift**

- casing used
- barrel withdrawn

**graphic log/core recovery**

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

**water**

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

**weathering**

| | |
|---|---|
| FR | fresh |
| SW | slightly weathered |
| MW | moderately weathered |
| HW | highly weathered |
| XW | extremely weathered |
| DW | distinctly weathered (covers MW and HW) |

**strength**

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

**defect type**

| | |
|---|---|
| JT | joint |
| PT | parting |
| SM | seam |
| SZ | sheared zone |
| SS | sheared surface |
| CS | crushed seam |

**planarity**

| | |
|---|---|
| PL | planar |
| CU | curved |
| UN | undulating |
| ST | stepped |
| IR | irregular |

**roughness**

| | |
|---|---|
| VR | very rough |
| RO | rough |
| SO | smooth |
| SL | slickensided |

**coating**

| | |
|---|---|
| CN | clean |
| SN | stained |
| VN | veneer |
| CO | coating |

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH6*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***17.2.2011*** |
| Principal: | |
| Date completed: | ***17.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307072 | slope: -90° | R.L. Surface: 64.75

hole diameter: 125 mm | Drilling fluid: | Northing: 6260628 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength (VL L M H VH EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm (30 100 300 1000 3000) | defect description: type, inclination, planarity, roughness, coating, thickness (particular / general) |
| NMLC | | | 56 | 9 | | **SHALE:** Pale grey/pale brown mottled dark grey, indistinctly bedded at 0-5°, with some laminations of fine grained sandstone, iron staining along defects. *(continued)* | MW / HW / SW | | D 0 A 0.2 | 70 | | Highly Fractured Zone, 30mm<br>PT<br>JT, 10-15°, PL, RO, 20mm<br>PT<br>Highly Fractured Zone, 170mm<br>SM, 80mm, CLAY FILLED<br>PT<br>PT |
| | | | 55 | 10 | | | | | D 0 A 0.3<br>D 0.2 A 0.4<br>D 0.1 A 0.5<br>D 0.5 A 0.5<br>D 0.5 A 0.4 | 80 | | PT, 0°, IR, SO, CN |
| | | | 54 | 11 | | BH6 terminated at 9.95m | | | | | | |
| | | | 53 | 12 | | | | | | | | |
| | | | 52 | 13 | | | | | | | | |
| | | | 51 | 14 | | | | | | | | |
| | | | 50 | 15 | | | | | | | | |
| | | | 49 | 16 | | | | | | | | |

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

**core-lift**
casing used
barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material
no core recovered

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

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**coating**
CN clean; SN stained; VN veneer; CO coating


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **17/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH6: 5.40m – 9.95m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH6 1 of 1** |
| original size | **A4** | | | |

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# Engineering Log - Borehole

Borehole No. **BH7**

Sheet 1 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***17.2.2011***

Principal:

Date completed: ***17.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model and mounting: Hydrapower Scout Truck | Easting: 307104 | slope: -90° | R.L. Surface: 61.74

hole diameter: 125 mm | Northing 6260658 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E | | | | | **FILL: BITUMEN:** Black. **FILL: CLAY:** Medium plasticity, grey. | W | | | PAVEMENT FILL |
| | | | | SPT 1,5,15 N*=20 | 61 | 1 | | CL | **CLAY:** Medium plasticity, grey/pale brown, trace of ironstone gravel. | <Wp | VSt | × | 0.5-0.6m PID=2.8ppm RESIDUAL SOIL |
| | | | | | 60 | 2 | | | | | | | |
| | | | | SPT 14,32 N*=R | | | | CL | **CLAY:** Medium plasticity, pale brown/dark brown mottled orange, trace of fine shale gravel. | | H | | 2.1-2.3m PID=2.1ppm |
| | | | | | 59 | 3 | | | | | | | |
| | | | | | | | | | Borehole BH7 continued as cored hole | | | | |
| | | | | | 58 | 4 | | | | | | | |
| | | | | | 57 | 5 | | | | | | | |
| | | | | | 56 | 6 | | | | | | | |
| | | | | | 55 | 7 | | | | | | | |
| | | | | | 54 | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil

C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown

water inflow

water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

Form GEO 5.3 Issue 3 Rev.2

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# Engineering Log - Cored Borehole

| | | | |
|---|---|---|---|
| Borehole No. | ***BH7*** | | |
| Sheet | 2 of 3 | | |
| Project No: | ***GEOTLCOV24207AB*** | | |
| Client: | ***Health Infrastructure*** | Date started: | ***17.2.2011*** |
| Principal: | | Date completed: | ***17.2.2011*** |
| Project: | ***Blacktown Hospital Development*** | Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** | Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307104 | slope: -90° | R.L. Surface: 61.74

hole diameter: 125 mm Drilling fluid: | Northing: 6260658 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 61 | 1 | | | | | | | | |
| | | | 60 | 2 | | | | | | | | |
| | | | 59 | 3 | | Continued from non-cored borehole | | | | | | |
| NMLC | | Groundwater Not Monitored | 58 | 4 | | **SHALE:** Pale brown/dark grey mottled orange brown, indistinctly bedded at 0-5°, ironstained. | XW / HW / MW | | D 0.28 A 0.48 | 73 | | — JT, 90°, IR, RO, 120mm<br>— PT<br>PT, ST, SO, SN<br>PT<br>PT<br>PT<br>— PT |
| | | | 57 | 5 | | **INTERLAMINATED SANDSTONE (60%) AND SHALE (40%):** Fine to medium grained, sandstone, pale grey/dark grey, thinly bedded at 5°. | MW / HW / SW | | D 0.12 A 0.35<br>D 0.11 A 0.24<br>D 0.28 A 0.38 | | | — PT<br>PT<br>— PT<br>— PT<br>PT<br>PT, 0-5°, CU, SO, SN<br>Highly Fractured Zone, 60mm<br>PT, 0°, IR, RO, SN<br>— PT, 0°, IR, RO, CN |
| | | | 56 | 6 | | | | | | | | — Highly Fractured Zone, 20mm<br>— PT, 0°, CU, SO, SN |
| | | | 55 | 7 | | **SANDSTONE:** Fine to medium grained, pale grey. | | | D 0.5 A 0.3<br>D 0.5 A 0.8<br>D 0.3 A 0.8<br>D 0.4 A 1.4<br>D 0.4 A 1.6 | 87 | | — PT, 0°, CU, SO, CN<br>PT, 0°, ST, SO, CN<br>JT, 80-85°, 80mm<br>PT<br>PT<br>PT, 0°-5°, PL, RO, SN<br>PT, 0°, PL, RO, CN<br>PT, 0°, IR, RO, CN |
| | | | 54 | 8 | | | | | D 1.1 A 2 | | | — PT, 0°, PL, RO, CN<br>— PT, 0°, IR, RO, CN |

All defects are: PT, 0°-10°; PL-IR, SO, CN-SN

**method**

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

**core-lift**

- casing used
- barrel withdrawn

**graphic log/core recovery**

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

**water**

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

**weathering**

| | |
|---|---|
| FR | fresh |
| SW | slightly weathered |
| MW | moderately weathered |
| HW | highly weathered |
| XW | extremely weathered |
| DW | distinctly weathered (covers MW and HW) |

**strength**

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

**defect type**

| | |
|---|---|
| JT | joint |
| PT | parting |
| SM | seam |
| SZ | sheared zone |
| SS | sheared surface |
| CS | crushed seam |

**planarity**

| | |
|---|---|
| PL | planar |
| CU | curved |
| UN | undulating |
| ST | stepped |
| IR | irregular |

**roughness**

| | |
|---|---|
| VR | very rough |
| RO | rough |
| SO | smooth |
| SL | slickensided |

**coating**

| | |
|---|---|
| CN | clean |
| SN | stained |
| VN | veneer |
| CO | coating |

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH7*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***17.2.2011*** |
| Principal: | |
| Date completed: | ***17.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307104 | slope: -90° | R.L. Surface: 61.74

hole diameter: 125 mm | Drilling fluid: | Northing: 6260658 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength (VL L M H VH EH) | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm (30 100 300 1000 3000) | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
| NMLC | | | 53 | 9 | | **SANDSTONE:** Fine to medium grained, pale grey. *(continued)* | SW | | D 0.2 A 0.5 | 87 | | PT, 0°, PL, RO, CN |
| | | | | | | | | | D 0.4 A 0.6 | | | PT, 0°, PL, RO, CN<br>PT, 0°, PL, RO, CN |
| | | | | | | | | | D 0.1 A 0.3 | | | |
| | | | 52 | 10 | | | | | D 0.4 A 0.5 | | | PT, 0°, PL, RO, CN<br>PT, 0°, PL, RO, CN<br>PT, 0°, PL, RO, CN |
| | | | | | | | | | D 0.2 A 0.3 | 100 | | |
| | | | | | | | | | D 0.4 A 0.3 | | | |
| | | | 51 | 11 | | BH7 terminated at 10m | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

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

**core-lift**
casing used; barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material; no core recovered

**water**
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**coating**
CN clean; SN stained; VN veneer; CO coating


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **18/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH7: 3.05m – 10.00m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH7 1 of 1** |
| original size | **A4** | | | |

coffey geotechnics

# Engineering Log - Borehole

Borehole No. **BH8**

Sheet 1 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***18.2.2011***

Principal:

Date completed: ***18.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model and mounting: Hydrapower Scout Truck | Easting: 307137 | slope: -90° | R.L. Surface: 61.2

hole diameter: 125 mm | Northing 6260722 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E + D | 61 | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: SAND:** Fine grained, brown, with some medium to coarse gravel, trace of clay. | | | | FILL<br>0.1-0.3m PID=2.9ppm<br>0.5-0.6m PID=6.7ppm |
| | | | | SPT 4,5,7 N*=12 | | 1 | | CL | **CLAY:** Medium plasticity, pale grey, with some fine to coarse ironstone gravel, trace of tree roots. | <Wp | St/VSt | | POSSIBLE FILL |
| | | | | | 60 | | | | | | | | |
| | | | | | | 2 | | | | | | | 2.0-2.1m PID=4.1ppm |
| | | | | SPT 5,9,13 N*=22 | 59 | | | CL/CH | **CLAY:** Medium to high plasticity, pale grey/pale brown mottled red/brown. | | VSt | | RESIDUAL SOIL |
| | | | | | 58 | 3 | | | | | | | |
| | | | | SPT 10,29,26 N*=55 | | | | | | | | | 3.5-3.6m PID=4.7ppm |
| | | | | | | 4 | | | **SANDSTONE:** Extremely weathered, pale grey/pale brown, estimated to be very low strength, remoulds to a sandy clay. | | | | SANDSTONE |
| | | | | | 57 | 5 | | | | | | | |
| | | | | | 56 | | | | Borehole BH8 continued as cored hole | | | | |
| | | | | | | 6 | | | | | | | |
| | | | | | 55 | | | | | | | | |
| | | | | | | 7 | | | | | | | |
| | | | | | 54 | | | | | | | | |
| | | | | | | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil

C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown

water inflow

water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

Form GEO 5.3 Issue 3 Rev.2

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | **BH8** |
| Sheet | 2 of 3 |
| Project No: | **GEOTLCOV24207AB** |
| Client: | **Health Infrastructure** |
| Date started: | **18.2.2011** |
| Principal: | |
| Date completed: | **18.2.2011** |
| Project: | **Blacktown Hospital Development** |
| Logged by: | **VJ** |
| Borehole Location: | **Blacktown District Hospital Carpark** |
| Checked by: | **SS** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307137 | slope: -90° | R.L. Surface: 61.2

hole diameter: 125 mm | Drilling fluid: | Northing: 6260722 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 61 | 1 | | | | | | | | |
| | | | 60 | 2 | | | | | | | | |
| | | | 59 | 3 | | | | | | | | |
| | | | 58 | 4 | | | | | | | | |
| | | | 57 | 5 | | Continued from non-cored borehole | | | | | | |
| NMLC | | Groundwater Not Monitored | 56 | 6 | | **SANDSTONE :** Fine to medium grained, pale grey/red brown, ironstained. | SW | | D 0.87 A 0.31 | 62 | | PT, CU |
| | | | | | | | MW | | | | | PT, ST, SN, RO |
| | | | | | | | | | D 2.18 A 0.7 | | | PT |
| | | | 55 | 7 | | | HW | | | | | PT |
| | | | | | | | MW | | | | | SM, 0°, RO, VN |
| | | | | | | | | | D 0.29 A 0.45 | | | PT |
| | | | | | | | | | D 0.17 A 0.22 | | | PT |
| | | | | | | | | | D 0.4 A 0.3 | | | PT |
| | | | 54 | 8 | | **SHALE:** Dark grey, with some fine grained sandstone laminations. | | | D 0.5 A 0.5 | | | PT |
| | | | | | | | | | D 0.2 A 0.2 | | | JT, 90°, PL, 100mm |
| | | | | | | | | | A 0 | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | Highly Fractured Zone, 20mm |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT, 0-5°, CU, RO, SN |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |

All defects are: PT, 0°-10°, PL-IR, RO, SN-CN unles s noted otherwise

CORED BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

Form GEO 5.5 Issue 3 Rev. 3

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

**core-lift**
casing used
barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material
no core recovered

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

**weathering**
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR irregular

**roughness**
VR very rough
RO rough
SO smooth
SL slickensided

**coating**
CN clean
SN stained
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

Borehole No. **BH8**
Sheet 3 of 3
Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***
Date started: ***18.2.2011***
Principal:
Date completed: ***18.2.2011***
Project: ***Blacktown Hospital Development***
Logged by: ***VJ***
Borehole Location: ***Blacktown District Hospital Carpark***
Checked by: ***SS***

drill model & mounting: Hydrapower Scout Truck | Easting: 307137 | slope: -90° | R.L. Surface: 61.2
hole diameter: 125 mm | Drilling fluid: | Northing: 6260722 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | | rock mass defects | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular | general |
| NMLC | | | 53 | | | **SHALE:** Dark grey, with some fine grained sandstone laminations. *(continued)* | SW | | D 0.3 | A 0.3 | 93 | | JT, 5-10°, CN, 20mm | |
| | | | | | | | | | D 0.3 | A 0.3 | | | JT, 20-30°, RO, SN, 30mm | |
| | | | | | | | | | | | | | JT, 10°, PL, 100mm | |
| | | | | | | | | | | | | | PT | |
| | | | | | | | | | | | | | JT, 70-80°, PL, SN, 90mm | |
| | | | | | | | | | | | | | JT, 45°, PL, SN, 50mm | |
| | | | | | | | | | D 0.3 | A 0.2 | | | Highly Fractured Zone, 70mm | |
| | | | | 9 | | | | | | | | | PT, 0°, IR | |
| | | | 52 | | | | | | D 0.2 | A 0.2 | 81 | | PT | |
| | | | | | | | | | | | | | PT | |
| | | | | | | | HW | | | | | | XW SM, 100mm | |
| | | | | | | | SW | | D 0.2 | A 0.2 | | | | |
| | | | | | | | MW | | D 0.2 | A 0.1 | | | PT | |
| | | | | 10 | | | | | | | | | Highly Fractured Zone, 10mm | |
| | | | | | | | | | | | | | PT, 0°, CU, IR, SN | |
| | | | 51 | | | BH8 terminated at 10m | | | | | | | | |
| | | | | 11 | | | | | | | | | | |
| | | | 50 | | | | | | | | | | | |
| | | | | 12 | | | | | | | | | | |
| | | | 49 | | | | | | | | | | | |
| | | | | 13 | | | | | | | | | | |
| | | | 48 | | | | | | | | | | | |
| | | | | 14 | | | | | | | | | | |
| | | | 47 | | | | | | | | | | | |
| | | | | 15 | | | | | | | | | | |
| | | | 46 | | | | | | | | | | | |
| | | | | 16 | | | | | | | | | | |

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

**core-lift**
casing used
barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material
no core recovered

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

**weathering**
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR irregular

**roughness**
VR very rough
RO rough
SO smooth
SL slickensided

**coating**
CN clean
SN stained
VN veneer
CO coating


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **21/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH8: 5.00m – 10.00m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH8 1 of 1** |
| original size | **A4** | | | |

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# Engineering Log - Borehole

Borehole No. **BH9**

Sheet 1 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***21.2.2011***

Principal:

Date completed: ***21.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model and mounting: Hydrapower Scout Truck | Easting: 307100 | slope: -90° | R.L. Surface: 61.35

hole diameter: 125 mm | Northing 6260716 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E + D | 61 | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: Gravelly SAND:** Fine to medium grained sand, dark grey, fine to coarse gravel. | | | | FILL 0.1-0.3m PID=0.9ppm |
| | | | | SPT 3,1,2 N*=3 | | 1 | | | **FILL: Sandy CLAY:** Medium plasticity, pale brown, fine to coarse sand, trace of fine gravel. | <Wp | | | 0.5-0.6m PID=3.4ppm |
| | | | | | 60 | | | CL | **CLAY:** Medium plasticity, pale grey. | | VSt | | POSSIBLE FILL |
| | | | | | | 2 | | | | | | | 2.0-2.1m PID=4.1ppm |
| | | | | SPT 1,2,5 N*=7 | 59 | | | | | | | × | |
| | | | | | | | | CL | **CLAY:** Medium plasticity, pale grey/pale brown. | | | × | RESIDUAL SOIL |
| | | | | | 58 | 3 | | | | | | | |
| | | | | SPT 15 N*=R | | | | | **SANDSTONE:** Extremely weathered, fine to medium grained, pale brown/red brown, estimated to be very low strength. | | | | SANDSTONE 3.5-3.6m PID=5.4ppm |
| | | | | | 57 | 4 | | | | | | | |
| | | | | | | 5 | | | Borehole BH9 continued as cored hole | | | | |
| | | | | | 56 | | | | | | | | |
| | | | | | | 6 | | | | | | | |
| | | | | | 55 | | | | | | | | |
| | | | | | | 7 | | | | | | | |
| | | | | | 54 | | | | | | | | |
| | | | | | | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil

C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown

water inflow

water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

coffey geotechnics

# Engineering Log - Cored Borehole

Borehole No. **BH9**
Sheet 2 of 3
Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***
Date started: ***21.2.2011***
Principal:
Date completed: ***21.2.2011***
Project: ***Blacktown Hospital Development***
Logged by: ***VJ***
Borehole Location: ***Blacktown District Hospital Carpark***
Checked by: ***SS***

drill model & mounting: Hydrapower Scout Truck | Easting: 307100 | slope: -90° | R.L. Surface: 61.35
hole diameter: 125 mm Drilling fluid: | Northing: 6260716 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
| | | | 61 | 1 | | | | | | | | |
| | | | 60 | 2 | | | | | | | | |
| | | | 59 | 3 | | | | | | | | |
| | | | 58 | 4 | | | | | | | | |
| | | | 57 | 5 | | Continued from non-cored borehole | | | | | | |
| NMLC | | Groundwater Not Monitored | 56 | 6 | | **SANDSTONE:** Fine to medium grained, pale brown/pale grey. | MW | | D A 0.36 0.91 | 52 | | PT |
| | | | 55 | 7 | | | HW | | D A 0.11 0.15 | | | JT, ~90°, PL, RO, 190mm |
| | | | 54 | 8 | | | MW | | D A 0.18 0.29 | | | PT, 0°, PL, SN |
| | | | | | | | | | D A 4.9 4.89 | | | Highly Fractured Zone, 50mm |
| | | | | | | | | | | | | HFZ, 30mm |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | Highly Fractured Zone, 100mm |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | Highly Fractured Zone, 330mm |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | JT, 80-85°, PL, SN, 110mm |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | | | | | | PT |
| | | | | | | | SW | | D A 0.1 0.6 | | | |
| | | | | | | | | | D A 0.2 0.1 | | | |
| | | | | | | | | | D A 0.2 0.4 | | | |

All defects are: PT, 0°-10°, PL-IR, RO, SN-CN unles s noted otherwise

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

**core-lift**
casing used
barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material
no core recovered

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

**weathering**
FR fresh
SW slightly weathered
MW moderately weathered
HW highly weathered
XW extremely weathered
DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint
PT parting
SM seam
SZ sheared zone
SS sheared surface
CS crushed seam

**planarity**
PL planar
CU curved
UN undulating
ST stepped
IR irregular

**roughness**
VR very rough
RO rough
SO smooth
SL slickensided

**coating**
CN clean
SN stained
VN veneer
CO coating

coffey geotechnics

# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH9*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***21.2.2011*** |
| Principal: | |
| Date completed: | ***21.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307100 | slope: -90° | R.L. Surface: 61.35

hole diameter: 125 mm | Drilling fluid: | Northing: 6260716 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
| NMLC | | | 53 | 9 | | **SHALE:** Grey/dark grey, thinly laminated. | SW | | D A<br>0.4 0.4<br>D A<br>0 0.1<br>D A<br>0.2 0.3<br>D A<br>0.1 0.4<br>D A<br>0.3 0.4<br>D A<br>0.1 0.3<br>D A<br>0.2 0.5 | 91 | | JT, 15-20°, PL<br>PT<br>PT<br>CS, PL<br>PT<br>PT<br>JT, 45°, IR<br>Highly Fractured Zone, 50mm<br>PT<br>PT<br>PT<br>PT |
| | | | 52 | 10 | | | | | | | | |
| | | | 51 | 11 | | BH9 terminated at 10m | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

**method**

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

**core-lift**

- casing used
- barrel withdrawn

**graphic log/core recovery**

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

**water**

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

**weathering**

| | |
|---|---|
| FR | fresh |
| SW | slightly weathered |
| MW | moderately weathered |
| HW | highly weathered |
| XW | extremely weathered |
| DW | distinctly weathered (covers MW and HW) |

**strength**

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

**defect type**

| | |
|---|---|
| JT | joint |
| PT | parting |
| SM | seam |
| SZ | sheared zone |
| SS | sheared surface |
| CS | crushed seam |

**planarity**

| | |
|---|---|
| PL | planar |
| CU | curved |
| UN | undulating |
| ST | stepped |
| IR | irregular |

**roughness**

| | |
|---|---|
| VR | very rough |
| RO | rough |
| SO | smooth |
| SL | slickensided |

**coating**

| | |
|---|---|
| CN | clean |
| SN | stained |
| VN | veneer |
| CO | coating |


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **20/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH9: 5.00m – 10.00m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH9 1 of 1** |
| original size | **A4** | | | |

coffey geotechnics

# Engineering Log - Borehole

| | |
|---|---|
| Borehole No. | ***BH10*** |
| Sheet | 1 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***21.2.2011*** |
| Principal: | |
| Date completed: | ***21.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model and mounting: Hydrapower Scout Truck | Easting: 307072 | slope: -90° | R.L. Surface: 61.34

hole diameter: 125 mm | Northing 6260735 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E + D | 61 | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: SAND:** Fine to medium grained sand, pale brown, with some fine to coarse gravel, trace of clay. | | | | FILL 0.1-0.3m PID=2.7ppm |
| | | | | SPT 3,3,4 N*=7 | | 1 | | | **FILL: CLAY:** Medium plasticity, brown, with some fine to medium grained sand. | <Wp | | | 0.5-0.6m PID=1.6ppm |
| | | | | | 60 | | | | | | | | |
| | | | | SPT 3,7,5 N*=12 | 59 | 2 | | | | | | | 2.0-2.1m PID=6.3ppm |
| | | | | | 58 | 3 | | | | | | | |
| | | | | SPT 4,5,5 N*=10 | | 4 | | CL/CH | **CLAY:** Medium to high plasticity, pale grey/red brown, with some fine grained angular ironstone gravel. | | VSt/H | | RESIDUAL SOIL 3.5-3.6m PID=0.7ppm |
| | | | | | 57 | 5 | | | | | | | |
| | | | | SPT 7,11,15 N*=26 | 56 | 6 | | | | | | | |
| | | | | | 55 | | | | | | | | |
| | | | | SPT 21 N*=R | | 7 | | | **SHALE:** Extremely weathered, dark grey/pale grey, estimated to be very low strength, remoulds to a gravelly clay. | | | | SHALE |
| | | | | | 54 | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil
C casing

**penetration**

1 2 3 4 no resistance ranging to refusal

**water**

10/1/98 water level on date shown
water inflow
water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

coffey geotechnics

# Engineering Log - Borehole

Borehole No. **BH10**

Sheet 2 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***21.2.2011***

Principal:

Date completed: ***21.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model and mounting: Hydrapower Scout Truck | Easting: 307072 | slope: -90° | R.L. Surface: 61.34

hole diameter: 125 mm | Northing 6260735 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | | SPT 2 N*=R | 53 | | | | Borehole BH10 continued as cored hole | | | | |
| | | | | | 52 | 9 | | | | | | | |
| | | | | | 51 | 10 | | | | | | | |
| | | | | | 50 | 11 | | | | | | | |
| | | | | | 49 | 12 | | | | | | | |
| | | | | | 48 | 13 | | | | | | | |
| | | | | | 47 | 14 | | | | | | | |
| | | | | | 46 | 15 | | | | | | | |
| | | | | | | 16 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**

M mud N nil

C casing

**penetration**

1 2 3 4 — no resistance ranging to refusal

**water**

10/1/98 water level on date shown

water inflow

water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description**

based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

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# Engineering Log - Cored Borehole

Borehole No. **BH10**

Sheet 3 of 3

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***21.2.2011***

Principal:

Date completed: ***21.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***VJ***

Borehole Location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

drill model & mounting: Hydrapower Scout Truck | Easting: 307072 | slope: -90° | R.L. Surface: 61.34

hole diameter: 125 mm | Drilling fluid: | Northing: 6260735 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
| | | | | | | Continued from non-cored borehole | | | | | | |
| NMLC | | Groundwater Not Monitored | 53 | 9 | | **SHALE:** Grey/dark grey, thinly laminated. | HW | | D 0 A 0.06 | 59 | | PT<br>PT<br>PT<br>PT<br>PT<br>PT<br>CS, 20mm<br>PT<br>PT, 0°, CU, SN, SN<br>JT, 75-80°, SN, 160mm<br>PT, 0°, ST, SN, SN<br>JT, 90°, CU, RO, SN ~90mm<br>JT, 30-35°, PL, SN, ~60mm<br>PT<br>Highly Fractured Zone, 80mm |
| | | | 52 | | | | MW | | D 0.05 A 0.17 | | | |
| | | | | 10 | | | | | D 0.2 A 0.21 | | | |
| | | | | | | | | | D 0.36 A 0.17 | | | |
| | | | | | | BH10 terminated at 10m | | | | | | |
| | | | 51 | 11 | | | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

All defects are PT, 0-5°, PL, RO, CN; unless noted otherwise

**method**

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

**core-lift**

- casing used
- barrel withdrawn

**graphic log/core recovery**

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

**water**

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

**weathering**

| | |
|---|---|
| FR | fresh |
| SW | slightly weathered |
| MW | moderately weathered |
| HW | highly weathered |
| XW | extremely weathered |
| DW | distinctly weathered (covers MW and HW) |

**strength**

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

**defect type**

| | |
|---|---|
| JT | joint |
| PT | parting |
| SM | seam |
| SZ | sheared zone |
| SS | sheared surface |
| CS | crushed seam |

**planarity**

| | |
|---|---|
| PL | planar |
| CU | curved |
| UN | undulating |
| ST | stepped |
| IR | irregular |

**roughness**

| | |
|---|---|
| VR | very rough |
| RO | rough |
| SO | smooth |
| SL | slickensided |

**coating**

| | |
|---|---|
| CN | clean |
| SN | stained |
| VN | veneer |
| CO | coating |


| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **20/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH10: 8.20m – 10.00m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH10 1 of 1** |
| original size | **A4** | | | |

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# Engineering Log - Borehole

| | |
|---|---|
| Borehole No. | ***BH11*** |
| Sheet | 1 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***22.2.2011*** |
| Principal: | |
| Date completed: | ***22.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model and mounting: Hydrapower Scout Truck | Easting: 307075 | slope: -90° | R.L. Surface: 61.6

hole diameter: 125 mm | Northing 6260694 | bearing: | datum: AHD

**drilling information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ADT | | C | | E | | | | | **FILL: BITUMEN:** Black. | D | | | PAVEMENT |
| | | | | | | | | | **FILL: SAND:** Fine to medium grained sand, brown, with some fine to coarse gravel, trace of clay. | | | | FILL 0.1-0.3m PID=4.5ppm |
| | | | | SPT 1,2,2 N*=4 | 61 | 1 | | CL | **CLAY:** Medium plasticity, brown, with some fine to medium sand and fine gravel. | <Wp | VSt | × | POSSIBLE FILL 0.5-0.6m PID=6.8ppm |
| | | | | | 60 | 2 | | | | | | | |
| | | | | SPT 4,9,16 N*=25 | | | | CL | **CLAY:** Medium plasticity, pale grey/pale brown, with some ironstone gravel. | | VSt/H | | RESIDUAL SOIL 2.0-2.1m PID=2.9ppm |
| | | | | | 59 | 3 | | | | | | | |
| | | | | SPT 9,8 N*=R | 58 | 4 | | | **SHALE:** Extremely weathered, pale grey/pale brown/orange brown, estimated to be very low strength, remoulds to a gravelly clay. | | | | SHALE 3.5-3.6m PID=3.9ppm |
| | | | | | 57 | 5 | | | | | | | |
| | | | | | | | | | Borehole BH11 continued as cored hole | | | | |
| | | | | | 56 | 6 | | | | | | | |
| | | | | | 55 | 7 | | | | | | | |
| | | | | | 54 | 8 | | | | | | | |

**method**

| | |
|---|---|
| AS | auger screwing* |
| AD | auger drilling* |
| RR | roller/tricone |
| W | washbore |
| CT | cable tool |
| HA | hand auger |
| DT | diatube |
| B | blank bit |
| V | V bit |
| T | TC bit |

*bit shown by suffix e.g. ADT

**support**: M mud, N nil, C casing

**penetration**: 1 2 3 4 — no resistance ranging to refusal

**water**: 10/1/98 water level on date shown; water inflow; water outflow

**notes, samples, tests**

| | |
|---|---|
| $U_{50}$ | undisturbed sample 50mm diameter |
| $U_{63}$ | undisturbed sample 63mm diameter |
| D | disturbed sample |
| N | standard penetration test (SPT) |
| N* | SPT - sample recovered |
| Nc | SPT with solid cone |
| V | vane shear (kPa) |
| P | pressuremeter |
| Bs | bulk sample |
| E | environmental sample |
| R | refusal |

**classification symbols and soil description** based on unified classification system

**moisture**

| | |
|---|---|
| D | dry |
| M | moist |
| W | wet |
| Wp | plastic limit |
| $W_L$ | liquid limit |

**consistency/density index**

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

BOREHOLE GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

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# Engineering Log - Cored Borehole

| | | | |
|---|---|---|---|
| Borehole No. | ***BH11*** | | |
| Sheet | 2 of 3 | | |
| Project No: | ***GEOTLCOV24207AB*** | | |
| Client: | ***Health Infrastructure*** | Date started: | ***22.2.2011*** |
| Principal: | | Date completed: | ***22.2.2011*** |
| Project: | ***Blacktown Hospital Development*** | Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** | Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307075 | slope: -90° | R.L. Surface: 61.6

hole diameter: 125 mm Drilling fluid: | Northing: 6260694 | bearing: | datum: AHD

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

| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 61 | 1 | | | | | | | | |
| | | | 60 | 2 | | | | | | | | |
| | | | 59 | 3 | | | | | | | | |
| | | | 58 | 4 | | | | | | | | |
| | | | 57 | 5 | | Continued from non-cored borehole | | | | | | |
| NMLC | | Groundwater Not Monitored | 56 | 6 | | **SHALE:** Pale grey/red brown, thinly bedded at 0-5°, with some laminations of fine grained sandstone. | HW / MW | | D 0.11 A 0.44; D 0.22 | 70 | | Highly Fractured Zone, 230mm; JT, 20°, CLAY SM, 20mm; PT; PT; PT; JT, 90°, PL, SN, 30mm; PT; PT; PT; PT; SM, 0°, ~5mm; PT; JT, 90°, IR, SN, ~130mm; PT; PT; SM, 0°, 5mm; PT; SM, 0°, ~5mm; PT, 0°, PL, SO, SN; PT, 0°, PL, SO, CN; PT, 0°, PL, SO, CN |
| | | | 55 | 7 | | **INTERLAMINATED SANDSTONE (70%) AND SHALE (30%):** Fine to medium grained sandstone, pale grey mottled orange brown/dark grey, thinly bedded at 0-5°, with some iron staining along defects. | SW | | D 0.3 A 1.01 | | | |
| | | | 54 | 8 | | **INTERLAMINATED SHALE (55%) AND SANDSTONE (45%):** Fine to medium grained sandstone, pale grey to dark grey, thinly bedded at 0-5°. | | | D 0.36 A 0.38; D 0.3 A 0.7; D A | | | |

All defects are: PT, 0°-10°, PL-IR, RO, CN-SN; unle ss noted otherwise

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

**core-lift**
casing used; barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material; no core recovered

**water**
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

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

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**coating**
CN clean; SN stained; VN veneer; CO coating

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# Engineering Log - Cored Borehole

| | |
|---|---|
| Borehole No. | ***BH11*** |
| Sheet | 3 of 3 |
| Project No: | ***GEOTLCOV24207AB*** |
| Client: | ***Health Infrastructure*** |
| Date started: | ***22.2.2011*** |
| Principal: | |
| Date completed: | ***22.2.2011*** |
| Project: | ***Blacktown Hospital Development*** |
| Logged by: | ***VJ*** |
| Borehole Location: | ***Blacktown District Hospital Carpark*** |
| Checked by: | ***SS*** |

drill model & mounting: Hydrapower Scout Truck | Easting: 307075 | slope: -90° | R.L. Surface: 61.6

hole diameter: 125 mm | Drilling fluid: | Northing: 6260694 | bearing: | datum: AHD

| drilling information | | | | | material substance | | | | | rock mass defects | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| method | core-lift | water | RL | depth metres | graphic log core recovery | material: rock type; grain characteristics, colour, structure, minor components | weathering alteration | estimated strength VL L M H VH EH | $Is_{(50)}$ MPa D- diametral A- axial | RQD % | defect spacing mm 30 100 300 1000 3000 | defect description: type, inclination, planarity, roughness, coating, thickness — particular / general |
| NMLC | | | 53 | 9 | | **INTERLAMINATED SHALE (55%) AND SANDSTONE (45%):** Fine to medium grained sandstone, pale grey to dark grey, thinly bedded at 0-5°. *(continued)* | SW | | 0.3 0.5 D A; 0.4 0.8 D A; 0.4 0.7; D A 0.2 0.3; D A 0.2 0.3; D A 0.4 0.5; D A 0.4 0.4 | 80 | | PT, 0°, PL, SO, CN; PT; Highly Fractured Zone, 60mm; PT; PT; Highly Fractured Zone, 80mm; PT; PT; PT |
| | | | 52 | 10 | | **NO CORE:** 0.03m | | | | | | |
| | | | | | | BH11 terminated at 10m | | | | | | |
| | | | 51 | 11 | | | | | | | | |
| | | | 50 | 12 | | | | | | | | |
| | | | 49 | 13 | | | | | | | | |
| | | | 48 | 14 | | | | | | | | |
| | | | 47 | 15 | | | | | | | | |
| | | | 46 | 16 | | | | | | | | |

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

**core-lift**
casing used; barrel withdrawn

**graphic log/core recovery**
core recovered - graphic symbols indicate material; no core recovered

**water**
10/1/98 water level on date shown; water inflow; partial drill fluid loss; complete drill fluid loss; 25 water pressure test result (lugeons) for depth interval shown

**weathering**
FR fresh; SW slightly weathered; MW moderately weathered; HW highly weathered; XW extremely weathered; DW distinctly weathered (covers MW and HW)

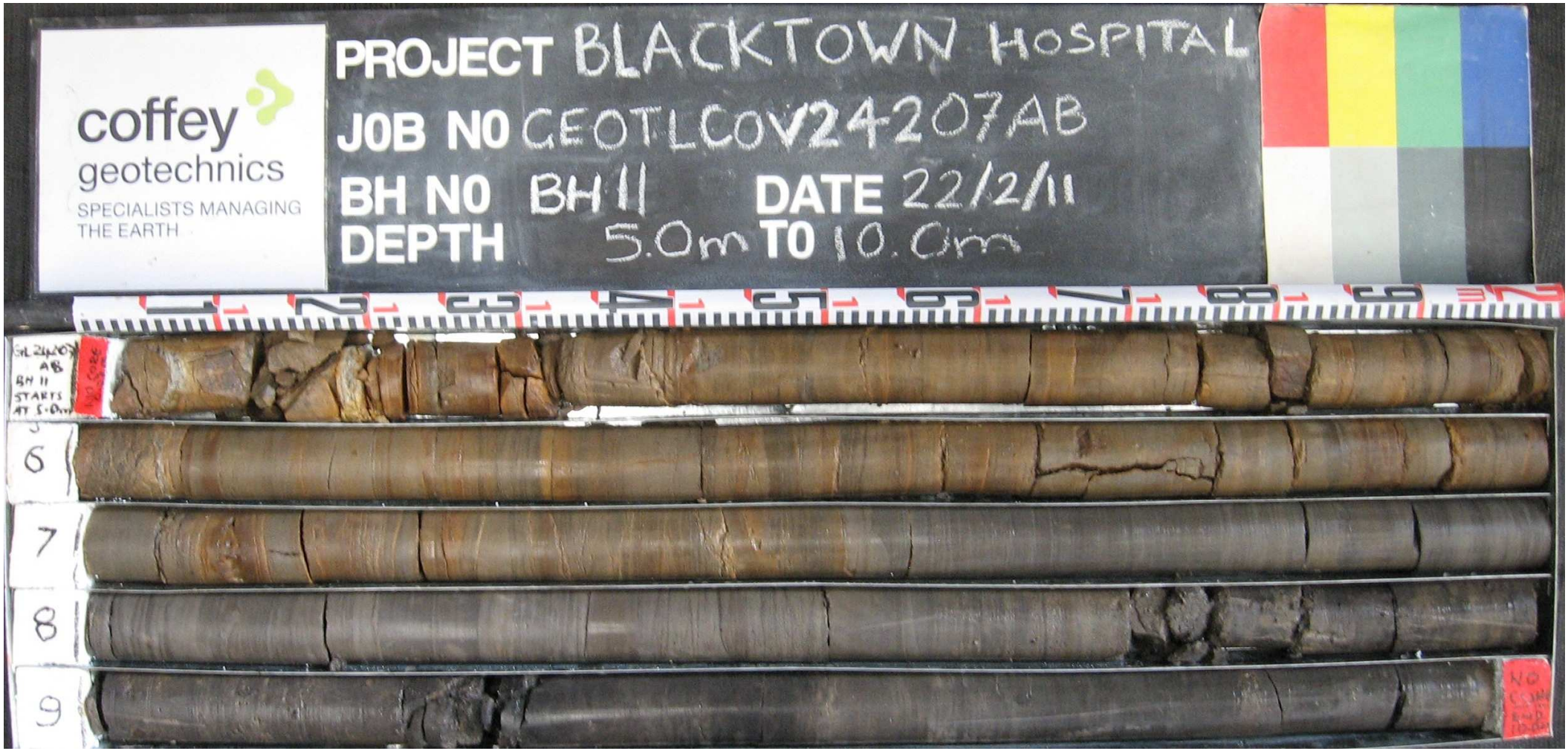
**strength**
VL very low; L low; M medium; H high; VH very high; EH extremely high

**defect type**
JT joint; PT parting; SM seam; SZ sheared zone; SS sheared surface; CS crushed seam

**planarity**
PL planar; CU curved; UN undulating; ST stepped; IR irregular

**roughness**
VR very rough; RO rough; SO smooth; SL slickensided

**coating**
CN clean; SN stained; VN veneer; CO coating




| | | | | |
|---|---|---|---|---|
| drawn | **BM** | coffey geotechnics SPECIALISTS MANAGING THE EARTH | client: | **Health Infrastructure , NSW** |
| approved | **SS** | | project: | **GEOTECHNICAL & ENVIRONMENTAL INVESTIGATION – BLACKTOWN HOSPITAL** |
| date | **22/2/2011** | | title: | **BOREHOLE PHOTOGRAPH–BH11: 5.00m – 10.00m** |
| scale | **Not to scale** | | project no: **GEOTLCOV24207AB** | Photo no: **BH11 1 of 1** |
| original size | **A4** | | | |

coffey geotechnics

# Engineering Log - Excavation

Excavation No. **TPB1**

Sheet 1 of 1

Project No: **GEOTLCOV24207AB**

Client: ***Health Infrastructure***

Date started: ***18.2.2011***

Principal:

Date completed: ***18.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***LJG***

Test pit location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

equipment type and model: Yanmar 5t Excavator | Pit Orientation: | Easting: 307294 m | R.L. Surface: 57.3

excavation dimensions: 3.3m long 1.9m wide | Northing: 6260716 m | datum: AHD

**excavation information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | | N | Groundwater Not Encountered | E + D | 57.0 | 0.5 | | | **FILL: Sandy CLAY:** Low to medium plasticity, fine grained sand, with some roots. | <Wp | | | TOPSOIL |
| | | | | | | | | | **FILL: CLAY:** Low to medium plasticity, brown, with some fine to medium roots, trace of gravel and sand. | | | | FILL 0.2-0.3m PID=4.0ppm |
| | | | | Bs | | | | | **FILL: CLAY:** Medium to high plasticity, pale grey/red brown, with some fine ironstone gravel, trace of sand, roots and terracotta pipe. | | | | From 0.4m fill has appearance of residual soil. |
| | | | | E + D | 56.5 | 1.0 | | | | | | | 0.8-0.9m PID=4.6ppm |
| | | | | E + D | 56.0 | 1.5 | | | | | | | 1.2-1.3m PID=3.4ppm |
| | | | | Bs | | | | | | | | | Terracotta pipe at 1.4m; 150mm diameter |
| | | | | | 55.5 | 2.0 | | CL/CH | **CLAY:** Medium to high plasticity, pale grey/red brown, with some fine ironstone gravel and fine angular shale gravel, trace of sand. | | VSt/H | × | RESIDUAL SOIL |
| | | | | E | 55.0 | 2.5 | | | | | | | 2.1-2.2m PID=1.1ppm |
| | | | | Bs | 54.5 | | | | **SHALE:** Extremely weathered, pale grey mottled red brown, estimated to be very low strength, remoulds to a gravelly clay. | | | | SHALE |
| | | | | | | 3.0 | | | **SHALE:** Highly weathered, pale grey mottled red brown, estimated to be low strength, remoulds to a gravelly clay. | | | | |
| | | | | | 54.0 | 3.5 | | | Test pit TPB1 terminated at 3m | | | | |
| | | | | | 53.5 | 4.0 | | | | | | | |

Sketch

**method**
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

**support**
S shoring N nil

**penetration**
1 2 3 4
no resistance ranging to refusal

**water**
water level on date shown
water inflow
water outflow

**notes, samples, tests**
$U_{50}$ undisturbed sample 50mm diameter
$U_{63}$ undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

**classification symbols and soil description**
based on unified classification system

**moisture**
D dry
M moist
W wet
Wp plastic limit
$W_L$ liquid limit

**consistency/density index**

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

coffey geotechnics

# Engineering Log - Excavation

Excavation No. ***TPB2***

Sheet 1 of 1

Project No: ***GEOTLCOV24207AB***

Client: ***Health Infrastructure***

Date started: ***18.2.2011***

Principal:

Date completed: ***18.2.2011***

Project: ***Blacktown Hospital Development***

Logged by: ***LJG***

Test pit location: ***Blacktown District Hospital Carpark***

Checked by: ***SS***

equipment type and model: Yanmar 5t Excavator | Pit Orientation: | Easting: 307330 m | R.L. Surface: 56.85

excavation dimensions: 2.8m long 1.7m wide | Northing: 6260714 m | datum: AHD

**excavation information** | **material substance**

| method | penetration 1 2 3 | support | water | notes samples, tests, etc | RL | depth metres | graphic log | classification symbol | material: soil type: plasticity or particle characteristics, colour, secondary and minor components. | moisture condition | consistency/ density index | pocket penetro-meter kPa 100 200 300 400 | structure and additional observations |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | | N | Groundwater Not Encountered | E + D | 56.5 | 0.5 | | | **FILL: Sandy CLAY:** Low to medium plasticity, dark brown, fine to medium grained sand, with some fine to medium roots. | <Wp | | | TOPSOIL<br>FILL<br>0.1-0.2m PID=0.2ppm<br>DUP 2: 0.1-0.2m |
| | | | | E + D | | | | | **FILL: CLAY:** Medium plasticity, brown, with some fine to medium roots, trace of fine gravel and fine sand. | | | | |
| | | | | Bs | 56.0 | 1.0 | | CL/CH | **CLAY:** Medium to high plasticity, brown/pale grey, with some fine rounded ironstone, trace of sand and roots. | | VSt | | RESIDUAL SOIL |
| | | | | E + D | | | | CL/CH | **CLAY:** Medium to high plasticity, red brown/pale grey, with some fine ironstone gravel, trace of roots. | | H | | 1.0-1.2m PID=4.5ppm<br>Large root at 1.25m |
| | | | | | 55.5 | 1.5 | | | | | | | |
| | | | | Bs | | | | | | | | | |
| | | | | | 55.0 | 2.0 | | | **SHALE:** Extremely weathered, pale grey/red brown, iron stained, estimated to be very low strength, remoulds to a gravelly clay.<br>At 1.80m becoming with some fine to medium angular shale gravel. | | | | SHALE |
| | | | | Bs | 54.5 | 2.5 | | | | | | | |
| | | | | | 54.0 | 3.0 | | | Test pit TPB2 terminated at 2.4m | | | | |
| | | | | | 53.5 | 3.5 | | | | | | | |
| | | | | | 53.0 | 4.0 | | | | | | | |

Sketch

**method**
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

**support**
S shoring N nil

**penetration**
1 2 3 4 no resistance ranging to refusal

**water**
water level on date shown
water inflow
water outflow

**notes, samples, tests**
$U_{50}$ undisturbed sample 50mm diameter
$U_{63}$ undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

**classification symbols and soil description**
based on unified classification system

**moisture**
D dry
M moist
W wet
Wp plastic limit
$W_L$ liquid limit

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

TESTPIT GEOTLCOV24207AB.GPJ COFFEY.GDT 15.3.11

Form GEO 5.2 Issue 3 Rev.2

# Appendix B

**Geotechnical  Laboratory Testing Results**

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 1 OF **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 15/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition[1] (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L[2] (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D[2] (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH1 | 6.80 | Shale | N | 27.0 | 50.0 | 0 | 0.00 | 1.00 | 0.00 | **V. Low** | 50.0 | 27.0 | 1719 | 0.00 | 0.00 | 0.92 | 0.00 | **V. Low** | BB |
| BH1 | 7.93 | Shale | N | 34.0 | 50.0 | 0.55 | 0.22 | 1.00 | 0.22 | **Low** | 50.0 | 34.0 | 2165 | 0.52 | 0.24 | 0.97 | 0.23 | **Low** | |
| BH1 | 8.10 | Shale | N | 35.0 | 50.0 | 0.82 | 0.33 | 1.00 | 0.33 | **Medium** | 50.0 | 35.0 | 2228 | 0.89 | 0.40 | 0.97 | 0.39 | **Medium** | |
| BH1 | 8.49 | Shale | N | 35.0 | 50.0 | 0.71 | 0.28 | 1.00 | 0.28 | **Low** | 50.0 | 35.0 | 2228 | 0.77 | 0.35 | 0.97 | 0.34 | **Medium** | |
| BH1 | 8.87 | Shale | N | 37.0 | 50.0 | 0.74 | 0.30 | 1.00 | 0.3 | **Low** | 50.0 | 37.0 | 2355 | 0.53 | 0.23 | 0.99 | 0.2 | **Low** | |
| BH1 | 9.0 | Shale | N | 29.0 | 50.0 | 0.41 | 0.16 | 1.00 | 0.2 | **Low** | 50.0 | 29.0 | 1846 | 0.56 | 0.30 | 0.93 | 0.3 | **Low** | |
| BH1 | 9.44 | Shale | N | 44.0 | 50.0 | 0.74 | 0.30 | 1.00 | 0.3 | **Low** | 50.0 | 44.0 | 2801 | 0.87 | 0.31 | 1.03 | 0.3 | **Medium** | |
| BH1 | 9.92 | Shale | N | 26.0 | 50.0 | 0.67 | 0.27 | 1.00 | 0.3 | **Low** | 50.0 | 26.0 | 1655 | 0.50 | 0.30 | 0.91 | 0.3 | **Low** | |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 2 of **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 16/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition(1) (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L (2) (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D (2) (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH2 | 8.01 | Shale | N | 28.0 | 50.0 | 0.78 | 0.31 | 1.00 | 0.31 | **Medium** | 50.0 | 28.0 | 1783 | 0.58 | 0.33 | 0.93 | 0.30 | **Medium** | |
| BH2 | 8.44 | Shale | N | 31.0 | 50.0 | 0.69 | 0.28 | 1.00 | 0.28 | **Low** | 50.0 | 28.0 | 1783 | 0.61 | 0.34 | 0.93 | 0.32 | **Medium** | |
| BH2 | 8.68 | Shale | N | 30.0 | 50.0 | 0.49 | 0.20 | 1.00 | 0.20 | **Low** | | | | | | | | | JT/BB (diametral) |
| BH2 | 9.17 | Shale | N | 39.0 | 50.0 | 0.49 | 0.20 | 1.00 | 0.20 | **Low** | 50.0 | 30.0 | 1910 | 1.30 | 0.68 | 0.94 | 0.64 | **Medium** | |
| BH2 | 9.80 | Shale | N | 27.0 | 50.0 | 0.63 | 0.25 | 1.00 | 0.3 | **Low** | 50.0 | 39.0 | 2483 | | | | | | BB |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 3 of **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 16/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition[1] (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L[2] (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D[2] (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH3 | 7.16 | Shale | N | 35.0 | 50.0 | 0 | 0.00 | 1.00 | 0.00 | **V. Low** | 50.0 | 35.0 | 2228 | 0.14 | 0.06 | 0.97 | 0.06 | **V. Low** | BB |
| BH3 | 7.60 | Shale | N | 36.0 | 50.0 | 0.42 | 0.17 | 1.00 | 0.17 | **Low** | 50.0 | 36.0 | 2292 | 0.28 | 0.12 | 0.98 | 0.12 | **Low** | BB |
| BH3 | 7.80 | Shale | N | 30.0 | 50.0 | 0.63 | 0.25 | 1.00 | 0.25 | **Low** | 50.0 | 30.0 | 1910 | 0.52 | 0.27 | 0.94 | 0.26 | **Low** | |
| BH3 | 8.51 | Shale | N | 35.0 | 50.0 | 1.07 | 0.43 | 1.00 | 0.43 | **Medium** | 50.0 | 35.0 | 2228 | 1.14 | 0.51 | 0.97 | 0.50 | **Medium** | |
| BH3 | 9.96 | Shale | N | 40.0 | 50.0 | 0.41 | 0.16 | 1.00 | 0.2 | **Low** | 50.0 | 40.0 | 2546 | 0.55 | 0.22 | 1.00 | 0.2 | **Low** | BB |
| BH3 | 9.39 | Shale | N | 30.0 | 50.0 | 0.64 | 0.26 | 1.00 | 0.3 | **Low** | 50.0 | 30.0 | 1910 | 0.71 | 0.37 | 0.94 | 0.3 | **Medium** | |
| BH3 | 9.97 | Shale | N | 35.0 | 50.0 | 0.46 | 0.18 | 1.00 | 0.2 | **Low** | 50.0 | 35.0 | 2228 | 0.64 | 0.29 | 0.97 | 0.3 | **Low** | |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 4 of **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 18/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition[1] (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L[2] (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D[2] (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH4 | 5.54 | Shale | N | 34.0 | 50.0 | 0.53 | 0.21 | 1.00 | 0.21 | **Low** | 50.0 | 34.0 | 2165 | 0.30 | 0.14 | 0.97 | 0.13 | **Low** | |
| BH4 | 5.93 | Shale | N | 28.0 | 50.0 | 0.2 | 0.08 | 1.00 | 0.08 | **V. Low** | 50.0 | 28.0 | 1783 | 0.35 | 0.20 | 0.93 | 0.18 | **Low** | BB |
| BH4 | 6.09 | Shale | N | 28.0 | 50.0 | 0 | 0.00 | 1.00 | 0.00 | **V. Low** | 50.0 | 28.0 | 1783 | 0.06 | 0.03 | 0.93 | 0.03 | **V. Low** | BB |
| BH4 | 6.87 | Shale | N | 36.0 | 50.0 | 0.24 | 0.10 | 1.00 | 0.10 | **V. Low** | 50.0 | 36.0 | 2292 | 0.22 | 0.10 | 0.98 | 0.09 | **V. Low** | BB |
| BH4 | 7.11 | Shale | N | 36.0 | 50.0 | 0.13 | 0.05 | 1.00 | 0.1 | **V. Low** | 50.0 | 36.0 | 2292 | 0.44 | 0.19 | 0.98 | 0.2 | **Low** | BB |
| BH4 | 7.93 | Shale | N | 35.0 | 50.0 | 0 | 0.00 | 1.00 | 0.0 | **V. Low** | 50.0 | 35.0 | 2228 | 0.49 | 0.22 | 0.97 | 0.2 | **Low** | BB |
| BH4 | 8.00 | Shale | N | 40.0 | 50.0 | 0.61 | 0.24 | 1.00 | 0.2 | **Low** | 50.0 | 40.0 | 2546 | 0.72 | 0.28 | 1.00 | 0.3 | **Low** | |
| BH4 | 8.27 | Shale | N | 27.0 | 50.0 | 0.55 | 0.22 | 1.00 | 0.2 | **Low** | 50.0 | 27.0 | 1719 | 0.53 | 0.31 | 0.92 | 0.3 | **Low** | |
| BH4 | 8.94 | Shale | N | 30.0 | 50.0 | 0.55 | 0.22 | 1.00 | 0.2 | **Low** | 50.0 | 30.0 | 1910 | 0.06 | 0.03 | 0.94 | 0.0 | **V. Low** | |
| BH4 | 9.58 | Shale | N | 35.0 | 50.0 | 0.88 | 0.35 | 1.00 | 0.4 | **Medium** | 50.0 | 35.0 | 2228 | 1.47 | 0.66 | 0.97 | 0.6 | **Medium** | |
| BH4 | 9.71 | Shale | N | 42.0 | 50.0 | 0.13 | 0.05 | 1.00 | 0.1 | **V. Low** | 50.0 | 42.0 | 2674 | 0.78 | 0.29 | 1.02 | 0.3 | **Low** | BB |
| | | | | | | | | | | | | | | | | | | | |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 5 of **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 17/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition(1) (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L (2) (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D (2) (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH5 | 6.77 | Shale | N | 35.0 | 50.0 | 0.33 | 0.13 | 1.00 | 0.13 | **Low** | 50.0 | 35.0 | 2228 | 0.44 | 0.20 | 0.97 | 0.19 | **Low** | BB |
| BH5 | 6.80 | Shale | N | | | | | | | | 50.0 | 30.0 | 1910 | 0.52 | 0.27 | 0.94 | 0.26 | **Low** | |
| BH5 | 7.07 | Shale | N | 28.0 | 50.0 | 0.31 | 0.12 | 1.00 | 0.12 | **Low** | 50.0 | 28.0 | 1783 | 0.42 | 0.24 | 0.93 | 0.22 | **Low** | BB |
| BH5 | 7.29 | Shale | N | 26.0 | 50.0 | 0.25 | 0.10 | 1.00 | 0.10 | **V. Low** | 50.0 | 26.0 | 1655 | 0.55 | 0.33 | 0.91 | 0.30 | **Medium** | |
| BH5 | 8.0 | Shale | N | 35.0 | 50.0 | 0.58 | 0.23 | 1.00 | 0.2 | **Low** | 50.0 | 35.0 | 2228 | 0.64 | 0.29 | 0.97 | 0.3 | **Low** | |
| BH5 | 8.7 | Shale | N | 26.0 | 50.0 | 0.53 | 0.21 | 1.00 | 0.2 | **Low** | 50.0 | 26.0 | 1655 | 0.67 | 0.40 | 0.91 | 0.4 | **Medium** | BB |
| BH5 | 8.97 | Shale | N | 30.0 | 50.0 | 0.6 | 0.24 | 1.00 | 0.2 | **Low** | 50.0 | 30.0 | 1910 | 0.72 | 0.38 | 0.94 | 0.4 | **Medium** | |
| BH5 | 9.07 | Shale | N | 26.0 | 50.0 | 0.08 | 0.03 | 1.00 | 0.0 | **V. Low** | 50.0 | 26.0 | 1655 | 0.50 | 0.30 | 0.91 | 0.3 | **Low** | |
| BH5 | 9.68 | Shale | N | 30.0 | 50.0 | 0.47 | 0.19 | 1.00 | 0.2 | **Low** | 50.0 | 30.0 | 1910 | 0.61 | 0.32 | 0.94 | 0.3 | **Medium** | |
| BH5 | 9.34 | Shale | N | 38.0 | 50.0 | 0.58 | 0.23 | 1.00 | 0.2 | **Low** | 50.0 | 358.0 | 22791 | 0.72 | 0.03 | 1.64 | 0.1 | **V. Low** | BB |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 6 of **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 17/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition(1) (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L (2) (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D (2) (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH6 | 6.41 | Shale | N | 32.0 | 50.0 | 0.08 | 0.03 | 1.00 | 0.03 | **V. Low** | 50.0 | 32.0 | 2037 | 0.36 | 0.18 | 0.95 | 0.17 | **Low** | BB |
| BH6 | 7.15 | Shale | N | 27.0 | 50.0 | 0 | 0.00 | 1.00 | 0.00 | **V. Low** | 50.0 | 27.0 | 1719 | 0.00 | 0.00 | 0.92 | 0.00 | **V. Low** | |
| BH6 | 7.42 | Shale | N | 31.0 | 50.0 | 0 | 0.00 | 1.00 | 0.00 | **V. Low** | 50.0 | 31.0 | 1974 | 0.78 | 0.40 | 0.95 | 0.37 | **Medium** | |
| BH6 | 7.90 | Shale | N | 33.0 | 50.0 | 0.31 | 0.12 | 1.00 | 0.12 | **Low** | 50.0 | 33.0 | 2101 | 0.41 | 0.20 | 0.96 | 0.19 | **Low** | |
| BH6 | 8.04 | Shale | N | 31.0 | 50.0 | 0 | 0.00 | 1.00 | 0.0 | **V. Low** | 50.0 | 31.0 | 1974 | 0.52 | 0.26 | 0.95 | 0.2 | **Low** | |
| BH6 | 8.86 | Shale | N | 34.0 | 50.0 | 0.06 | 0.02 | 1.00 | 0.0 | **V. Low** | 50.0 | 34.0 | 2165 | 0.56 | 0.26 | 0.97 | 0.3 | **Low** | |
| BH6 | 8.96 | Shale | N | 30.0 | 50.0 | 0.39 | 0.16 | 1.00 | 0.2 | **Low** | 50.0 | 30.0 | 1910 | 0.72 | 0.38 | 0.94 | 0.4 | **Medium** | |
| BH6 | 9.12 | Shale | N | 36.0 | 50.0 | 0.27 | 0.11 | 1.00 | 0.1 | **Low** | 50.0 | 36.0 | 2292 | 1.10 | 0.48 | 0.98 | 0.5 | **Medium** | |
| BH6 | 9.72 | Shale | N | 36.0 | 50.0 | 1.24 | 0.50 | 1.00 | 0.5 | **Medium** | 50.0 | 36.0 | 2292 | 1.10 | 0.48 | 0.98 | 0.5 | **Medium** | |
| BH6 | 9.92 | Shale | N | 29.0 | 50.0 | 1.16 | 0.46 | 1.00 | 0.5 | **Medium** | 50.0 | 29.0 | 1846 | 0.72 | 0.39 | 0.93 | 0.4 | **Medium** | |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 7 of **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 18/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition[1] (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L [2] (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D [2] (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH7 | 4.4 | Shale | N | 36.0 | 50.0 | 0.69 | 0.28 | 1.00 | 0.28 | **Low** | 50.0 | 36.0 | 2292 | 1.13 | 0.49 | 0.98 | 0.48 | **Medium** | |
| BH7 | 4.74 | Shale | N | 30.0 | 50.0 | 0.3 | 0.12 | 1.00 | 0.12 | **Low** | 50.0 | 30.0 | 1910 | 0.71 | 0.37 | 0.94 | 0.35 | **Medium** | |
| BH7 | 5.27 | Shale | N | 30.0 | 50.0 | 0.27 | 0.11 | 1.00 | 0.11 | **Low** | 50.0 | 30.0 | 1910 | 0.49 | 0.26 | 0.94 | 0.24 | **Low** | BB |
| BH7 | 5.60 | Shale | N | 40.0 | 50.0 | 0.69 | 0.28 | 1.00 | 0.28 | **Low** | 50.0 | 40.0 | 2546 | 0.97 | 0.38 | 1.00 | 0.38 | **Medium** | |
| BH7 | 6.17 | Sandstone | N | 34.0 | 50.0 | 1.3 | 0.52 | 1.00 | 0.5 | **Medium** | 50.0 | 34.0 | 2165 | 0.75 | 0.35 | 0.97 | 0.3 | **Medium** | |
| BH7 | 6.38 | Sandstone | N | 35.0 | 50.0 | 1.35 | 0.54 | 1.00 | 0.5 | **Medium** | 50.0 | 35.0 | 2228 | 1.79 | 0.80 | 0.97 | 0.8 | **Medium** | |
| BH7 | 6.87 | Sandstone | N | 40.0 | 50.0 | 0.86 | 0.34 | 1.00 | 0.3 | **Medium** | 50.0 | 40.0 | 2546 | 1.98 | 0.78 | 1.00 | 0.8 | **Medium** | BB |
| BH7 | 7.05 | Sandstone | N | 35.0 | 50.0 | 0.94 | 0.38 | 1.00 | 0.4 | **Medium** | 50.0 | 35.0 | 2228 | 3.14 | 1.41 | 0.97 | 1.4 | **High** | BB |
| BH7 | 7.22 | Sandstone | N | 35.0 | 50.0 | 1.11 | 0.44 | 1.00 | 0.4 | **Medium** | 50.0 | 35.0 | 2228 | 3.64 | 1.63 | 0.97 | 1.6 | **High** | |
| BH7 | 7.76 | Sandstone | N | 35.0 | 50.0 | 2.76 | 1.10 | 1.00 | 1.1 | **High** | 50.0 | 35.0 | 2228 | 4.47 | 2.01 | 0.97 | 2.0 | **High** | |
| BH7 | 8.07 | Sandstone | N | 35.0 | 50.0 | 0.61 | 0.24 | 1.00 | 0.2 | **Low** | 50.0 | 35.0 | 2228 | 1.10 | 0.49 | 0.97 | 0.5 | **Medium** | |
| BH7 | 8.45 | Sandstone | N | 27.0 | 50.0 | 1.11 | 0.44 | 1.00 | 0.4 | **Medium** | 50.0 | 27.0 | 1719 | 1.11 | 0.65 | 0.92 | 0.6 | **Medium** | BB |
| BH7 | 8.70 | Sandstone | N | 30.0 | 50.0 | 0.30 | 0.12 | 1.00 | 0.1 | **Low** | 50.0 | 30.0 | 1910 | 0.63 | 0.33 | 0.94 | 0.3 | **Medium** | BB |
| BH7 | 9.01 | Sandstone | N | 30.0 | 50.0 | 0.89 | 0.36 | 1.00 | 0.4 | **Medium** | 50.0 | 30.0 | 1910 | 1.10 | 0.58 | 0.94 | 0.5 | **Medium** | |
| BH7 | 9.53 | Sandstone | N | 36.0 | 50.0 | 0.53 | 0.21 | 1.00 | 0.2 | **Low** | 50.0 | 36.0 | 2292 | 0.63 | 0.27 | 0.98 | 0.3 | **Low** | |
| BH7 | 9.90 | Sandstone | N | 35.0 | 50.0 | 1.05 | 0.42 | 1.00 | 0.4 | **Medium** | 50.0 | 35.0 | 2228 | 1.14 | 0.51 | 0.97 | 0.5 | **Medium** | |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 8 of **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 21/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition[1] (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L [2] (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D [2] (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH8 | 5.30 | Sandstone | N | 30.0 | 50.0 | 0.78 | 0.31 | 1.00 | 0.31 | **Medium** | 50.0 | 30.0 | 1910 | 1.77 | 0.93 | 0.94 | 0.87 | **Medium** | |
| BH8 | 5.86 | Sandstone | N | 30.0 | 50.0 | 1.74 | 0.70 | 1.00 | 0.70 | **Medium** | 50.0 | 30.0 | 1910 | 4.16 | 2.18 | 0.94 | 2.05 | **High** | |
| BH8 | 6.43 | Sandstone | N | 35.0 | 50.0 | 1.13 | 0.45 | 1.00 | 0.45 | **Medium** | 50.0 | 35.0 | 2228 | 0.67 | 0.30 | 0.97 | 0.29 | **Low** | |
| BH8 | 6.70 | Sandstone | N | 38.0 | 50.0 | 0.56 | 0.22 | 1.00 | 0.22 | **Low** | 50.0 | 38.0 | 2419 | 0.41 | 0.17 | 0.99 | 0.17 | **Low** | BB |
| BH8 | 6.93 | Sandstone | N | 32.0 | 50.0 | 0.85 | 0.34 | 1.00 | 0.3 | **Medium** | 50.0 | 32.0 | 2037 | 0.86 | 0.42 | 0.95 | 0.4 | **Medium** | |
| BH8 | 7.07 | Sandstone | N | 26.0 | 50.0 | 1.13 | 0.45 | 1.00 | 0.5 | **Medium** | 50.0 | 26.0 | 1655 | 0.93 | 0.56 | 0.91 | 0.5 | **Medium** | |
| BH8 | 7.89 | Shale | N | 26.0 | 50.0 | 0.09 | 0.04 | 1.00 | 0.0 | **V. Low** | | | | | | | | | |
| BH8 | 7.35 | Shale | N | 27.0 | 50.0 | 0.47 | 0.19 | 1.00 | 0.2 | **Low** | 50.0 | 26.0 | 1655 | 0.38 | 0.23 | 0.91 | 0.2 | **Low** | |
| BH8 | 8.14 | Shale | N | 30.0 | 50.0 | 0.80 | 0.32 | 1.00 | 0.3 | **Medium** | 50.0 | 30.0 | 1910 | 0.61 | 0.32 | 0.94 | 0.3 | **Medium** | |
| BH8 | 8.44 | Shale | N | 35.0 | 50.0 | 0.74 | 0.30 | 1.00 | 0.3 | **Low** | 50.0 | 35.0 | 2228 | 0.78 | 0.35 | 0.97 | 0.3 | **Medium** | |
| BH8 | 8.87 | Shale | N | 34.0 | 50.0 | 0.50 | 0.20 | 1.00 | 0.2 | **Low** | 50.0 | 34.0 | 2165 | 0.71 | 0.33 | 0.97 | 0.3 | **Medium** | |
| BH8 | 9.15 | Shale | N | 30.0 | 50.0 | 0.60 | 0.24 | 1.00 | 0.2 | **Low** | 50.0 | 30.0 | 1910 | 0.50 | 0.26 | 0.94 | 0.2 | **Low** | |
| BH8 | 9.66 | Shale | N | 35.0 | 50.0 | 0.17 | 0.07 | 1.00 | 0.1 | **V. Low** | 50.0 | 35.0 | 2228 | 0.39 | 0.18 | 0.97 | 0.2 | **Low** | BB |
| BH8 | 9.62 | Shale | N | 30.0 | 50.0 | 0.52 | 0.21 | 1.00 | 0.2 | **Low** | 50.0 | 30.0 | 1910 | 0.50 | 0.26 | 0.94 | 0.2 | **Low** | |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |

## *POINT LOAD STRENGTH INDEX*

*Australian Standard AS4133.4.1-1993 Method 4.1:Rock Strength Tests - Determination of Point Load Strength Index*

**Job No.** GEOTLCOV24207AB
**Sheet** 9 of **11**

**CLIENT:** Health Infrastructure NSW
**PROJECT:** GEOTLCOV24207AB
**LOCATION:** Blacktown Hospital

**Test Machine:** GSA bench-mounted
**Testing Locality:** Lane Cove West indoor storage area
**Tested By:** BM
**Test Date:** 23/2/2011
**Checked:**

**Date of Calibration:**
**Calibrated By:**
**Sampled Date:** 20/2/2011
**Storage Location:** Lane Cove West indoor storage area

| Borehole No. / Test Depth (m) | | Rock Description | Moisture Condition(1) (N, D or S) | Diametral test | | | | | | | Axial or Irregular lump | | | | | | | | Comments / Strength Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Length L (2) (mm) | Diameter D (mm) | Load P (Gauge) (N) | $I_s=(P/D^2)$ x 1000 (MPa) | Size Correction $F=(D/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Diametral) | Width W (core diameter) (mm) | Platen Separation D (2) (mm) | $D_e^2$ | Load (Gauge) (kN) | $I_s=(P/D_e^2)$ x 1000 (MPa) | Size Correction $F=(D_e/50)^{0.45}$ | $I_{s(50)}$ (MPa) | Strength Class (Axial) | |
| BH9 | 5.24 | Sandstone | N | 31.0 | 50.0 | 0.89 | 0.36 | 1.00 | 0.36 | **Medium** | 50.0 | 31.0 | 1974 | 1.90 | 0.96 | 0.95 | 0.91 | **Medium** | |
| BH9 | 5.50 | Sandstone | N | 32.0 | 50.0 | 0.28 | 0.11 | 1.00 | 0.11 | **Low** | 50.0 | 32.0 | 2037 | 0.31 | 0.15 | 0.95 | 0.15 | **Low** | BB |
| BH9 | 6.28 | Sandstone | N | 31.0 | 50.0 | 0.46 | 0.18 | 1.00 | 0.18 | **Low** | 50.0 | 31.0 | 1974 | 0.60 | 0.30 | 0.95 | 0.29 | **Low** | BB |
| BH9 | 6.43 | Sandstone | N | 27.0 | 50.0 | 12.25 | 4.90 | 1.00 | 4.90 | **V. High** | 50.0 | 27.0 | 1719 | 9.15 | 5.32 | 0.92 | 4.89 | **V. High** | |
| BH9 | 7.30 | Sandstone | N | 34.0 | 50.0 | 0.31 | 0.12 | 1.00 | 0.1 | **Low** | 50.0 | 34.0 | 2165 | 1.35 | 0.62 | 0.97 | 0.6 | **Medium** | |
| BH9 | 7.55 | Sandstone | N | 35.0 | 50.0 | 0.39 | 0.16 | 1.00 | 0.2 | **Low** | 50.0 | 35.0 | 2228 | 0.17 | 0.08 | 0.97 | 0.1 | **V. Low** | |
| BH9 | 7.85 | Sandstone | N | 31.0 | 50.0 | 0.53 | 0.21 | 1.00 | 0.2 | **Low** | 50.0 | 31.0 | 1974 | 0.89 | 0.45 | 0.95 | 0.4 | **Medium** | |
| BH9 | 8.02 | Sandstone | N | 32.0 | 50.0 | 0.93 | 0.37 | 1.00 | 0.4 | **Medium** | 50.0 | 32.0 | 2037 | 0.78 | 0.38 | 0.95 | 0.4 | **Medium** | BB |
| BH9 | 8.28 | Shale | N | 27.0 | 50.0 | 0.06 | 0.02 | 1.00 | 0.0 | **V. Low** | 50.0 | 27.0 | 1719 | 0.28 | 0.16 | 0.92 | 0.1 | **Low** | BB |
| BH9 | 8.46 | Shale | N | 28.0 | 50.0 | 0.61 | 0.24 | 1.00 | 0.2 | **Low** | 50.0 | 28.0 | 1783 | 0.61 | 0.34 | 0.93 | 0.3 | **Medium** | BB |
| BH9 | 8.97 | Sha;e | N | 30.0 | 50.0 | 0.31 | 0.12 | 1.00 | 0.1 | **Low** | 50.0 | 30.0 | 1910 | 0.89 | 0.47 | 0.94 | 0.4 | **Medium** | |
| BH9 | 9.17 | Shale | N | 31.0 | 50.0 | 0.67 | 0.27 | 1.00 | 0.3 | **Low** | 50.0 | 31.0 | 1974 | 0.89 | 0.45 | 0.95 | 0.4 | **Medium** | |
| BH9 | 9.46 | Shale | N | 34.0 | 50.0 | 0.27 | 0.11 | 1.00 | 0.1 | **Low** | 50.0 | 34.0 | 2165 | 0.64 | 0.30 | 0.97 | 0.3 | **Low** | BB |
| BH9 | 9.77 | Shale | N | 34.0 | 50.0 | 0.38 | 0.15 | 1.00 | 0.2 | **Low** | 50.0 | 34.0 | 2165 | 1.08 | 0.50 | 0.97 | 0.5 | **Medium** | |
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**NOTES**

(1): N = Natural, D = Dry, S = Saturated
(2): L > 0.5D, 0.3 < D/W < 1.0

$I_{s(50)}$ MPa and Strength Classification

| | | | |
|---|---|---|---|
| < 0.1 | Very Low | 1 - 3 | High |
| 0.1 - 0.3 | Low | 3 - 10 | Very High |
| 0.3 - 1 | Medium | > 10 | Extreamly High |