Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Hornsby Hospital Redevelopment
Corner Palmerston and Lowe Roads, Hornsby

Prepared for
Health Infrastructure

Project 72247.00
February 2011

Douglas Partners
Geotechnics / Environment / Groundwater

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
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Reviewer	Terry Wiesner	21.2.11

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Report on Geotechnical Investigation
Proposed Hornsby Hospital Redevelopment
Corner Palmerston and Lowe Roads, Hornsby

1. Introduction

This report provides the results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (DP) for a proposed redevelopment at Hornsby Hospital, Hornsby. The work was carried out at the request of TSA Management Pty Limited, the project managers for the project, acting on behalf of the client, Health Infrastructure.

It is understood that the proposed redevelopment will include demolition of the existing buildings and the construction of a new two-storey building. No basement level is currently proposed.

The investigation included the drilling of five boreholes with Standard penetration testing of the overburden soils and coring of the rock. Details of the field work are given in the report together with comments on subsurface conditions, site preparation and design of footings.

2. Site Description and Geology

The proposed site of the new building is within the north-western portion of Hornsby Hospital on an area currently occupied by relatively dilapidated one and two-storey masonry and timber buildings (Building 6). Building 6 is surrounded by asphaltic concrete (AC) paved carpark and grassed areas with mature trees. Palmerston Road and Lowe Road border the site to the west and north, respectively. A one and two-storey masonry building (MIHCU Building) and a three-storey reinforced concrete building (Building 5) are both located within about 10 - 20 m of the existing Building 6 to the east and south, respectively.

The existing Building 6 and associated carpark area is approximately 90 m square and dips gently at less than 1° towards the north and west.

Reference to the Sydney 1:100 000 Series Geological Sheet indicates that most of the site is underlain by Hawkesbury Sandstone of Triassic age. This formation typically comprises medium to coarse grained quartz sandstone with minor shale bands or lenses and was confirmed by the boreholes. Ashfield Shale is located immediately to the south-east of the site and was not encountered in the boreholes.

3. Field Work Methods

The field work included drilling of five boreholes (BH1 to BH5 inclusive) to depths of between 4.5 m and 4.95 m using a bobcat-mounted drilling rig.

The boreholes were initially drilled using spiral flight augers within the soils and then cased and continued into the underlying rock using NMLC diamond core drilling techniques to obtain 50 mm diameter continuous core samples of the bedrock. Standard penetration tests (SPTs) were carried out at 1 m depth within the soil to sample the soil and assess the in-situ strength.

The rock cores were returned to the DP office where they were logged by a geologist, the cores photographed and Point Load Strength Index (Is_{50}) tests carried out on selected samples of the rock core.

Groundwater observations were made during drilling of the boreholes. No long-term monitoring of groundwater levels was carried out.

The ground surface levels at the bore locations were leveled relative to a nearby survey mark (SSM 83810) and a temporary benchmark. The surface levels in the borelogs are relative to Australian Height Datum (AHD).

The borehole locations are shown on the attached Drawing 1.

4. Field Work Results

Details of the field work results are presented in the borehole logs which are attached, together with photographs of the rock cores, and notes explaining descriptive terms and classification methods used.

The boreholes intersected a relatively consistent subsurface profile generally comprising:

PAVEMENTS: Asphaltic concrete 0.04 m to 0.05 m thick in all boreholes underlain by roadbase gravel to 0.15 m to 0.5 m depth in BH2 to BH5 inclusive;

FILLING: Encountered below the pavements in BH1 to BH3 inclusive, to depths of between 0.5 m and 1.9 m, and generally comprised gravelly sand with some sandstone gravel;

SILTY CLAY/
SANDY CLAY: Variably firm to stiff, stiff, very stiff and hard residual clayey soils in all boreholes (except BH2), extending to the top of the weathered bedrock;

SANDSTONE: Encountered in BH1 to BH5 inclusive, commencing at depths of 1.6 m (RL 175.0 m), 0.8 m (RL 176.7 m), 1.5 m (RL 176.2 m), 1.0 m (RL 175.9 m) and 1.65 m (RL 175.5 m), respectively. Generally, the sandstone was initially extremely low and very low strength, becoming medium and high strength with depth. The sandstone was slightly fractured or unbroken.

No free groundwater was observed during augering of the boreholes. The use of water during rock coring precluded any further groundwater observations.

5. Laboratory Testing

Selected samples of the rock core were tested in DP's laboratory to determine the Point Load Strength Index $Is_{(50)}$ values to assist with the rock strength classification. The $Is_{(50)}$ values for the rock generally ranged from 0.2 MPa to 1.6 MPa, corresponding to a low to high strength classification (and with inferred UCS ranging from 4 MPa to 32 MPa based on a UCS:$Is_{(50)}$ ratio of 20:1). An $Is_{(50)}$ value of 3.9 MPa was recorded on an ironstone band, corresponding to very high strength.

Testing for pH, electrical conductivity, sulphate ion and chloride ion concentration analyses for assessment of soil aggressivity were undertaken on selected soil samples. The results of the chemical properties are attached and are summarised in Table 1.

Table 1: Results of pH, Electrical Conductivity, Sulphate and Chloride Testing

Bore	Material	Sample Depth (m)	pH	EC (µS/cm)	Chloride (mg/kg) or *(mg/L)	Sulphate (mg/kg) or *(mg/L)
3	Sandy Clay	1.0	8.5	180	27	66
4	Sandstone	1.0	8.4	400	46	600
5	Sandy Clay	1.0	5.0	34	10	33

Comparison of the results of aggressivity testing with Table 6.4.2(C) and 6.5.2(C) in AS 2159 "Piling Design and Installation" - 2009, indicates that the subsurface conditions are likely to be mildly aggressive to buried concrete elements. For buried steel elements, the subsurface conditions are likely to be non - aggressive.

6. Comments

6.1 Proposed Development

A new mental health unit is proposed at Hornsby Hospital requiring the demolition of the existing building (Building 6). Removal of the existing building footings and replacement of the existing services are both also likely. The redevelopment will include a two-storey building with anticipated column loads in the order of 1000 – 2000 kN. The proposed floor level is likely to be close to the existing surface levels on the site and will require only minor cut and fill for site preparation, as no basement level is proposed.

6.2 Excavation Conditions

The boreholes indicate that minor excavation to achieve the design floor levels for the new building will mostly require removal of the pavement materials, filling and natural soils. Sandstone bedrock of

extremely low, very low and medium strength may be encountered within the deeper excavations for the footings.

Excavation of near-surface soils and extremely low and very low strength rock should be readily achieved using conventional earthmoving equipment such as tracked hydraulic excavators. Excavation of low or greater strength sandstone for the construction of footings will probably require the use of a relatively large piling rig of sufficient torque capacity for effective excavation.

Seepage should be expected along the top of the rock surface, particularly following periods of extended wet weather.

6.3 Footings

Given the importance of a hospital building and the relatively shallow depth to bedrock, it is reasonable that all new structures should be founded onto the sandstone bedrock. Either pad footings or uncased bored pile footings should be suitable.

Footings founded on at least very low strength sandstone may be designed for an allowable bearing pressure of 1000 kPa. Alternatively, footings founded on medium strength sandstone may be designed for an allowable bearing pressure of 3000 kPa. Settlement of footings based on these allowable (working) parameters should be less than 1% of the minimum footing dimension.

All footings should be inspected at the time of drilling by a geotechnical engineer to confirm that foundation conditions are suitable for the design parameters. All footings should be cleaned free of loose debris and groundwater (if any) prior to pouring of concrete.

6.4 Seismic Design

In accordance with the Australian Standard AS1170.4-2007 Earthquake Loading, the site has a hazard factor (z) of 0.08 and a site sub-soil class of rock (B_e), assuming that all major structural loads are carried to rock of at least extremely low strength to very low strength.

7. Limitations

Douglas Partners (DP) has prepared this report for Health Infrastructure care of TSA Management Pty Limited in accordance with the DP proposal dated 10 December 2010. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of Health Infrastructure and TSA Management Pty Limited for the specific project and purpose as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other sites or by a third party.

The results provided in the report are considered to be indicative of the sub-surface conditions on the site only to the depths investigated at the specific sampling and/or testing locations, and only at the time the work was carried out. DP's advice is based on observations, measurements, tests or derived

interpretations. The accuracy of the advice provided by DP in this report may be limited by unobserved features and variations in ground conditions across the site in areas between test locations and beyond the site boundaries or by variations with time. The advice may also be limited by restrictions in the sampling and testing which was able to be carried out, as well as by the amount of data that could be collected given the project and site constraints. Actual ground conditions and materials behaviour observed or inferred at the test locations may differ from those which may be encountered elsewhere on the site. If variations in subsurface conditions be encountered, then additional advice should be sought from DP and, if required, amendments made.

This report must be read in conjunction with the attached “About This Report” and any other attached explanatory notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others, which are not otherwise supported by an expressed statement, interpretation, outcome or conclusion stated in this report. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

Douglas Partners Pty Ltd

Appendix A

Notes About this Report
Results of Field Work

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Hornsby Hospital Redevelopment
LOCATION: Cnr Palmerston & Lowe Road, Hornsby

SURFACE LEVEL: 177.1 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 72247
DATE: 31/1/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
177	0.05	ASPHALTIC CONCRETE							A			
		FILLING - dark grey to grey brown, medium to coarse grained, gravelly sand filling							A			
176	0.9	SANDY CLAY - stiff, yellow brown, fine to medium grained, sandy clay with some ironstone gravel, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	A			
	1.6								S			2,4,6 N = 10
	1.85	SANDSTONE - extremely low strength, brown, fine to medium grained sandstone										
175	2	SANDSTONE - high strength, moderately to slightly then slightly weathered, slightly fractured and unbroken, light grey brown to red brown, medium to coarse grained sandstone. Some very low strength bands						2.15 & 2.22m: B (x2) 5°, cly, co				PL(A) = 1.1
174	3	2.6-2.9m: medium strength sandstone						2.65m: B0°, cly, vn & J, sv, pl, ro, cln 2.92m: B0°, 30mm Cs				PL(A) = 0.7
									C	100	95	PL(A) = 1.1
173	4							4.11m: B0°, 30mmCs				
								4.65m: B0°, 10mm Cs				PL(A) = 1.2
172	4.95	Bore discontinued at 4.95m										
171	6											
170	7											
169	8											
168	9											

RIG: Bobcat **DRILLER:** S Younan **LOGGED:** SI **CASING:** HW to 1.85m

TYPE OF BORING: Solid flight auger to 1.85m; NMLC-Coring to 4.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SURVEY DATUM:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Hornsby Hospital Redevelopment
LOCATION: Cnr Palmerston & Lowe Road, Hornsby

SURFACE LEVEL: 177.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 72247
DATE: 31/1/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
177	0.05	ASPHALTIC CONCRETE							A			
	0.3	ROADBASE GRAVEL										
		FILLING - brown, fine to medium grained, sand filling with some crushed sandstone gravel						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes at 0°-10°	A			
	0.8	SANDSTONE - extremely low strength, light grey brown, fine grained sandstone							A / S			10/50mm refusal
176	1.3	- very low strength at 1.1m										
		SANDSTONE - medium and high strength, moderately and slightly weathered, slightly fractured, light grey brown to red brown, medium to coarse grained sandstone						1.74m: B0°, 10mm Cs				PL(A) = 0.8
175		2.65-2.85m: very high strength ironstone band						2.63m: B5°, fe	C	100	99	PL(A) = 3.9
								3.15m: J30°, pl, ro, cln				
174		3.45-4.0m: fresh sandstone						3.4m: B0°, cly, vn				PL(A) = 0.8
	4.35	Bore discontinued at 4.35m						4.22m: B0°, fe				PL(A) = 1.3
173												
172												
171												
170												
169												
168												

RIG: Bobcat **DRILLER:** S Younan **LOGGED:** SI **CASING:** HW to 1.0m

TYPE OF BORING: Solid flight auger to 1.0m; Rotary to 1.3m; NMLC-Coring to 4.35m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: 100% water loss at 4.2m

SURVEY DATUM:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Hornsby Hospital Redevelopment
LOCATION: Cnr Palmerston & Lowe Road, Hornsby

SURFACE LEVEL: 177.7 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 72247
DATE: 31/1/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
177	0.04	ASPHALTIC CONCRETE							A			
	0.15	ROADBASE GRAVEL										
	0.5	FILLING - grey and brown, gravelly sand filling							A			
	0.9	SILTY CLAY - stiff, orange and grey brown silty clay with a trace of fine grained sand and ironstone gravel, medium plasticity, damp						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0°-10°	A			20/100mm refusal
176	1.5	SANDY CLAY - hard, light grey and yellow, fine to medium grained sandy clay with ironstone band (possible extremely low strength sandstone)							S			
	1.85	SANDSTONE - high then medium strength, moderately and slightly weathered, slightly fractured and unbroken, light grey and brown, medium to coarse grained sandstone						1.7m: CORE LOSS: 150mm 1.85-1.87m: Cz (20mm) 2.15m: J20°, pl, ro, cly, vn				PL(A) = 1.2
175												PL(A) = 1.2
									C	95	91	
174								3.5m: J (x2) 30°- 35°, pl, ro, cly, co 3.55 & 3.83m: B (x2) 5°, cly, vn				PL(A) = 1.3
								4.16m: B5°, 10mm Cs 4.3m: B0°, 30mm Cs				PL(A) = 0.8
	4.5	Bore discontinued at 4.5m										
173												
172												
171												
170												
169												
168												

RIG: Bobcat **DRILLER:** S Younan **LOGGED:** SI **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger to 1.5m; NMLC-Coring to 4.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SURVEY DATUM:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Hornsby Hospital Redevelopment
LOCATION: Cnr Palmerston & Lowe Road, Hornsby

SURFACE LEVEL: 176.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 72247
DATE: 1/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
176	0.05	ASPHALTIC CONCRETE							A			
		ROADBASE - gravel with cemented sand										
	0.5	SILTY CLAY - very stiff, brown silty clay with some ironstone gravel, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping 0°- 10°	A			
	1.0	SANDSTONE - extremely low strength, light grey brown, fine grained sandstone							A			
	1.5								S			9,10,14 N = 24
175	2	SANDSTONE - alternate bands of very low and high strength, highly weathered, slightly fractured, light grey and red brown, fine to medium grained sandstone						1.57m: B0°, cly, co 1.8m: B5°, 20mm Cs 1.92m: B0°, 20mm Cs 2.05m: B0°, 5mm sand 2.17-2.22m: fg, fe, cly				PL(A) = 1.4
	2.4	SANDSTONE - medium then high strength, moderately weathered then fresh, slightly fractured, brown then light grey, medium grained sandstone						2.48m: J, sv, pl, ro, cln				PL(A) = 0.8
174	3							2.92-3.4m: B (x3) 0°- 5°, fe	C	100	89	
173	4							3.92m: B5°, cly, co				PL(A) = 1.3
	4.6	Bore discontinued at 4.6m										PL(A) = 1.6
172	5											
171	6											
170	7											
169	8											
168	9											
167												

RIG: Bobcat **DRILLER:** S Younan **LOGGED:** SI **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger to 1.5m; NMLC-Coring to 4.6m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SURVEY DATUM:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Hornsby Hospital Redevelopment
LOCATION: Cnr Palmerston & Lowe Road, Hornsby

SURFACE LEVEL: 177.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 72247
DATE: 1/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
177	0.05	ASPHALTIC CONCRETE							A			
	0.3	ROADBASE GRAVEL							A			
		SILTY CLAY - firm to stiff, brown silty clay with a trace of ironstone gravel, moist						Note: Unless otherwise stated, rock is fractured along rough planar bedding dipping at 0°-10°	A			
	0.9	SANDY CLAY - firm to stiff, mottled orange brown and light grey, fine grained sandy clay, moist (possible extremely low strength sandstone)							S			2,4,4 N = 8
176	1											
	1.65	SANDSTONE - alternate bands of very low and high strength, highly weathered, fractured, light grey and red brown, fine grained sandstone						1.65m: J65°, un, ro, fe 1.76m: J40°, pl, sm, cly 1.83m: B0°, cly band 1.97 & 2.04m: B (x2) 0°, Cs				PL(A) = 0.2
	2											
175	2.15											
	2.3	SANDSTONE - medium strength, moderately and slightly weathered, slightly fractured, light grey brown, medium grained sandstone						2.1m: CORE LOSS: 50mm 2.25 & 2.27m: B (x2) 0°, Cs 2.56 & 2.86m: B (x2) 5°, cly, vn 3.03m: J25°, pl, ro, fe 3.4m: B5°, 5mm Cs 3.56m: B0°, fe	C	98	86	PL(A) = 0.4 PL(A) = 0.7
174	3											
173	4											
	4.0	SANDSTONE - high strength, fresh, slightly fractured, light grey, medium to coarse grained sandstone										PL(A) = 1.3
	4.65	Bore discontinued at 4.65m										
172	5											
171	6											
170	7											
169	8											
168	9											

RIG: Bobcat **DRILLER:** S Younan **LOGGED:** SI **CASING:** HW to 1.5m

TYPE OF BORING: Solid flight auger to 1.5m; Rotary to 1.65m; NMLC-Coring to 4.65m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SURVEY DATUM:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
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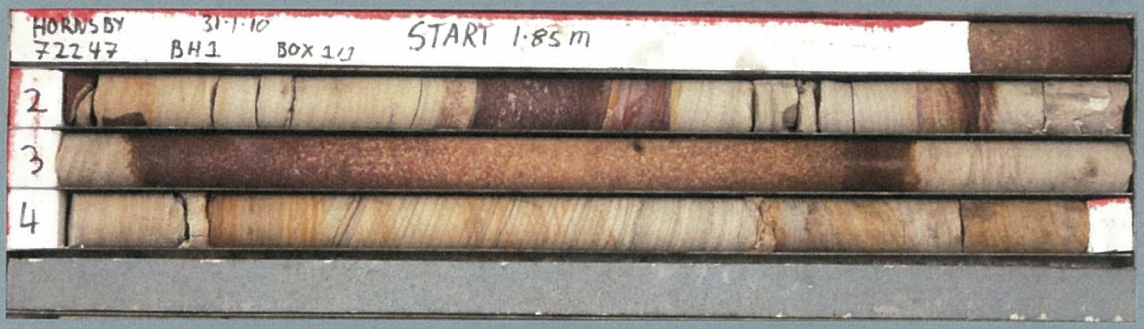
DOUGLAS PARTNERS PTY LTD

HORNSBY HOSPITAL REDEVELOPMENT - HORNSBY

BORE 1 PROJECT 72247 JAN 2011

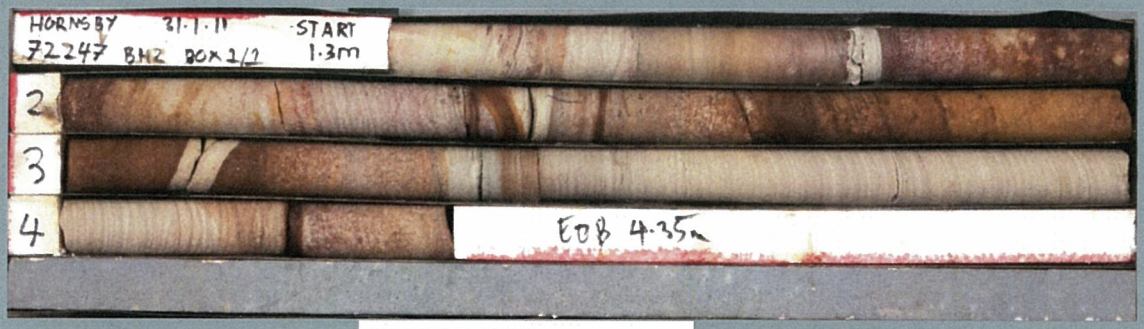


1.85 – 4.95m

DOUGLAS PARTNERS PTY LTD

HORNSBY HOSPITAL REDEVELOPMENT - HORNSBY

BORE 2 PROJECT 72247 JAN 2011

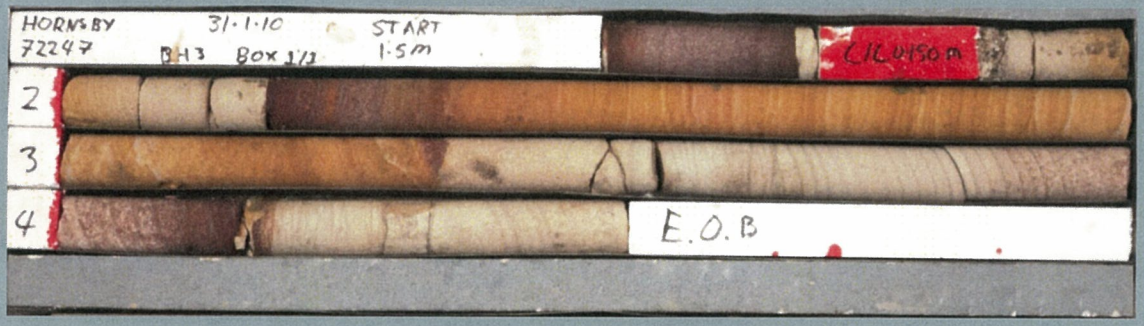


1.3 - 4.35m

DOUGLAS PARTNERS PTY LTD

HORNSBY HOSPITAL REDEVELOPMENT - HORNSBY

BORE 3 PROJECT 72247 JAN 2011

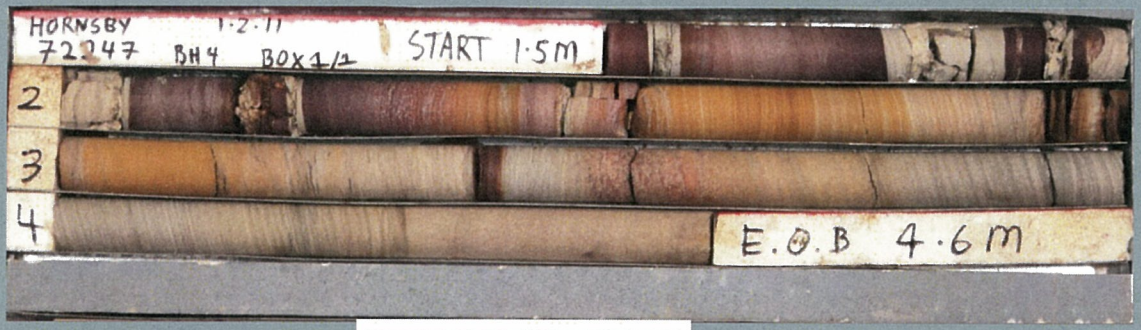


1.5 – 4.5m

DOUGLAS PARTNERS PTY LTD

HORNSBY HOSPITAL REDEVELOPMENT - HORNSBY

BORE 4 PROJECT 72247 FEB 2011

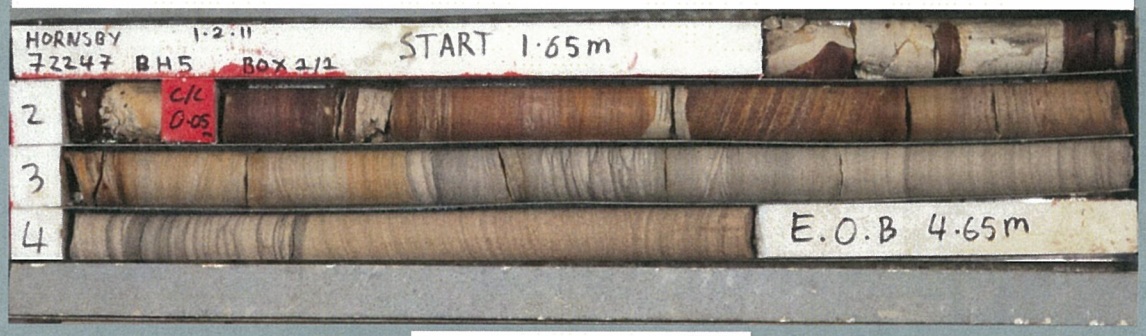


1.5 – 4.6m

DOUGLAS PARTNERS PTY LTD

HORNSBY HOSPITAL REDEVELOPMENT- HORNSBY

BORE 5 PROJECT 72247 FEB 2011



1.65 – 4.65m

Appendix B

Results of Laboratory Testing

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 51239

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Peter Valenti

Sample log in details:

Your Reference:	**72247, Hornsby Hospital**
No. of samples:	3 Soils
Date samples received / completed instructions received	02/02/11 / 02/02/11

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	9/02/11 / 10/02/11
Date of Preliminary Report:	not issued

NATA accreditation number 2901. This document shall not be reproduced except in full.
This document is issued in accordance with NATA's accreditation requirements.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Nick Sarlamis
Inorganics Supervisor

ACCREDITED FOR TECHNICAL COMPETENCE

Miscellaneous Inorg - soil				
Our Reference:	UNITS	51239-1	51239-2	51239-3
Your Reference	----------	BH3/1.0	BH4/1.0	BH5/1.0
Date Sampled	----------	31/01/2011	1/02/2011	1/02/2011
Type of sample		Soil	Soil	Soil
Date prepared	-	07/02/2011	07/02/2011	07/02/2011
Date analysed	-	08/02/2011	08/02/2011	08/02/2011
pH 1:5 soil:water	pH Units	8.5	8.4	5.0
Sulphate, SO4 1:5 soil:water	mg/kg	66	600	33
Chloride, Cl 1:5 soil:water	mg/kg	27	46	10
Electrical Conductivity 1:5 soil:water	µS/cm	180	400	34

Method ID	Methodology Summary
LAB.1	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
LAB.81	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 21st ED, 4110-B.
LAB.2	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA2510 20th ED and Rayment & Higginson.

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			07/02/2011	[NT]	[NT]	LCS-1	07/02/2011
Date analysed	-			08/02/2011	[NT]	[NT]	LCS-1	08/02/2011
pH 1:5 soil:water	pH Units		LAB.1	[NT]	[NT]	[NT]	LCS-1	100%
Sulphate, SO4 1:5 soil:water	mg/kg	2	LAB.81	<2.0	[NT]	[NT]	LCS-1	118%
Chloride, Cl 1:5 soil:water	mg/kg	2	LAB.81	<2.0	[NT]	[NT]	LCS-1	102%
Electrical Conductivity 1:5 soil:water	µS/cm	1	LAB.2	<1.0	[NT]	[NT]	LCS-1	106%

Report Comments:

Asbestos ID was analysed by Approved Identifier:	Not applicable for this job
Asbestos ID was authorised by Approved Signatory:	Not applicable for this job

INS: Insufficient sample for this test	PQL: Practical Quantitation Limit	NT: Not tested
NA: Test not required	RPD: Relative Percent Difference	NA: Test not required
<: Less than	>: Greater than	LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

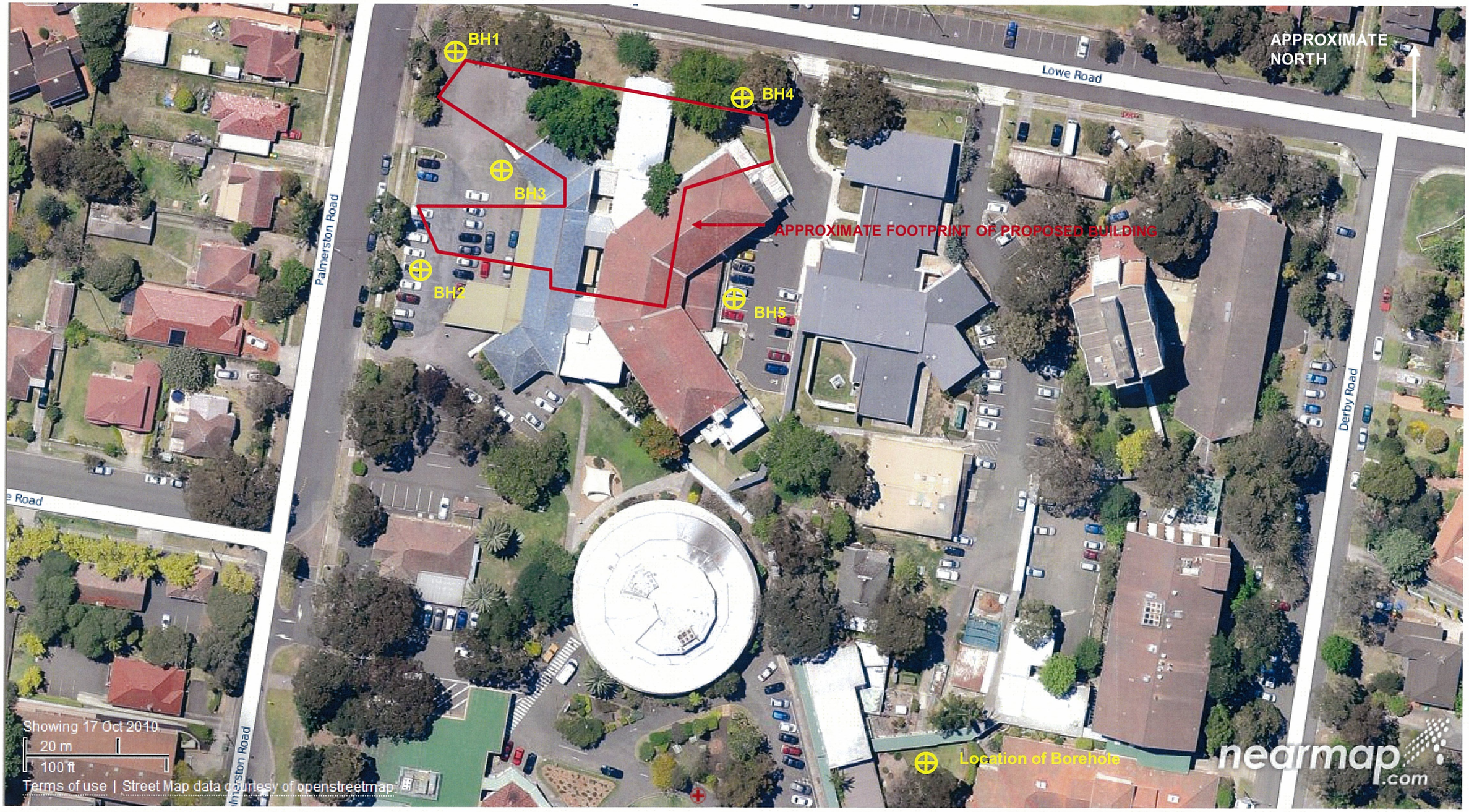
Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batched of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable.

Appendix C

Drawing 1 - Location of Boreholes



Douglas Partners Geotechnics / Environment / Groundwater	CLIENT: Health Infrastructure		TITLE: **Site Plan – Location of Boreholes** **Proposed Hornsby Hospital Redevelopment** **Corner Palmerston & Lowe Roads, Hornsby**	PROJECT No:	72247
	OFFICE: Sydney	DRAWN BY: PAV		DRAWING No:	1
	SCALE: As shown	DATE: 8.2.11		REVISION:	A