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Report on
Preliminary Geotechnical Investigation

Campbelltown Hospital Stage 2 Redevelopment
Therry Road, Campbelltown

Prepared for
Health Infrastructure

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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.

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Report on Preliminary Geotechnical Investigation
Campbelltown Hospital Stage 2 Redevelopment
Therry Road, Campbelltown

1. Introduction

This report presents the results of a preliminary geotechnical investigation undertaken for the proposed Stage 2 Redevelopment of Campbelltown Hospital at Therry Road, Campbelltown. The investigation was initially commissioned in an email dated 25 July 2017 by Mrs Margo Kouvaris of Health Infrastructure (the Client) and was undertaken in accordance with Douglas Partners Pty Ltd's (DP) revised proposal MAC170234 Rev2 (Variations 2 and 4), dated 18 January 2018 and receipt of approval from the Client.

It is understood that the proposed development will include the construction of a new multi-storey clinical services building (CSB), an expansion of the existing cancer treatment centre (CTC) and the construction of several link structures.

The purpose of the preliminary geotechnical investigation was to assess subsurface conditions underlying the proposed development area to provide comment on the following:

- In situ and laboratory testing results;
- Site preparation and general earthworks;
- Excavation and retention;
- Footing parameters and suitable footing types;
- On-grade slabs; and
- Potential construction difficulties.

The investigation included review of existing information and drilling of boreholes followed by laboratory testing of selected samples. Details of the work undertaken and the results obtained are given within this report, together with comments relating to the above items.

As part of the investigation, a conceptual building cross-section showing nominal finished floor levels and excavation depths was provided to DP (prepared by Billard Leece Partners) and is included in Appendix A.

2. Background Information

Several previous geotechnical and environmental investigations within the Campbelltown Hospital site have been undertaken by Douglas Partners Pty Ltd (DP) since August 1990 during separate stages of redevelopment. The relevant investigations to the subject development were undertaken in August 1990, October 1998 and May 2011 as part of geotechnical investigations for the (then

proposed) psychiatric unit buildings, several additional ward structures (including a four storey building) and an acute health services building and associated on-grade parking. The results of the investigations were formalised in the following reports:

- *"Report on Geotechnical Investigation, Proposed Psychiatric Units, Campbelltown Hospital, Campbelltown"* (Project 14060) dated 13 August 1990;
- *"Report on Geotechnical Investigation, Macarthur Strategy Project, Campbelltown Hospital"* (Project 22884-1) dated 27 October 1998; and
- *"Report on Geotechnical Investigation, Proposed Campbelltown Hospital Redevelopment, Therry Road, Campbelltown"* (Project 34275.00) dated 10 May 2011.

The previous investigations comprised site inspections, borehole drilling, sampling, laboratory testing of selected samples, engineering analysis and reporting. Recommendations were provided for deep excavations, retention and foundation options for a range of founding conditions, with allowable base bearing pressure parameters ranging from 100 kPa for controlled filling to 3,500 kPa for foundations founded in medium strength rock.

Relevant borehole information from the previous reports have been included in Appendix B.

3. Site Description and Regional Geology

The Campbelltown Hospital site is irregular shaped and comprises two separate portions (separated by Central Road) with a total area of approximately 21.3 ha. The area of the proposed development is approximately 1.9 ha (refer Drawing 1) and currently includes access roads, car parking, landscaped areas, pathways and existing structures. Overall topographic relief ranges from approximately RL 114 within the south-eastern portion of the site to the lowest part (approximately RL 76) within the western portion of the site.

At the time of the investigation, the site was occupied mainly by numerous brick and concrete hospital buildings, on-grade car parking and roadways. The remainder of the site was grass covered with some scattered large eucalypt trees.

The area of the proposed CSB covers approximately 1 ha and will be located in the southern terraced visitors parking area and loading dock. The existing surface slopes towards the north and the terracing is formed by four batters facing north and north-west, with the northern-most batter supported at the toe by a 2 m high concrete block retaining wall. The existing area is terraced with differences in level between terraces ranging from around 2 m and up to approximately 8 m. The individual terraces are supported by batters shaped at approximately 1 in 1 to 1 in 2. The batters appear to be cut into competent rock (at least low to medium strength), however, deep mulch has been used to face most of the batters. The total vertical relief in this area is approximately 20 m.

The area of the proposed link building between Buildings A and D currently includes pavements, awning structure, a retaining wall approximately 4 m high and grassed areas. This part of the site is relatively level, with a slight fall towards the west and north-west at approximately 1 in 50. The total vertical relief in this area is estimated to be less than 5 m (or approximately 9 m in the northern corner where an existing the retaining wall is situated).

The site of the CTC expansion and proposed pedestrian link structure is between existing structures. The topography ranged from almost level to undulating and mainly comprised concrete, asphalt surfaced pavements and grass areas. The total vertical relief was estimated to be less than 4 m

Various features of the site are shown in the colour photoplates (Plates 1 – 4) included in Appendix A.

Reference to the 1:100 000 Wollongong – Port Hacking Geological Series Sheet (Ref 1) indicates that the site is underlain by The Ashfield Shale of the Wianamatta Group of Triassic age. Ashfield Shale typically comprises siltstone and laminite, all of which weather to form clays of high plasticity. The results of the investigation were consistent with the geological mapping, with siltstone encountered in all of the boreholes.

4. Field Work Methods

The current fieldwork included the drilling of 17 boreholes (Bores 101 – 116 and 118), eight of which were extended into the rock using NMLC diamond core drilling equipment. Bore 117 was not drilled due to underground services restrictions.

The boreholes were drilled to depths of 1.0 – 5.6 m with a drilling rig fitted with 110 mm diameter augers and a 'TC' bit. The boreholes were drilled through the overlying very low to low strength rock to 'TC' bit refusal (typically in rock of at least low to medium strength) at depths of 1.0 – 5.6 m. Core drilling for a penetration of 9 – 23 m into rock was carried out in Bores 101, 103, 105, 106, 110, 113, 114 and 116.

Standard penetration tests (AS 1289.6.3.1 – SPT) were carried out at a depth of 1.0 m and then at 1.5 m depth intervals in all boreholes. The standard penetration test procedure is given in the attached notes and the penetration 'N' value is shown on the borehole logs in Appendix B. The boreholes were logged by an experienced geotechnical engineer prior to backfilling. Disturbed auger samples, 'undisturbed' samples (in 50 mm diameter thin-walled tubes) and bulk samples were collected at regular depth intervals to assist in strata identification and for laboratory testing.

The current test locations were determined in consultation with the client and set out on site by DP and are shown on Drawing 1 (Appendix A). The surface levels (to Australian Height Datum, AHD) and co-ordinates were recorded using a differential GPS unit for which an accuracy of ±20 mm is typical (MGA94 Zone 56 coordinates).

Previous subsurface investigations (DP 1990, DP 1998 and DP 2011) have been used as part of this assessment comprised:

- Boreholes drilling using a Pengo soil sampling and drilling rig (DP Project 14060 dated August 1990, Bores 3 - 5). The boreholes were drilled using a 300 mm diameter spiral flight augers to termination depths of 3.0 – 3.5 m;
- Borehole drilling using a B40 and Bobcat soil sampling and drilling rigs (DP Project 22884-1 dated October 1998, Bores 1 – 12 and 16). Bores 1 – 6 were drilled using a 100 mm diameter spiral flight augers and rotary drilling techniques to depths in the range of 2.1 – 6.2 m. The boreholes were then extended into the underlying rock using NMLC (50 mm diameter core) diamond drilling equipment to termination depths of 7.0 – 9.2 m. Bores 7 – 12 and 16 were drilled using a 250 mm diameter spiral flight augers to depths in the range of 1.5 – 2.3 m, with refusal encountered at depths of 1.5 m in Bore 8 and 1.8 m in Bore 10.

- Borehole drilling using a Bobcat soil sampling and drilling rig and a mini-excavator (DP Project 34275.00 dated May 2011, Bores 1, 3 – 5 and 38 – 40). The Bores 1 and 3 – 5 were drilled using a 100 mm diameter spiral flight augers and rotary drilling techniques to depths in the range of 4.0 – 5.7 m. The boreholes were then extended into the underlying rock using NMLC (50 mm diameter core) diamond drilling equipment to termination depths of 8.8 – 10.0 m. Bores 38 – 40 were drilled using a 150 mm diameter spiral flight augers to depths of refusal in the range of 2.8 – 4.5 m.

The surface levels to Australian Height Datum (AHD) and coordinates to Map Grid of Australia (MGA Zone 56) shown on the DP's May 2011 borehole logs (with the exception of Bores 38 – 40) were determined using a differential GPS unit, for which an accuracy of ± 20 mm is typical. The surface levels shown on the logs for Bores 4, 38 and 39 (DP's May 2011) and DP's October 1998 borehole logs were interpolated from the survey drawings, whilst the borehole coordinates were measured from existing site features. Consequently, these levels should be considered approximate. The surface levels and coordinates shown on DP's August 1990 borehole logs were surveyed. The previous borehole locations are shown on Drawing 1 (Appendix A).

5. Field Work Results

The borehole logs are included in Appendix B, and should be read in conjunction with the accompanying standard notes defining classification methods and descriptive terms. Summary cross-sections are given on Drawings 2 – 5 (Appendix B). The succession of strata is broadly summarised as follows:

ASPHALT: 30 – 50 mm thick wearing course in Bores 101 – 105, 107, 108 and 114 – 116;

CONCRETE: 370 – 550 mm thick concrete pavement in Bores 106 – 108;

TOPSOIL: Clayey silt topsoil filling to depths of 0.1 – 0.3 m in Bores 109 – 113;

FILLING: Crushed sandstone roadbase filling to depths of 0.3 – 0.6 m in Bores 101 – 105, 108 and 114 – 116 and silty clay filling to depths of 1.8 – 1.9 m in Bores 114 and 115;

CLAY: Generally very stiff to hard silty clay encountered to depths ranging from 0.3 – 4.0 m in Bores 108, 112, 114 and 115;

BEDROCK: Siltstone directly underlies the clays and filling at depths of 0.1 – 4.0 m, initially very low up to low strength and grading to medium and high strength to the termination depths ranging from 1.0 – 23.0 m in all boreholes. 'TC' bit refusal in low to medium strength siltstone was encountered in Bores 107 – 109, 111, 112, 115 and 118 at depths of 1.0 – 5.0 m. The fracture spacings shown on the recovered core ranged from 'fragmented' to 'unbroken' (fracture spacings of 20 – 1000 mm). The core was characterised by a 'fractured zone' of approximately 4 – 5 m (but 8 m towards the north of the site) then grading towards 'slightly fractured to unbroken' (fracture spacings approximately 200 mm to 1,000 mm). The cored borehole logs indicate that the rock structure is mainly governed by horizontal to sub-horizontal (0º – 10º) bedding and moderately to steeply-inclined (30° – 90°) jointing.

The resulting rock classifications for the cored boreholes (in accordance with Ref 2) as well as estimated classifications for the non-cored boreholes, including their corresponding Reduced Levels (RL – mAHD) are summarised in Tables 1 and 2.

Table 1: Summary of Rock Class Levels – CSB and CTC Buildings

Bore No.	Surface RL (mAHD)	Rock Levels (Top of Layer)							
		Class V Shale		Class IV Shale		Class III Shale		Class II Shale	
		Depth (m)	RL (m)	Depth (m)	RL (m)	Depth (m)	RL (m)	Depth (m)	RL (m)
Clinical Services Building									
101	95.7	-	-	0.3	95.4	4.7	91.0	8.5	87.2
102	94.7	-	-	0.3(3)	94.4(3)	-	-	-	-
103	93.3	-	-	0.3	93.0	-	-	4.5	88.8
104	92.0	-	-	0.4(3)	91.6(3)	-	-	-	-
105	87.4	-	-	0.3	87.1	2.6	84.8	4.6	82.8
106	87.5	0.4	87.1	-	-	1.2(1)	86.3(1)	3.7	83.8
107	91.6	-	-	0.5(3)	91.1(3)	-	-	-	-
108	92.8	-	-	1.5(3)	91.3(3)	-	-	-	-
109	84.7	-	-	0.1(3)	84.6(3)	-	-	-	-
110	85.1	-	-	0.1	85.0	3.0	82.1	4.1	81.0
111	83.8	-	-	0.1(3)	83.7(3)	-	-	-	-
113	83.5	-	-	0.3	83.2	2.6	80.9	3.6	79.9
116	96.1	-	-	0.3	95.8	2.7	93.4	7.9	88.2
118	100.9	-	-	0.4(3)	100.5(3)	-	-	-	-
3(5)	87.5	1.2	86.3	2.2(3)	85.3(3)	-	-	-	-
4(5)	86.5	1.3	85.2	2.1(3)	84.4(3)	-	-	-	-
6(5)	87.0	2.8	84.2	3.9(3)	83.1(3)	-	-	-	-
Cancer Treatment Centre									
114	81.9	-	-	4.0	77.9	-	-	10.0	71.9
115	82.3	-	-	2.5(3)	79.8(3)	-	-	-	-
38(4)	83.0	0.8	82.2	1.6(3)	81.4(3)	-	-	-	-
39(4)	82.5	2.6(3)	79.9(3)	-	-	-	-	-	-
40(4)	81.9	-	-	2.8(3)	79.1(3)	-	-	-	-
7(5)	79.0	-	-	1.1(3)	77.9(3)	-	-	-	-

Note (1) Underlain by Class V rock band;
(2) Underlain by Class III rock band;
(3) Siltstone minimum requirements: very low to low strength;
(4) Project 34275
(5) Project 22884-1
(6) Project 14060

Table 2: Summary of Rock Class Levels – Link Building and Pedestrian Link

Bore No.	Surface RL (mAHD)	Rock Levels (Top of Layer)							
		Class V Shale		Class IV Shale		Class III Shale		Class II Shale	
		Depth (m)	RL (m)	Depth (m)	RL (m)	Depth (m)	RL (m)	Depth (m)	RL (m)
Link Building									
111	83.8	-	-	0.1(3)	83.7(3)	-	-	-	-
112	83.6	-	-	2.0(3)	81.6(3)	-	-	-	-
113	83.5	-	-	0.3	83.2	2.6	80.9	3.6	79.9
1(4)	81.9	4.9	77.0	5.6	76.3	7.7	74.2	8.3	73.6
4(4)	83.1	4.5	78.6	4.8(1)	78.3(1)	7.8	75.3	6.5(2)	76.6(2)
5(4)	82.1	4.9	77.2	5.8	76.3	7.2	74.9	8.5	73.6
5(5)	83.0	2.8	80.2	4.7(3)	78.3(3)	-	-	-	-
6(5)	87.0	2.8	84.2	3.9(3)	83.1(3)	-	-	-	-
10(5)	80.5	0.8	79.7	1.8(3)	78.7(3)	-	-	-	-
3(6)	77.9	1.3	76.6	2.2(3)	75.7(3)	-	-	-	-
4(6)	80.3	0.9	79.4	1.6(3)	78.7(3)	-	-	-	-
5(6)	79.3	0.6	78.7	1.7(3)	77.6(3)	-	-	-	-
Pedestrian Link									
103	93.3	-	-	0.3	93.0	-	-	4.5	88.8
104	92.0	-	-	0.4(3)	91.6(3)	-	-	-	-
105	87.4	-	-	0.3	87.1	2.6	84.8	4.6	82.8
114	81.9	-	-	4.0	77.9	-	-	10.0	71.9
115	82.3	-	-	2.5(3)	79.8(3)	-	-	-	-
38(4)	83.0	0.8	82.2	1.6(3)	81.4(3)	-	-	-	-
39(4)	82.5	2.6(3)	79.9(3)	-	-	-	-	-	-
40(4)	81.9	-	-	2.8(3)	79.1(3)	-	-	-	-
1(5)	83.0			8.4(3)	74.6(3)				
2(5)	86.9	4.0	82.9	5.7(3)	81.2(3)				
3(5)	87.5	1.2	86.3	2.2(3)	85.3(3)				

Note (1) Underlain by Class V rock band;
(2) Underlain by Class III rock band;
(3) Siltstone minimum requirements: very low to low strength;
(4) Project 34275
(5) Project 22884-1
(6) Project 14060

6. Groundwater

No free groundwater was observed in the current or previous boreholes during augering or for the short time that they were left open. The introduction of water into the cored boreholes during rotary coring and the immediate backfilling of the boreholes precluded further monitoring of any groundwater levels that might be present.

During DP's May 2011 investigation, piezometers were installed in Bores 1 and 3. Groundwater depth measurements were taken approximately 4 days after installation (22 March 2011) and measured 6.8 m (RL 75.1) in Bore 1 and 3.6 m (RL 76.1) in Bore 3. No measurements have been made since March 2011.

During DP's August 1998 investigation, piezometers were installed in Bores 1, 3, 5 and 6. Groundwater depth measurements were taken during the period of 8 – 21 September 1998 and measured 4.1 – 5.2 m (RL 77.8 – 78.9) in Bore 1, 5.7 – 6.8 m (RL 80.7 – 81.8) in Bore 3, 6.6 – 6.7 m (RL 76.3 – 76.4) in Bore 5 and 3.2 – 6.6 m (RL 80.9 – 84.3) in Bore 6.

Groundwater levels are transient and subject to seasonal variations, soil permeability and preceding climatic conditions. The results of groundwater level monitoring are given in Appendix B (Table B1: Summary Table – Groundwater Levels).

7. Laboratory Testing

7.1 Mechanical Testing

Selected samples from the boreholes were tested in the laboratory for measurement of field moisture content, Atterberg limits, shrink-swell, California bearing ratio (CBR) and point load strength index testing. The detailed test report sheets are given in Appendix C and summarised below.

Table 3: Summary of Test Results – Atterberg Limits

Bore No.	Depth (m)	W_F (%)	W_L (%)	W_P (%)	PI (%)	LS (%)	I_{ss} (%/ΔpF)	Material
114	1.00 – 1.45	13.0	40	19	21	11.0	-	Clayey fill
115	1.00 – 1.45	14.4	39	20	19	9.0	-	Silty clay
16[(1)]	0.6 – 0.9	23.8	-	-	-	-	1.4	Silty clay

Where W_F = Field moisture content, W_P = Plastic limit, W_L = Liquid limit, PI = Plasticity Index, LS = Linear shrinkage, I_{ss} = Shrink-swell index

Notes: (1) Project 22884-1

The results indicate that the natural silty clay and clayey fill samples tested are of intermediate plasticity and would be susceptible to shrinkage and swelling movements resulting from changes in soil moisture content.

The CBR samples were compacted to nominally 100% dry density ratio relative to Standard compaction at approximately optimum moisture content and then soaked for four days under surcharge loadings of 4.5 kg. The results of the field moisture content tests listed in Table 4 indicate the proposed subgrade soils at the time of the sampling ranged between approximately 1.2% dry to 2.4% wet of standard optimum moisture content.

Table 4: Summary of Test Results – California Bearing Ratio (CBR)

Bore No	Depth (m)	W_F (%)	OMC (%)	MDD (t/m3)	Swell (%)	CBR (%)	Material
109	0.3 – 0.5	6.8	8.0	1.88	2.5	3.0	Siltstone
7(1)	0.5 – 1.0	22.3	19.9	1.68	-	3.5	Clay
8(1)	0.5 – 1.0	23.2	21.1	1.62	-	5	Clayey Fill
9(1)	0.5 – 1.0	18.9	18.7	1.74	-	6	Clay
10(1)	0.5 – 1.0	11.6	12.0	1.90	-	2.0	Clay and Shale
11(1)	0.5 – 1.0	22.3	21.6	1.67	-	8	Silty Clay
12(1)	0.5 – 1.0	13.0	13.3	1.92	-	6	Silty Clay Fill
16(1)	0.5 – 1.0	15.8	15.8	1.79	-	9	Silty Clay

Where W_F = Field moisture content OMC = Optimum moisture content
MDD = Maximum dry density CBR = California bearing ratio
Notes: (1) Project 22884-1 (October 1998)

Point load index ($Is_{[50]}$) tests were carried out on selected samples of the rock core and the results of these tests are given on the borehole logs. The results indicate rock strength ranging from very low strength to high strength with inferred unconfined compressive strengths (UCS) in the range 1 – 48 MPa using a UCS:$Is_{[50]}$ correlation factor of 20.

7.2 Aggressivity Testing

Selected samples from the boreholes were tested in the laboratory for measurement of pH, sulphates, chlorides and electrical conductivity. The detailed test report sheets and aggressivity table (Table C1) are given in Appendix C summarised below.

Twenty-seven samples were tested with pH results in the range 5.1 – 9.7 (average 8.3) and electrical conductivity in the range 74 – 370 µS/cm (average 128 µS/cm). Seven samples were tested with chloride results in the range 10 – 420 mg/kg (average 121 mg/kg) and nine samples were tested with sulphate results in the range 10 – 61 mg/kg (average 24 mg/kg).

The exposure classification for concrete and steel piles was determined in accordance with AS 2159 – 1996 (Ref 3) which indicates the soils tested would be classified as *"mildly aggressive"* to concrete and *"non-aggressive"* to steel.

8. Proposed Development

The comments provided herein are based on the nominal foundation and excavation depths shown on the conceptual building cross-sections prepared by Billard Leece Partners (refer Appendix A) and the preliminary column loads as advised by Enstruct, consulting engineers. As such, the advice given within must be considered as preliminary and will need to be reassessed once the design progresses.

Based on the conceptual design drawings provided the proposed development comprises the construction of a multi-storey clinical service building (CSB), expansion of the existing cancer treatment centre (CTC) and construction of several link structures. Although structural design is in the early stages, DP was advised that the CSB is expected to have 15 MN working column loads. Although no information was available for the CTC or link buildings, it is expected that column loads of the order of 1,000 – 2,000 kN would be likely for these structures. It is expected that excavation for the CSB and CTC will necessitate cuts of up to approximately 14 m and 5 – 6 m, respectively, to achieve the finished floor level (FFL) of each structure (RLs 82.3 m AHD and 78.0 m AHD).

Demolition of the existing buildings and pavements within the footprint of the proposed buildings will be undertaken as part of site preparation works. The extent of works is shown in Figure 1 with sections and elevations included in Appendix A.

Figure 1 shows the extent of the proposed demolition and construction of new hospital facilities, shown in purple, whilst the yellow area will form the proposed pedestrian transport corridor.

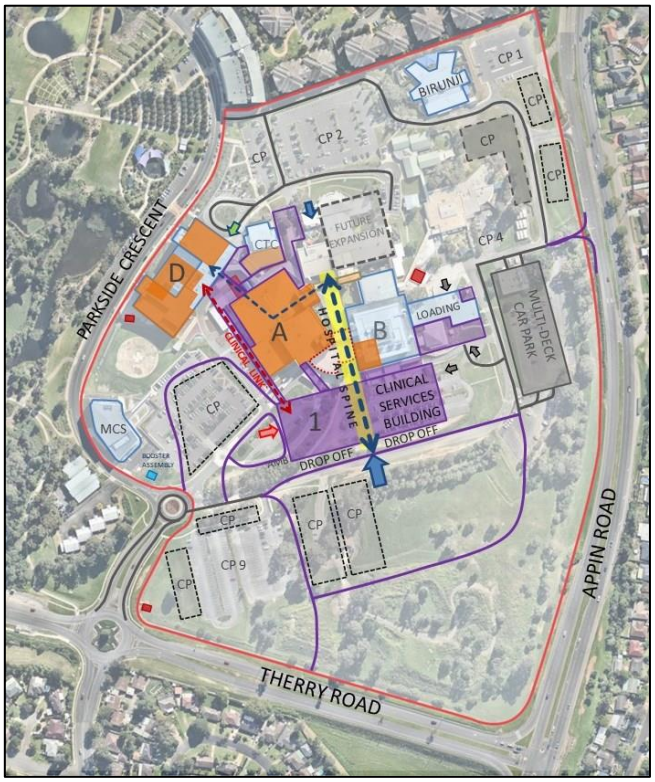

Figure 1: Location of site structures to be demolished and rebuilt (purple) or renovated (orange)

9. Comments

9.1 General

The following comments are based on the results of previous and current investigations to assist in the preliminary design of foundations, excavations and retention. As detailed design of the proposed redevelopment works has not been undertaken, the comments given must also be considered as being preliminary. Once further details are available, they should be forwarded to DP for review to assess the appropriateness or otherwise of comments given within.

9.2 Earthquake Actions – Sub-soil Class

The overall site stratigraphy comprises pavements, filling or topsoil underlain by stiff to hard silty clays, overlying bedrock at depths less than 10 m.

The proposed CSB and CTC structures will be founded on the bedrock based on the proposed bulk excavation levels. The sub-soil class for these structures, when assessed in accordance with AS 1170.4 – 2007 (Ref 4), is considered a rock site and a classification of Class B_e is suggested.

As the link structures don't have defined bulk excavation levels as yet, and the link building located between Buildings A and D will have a bulk excavation level at close to current levels over filling and soils to depths of approximately 4 – 5 m. Therefore, the sub-soil class for these areas, when assessed in accordance with AS 1170.4 – 2007 (Ref 4), is considered a shallow soil site and a classification of Class C_e is suggested.

9.3 Excavation

Excavation for the proposed CSB basement will necessitate cuts of up to approximately 14 m to achieve a basement floor level at RL 82.3. Excavation for the proposed CTC basement will necessitate cuts of up to approximately 6 m to achieve a basement floor level at RL 78.0. The link building (between Buildings A and D) will have a FFL of approximately RL 83.7 (at about current ground level) and, as such, is likely to require cuts of less than 1 m. No preliminary information was available regarding the FFL of the pedestrian link and, as such, it is assumed that this area is approximately at current levels with no excavation required.

9.3.1 Clinical Services Building

Within the 14 m depth of excavation, a wide range of materials will be encountered (refer Drawings 2 – 5 in Appendix A) and will initially comprise AC wearing course, concrete pavements (to depths of 0.4 – 0.6 m in the vicinity of Bores 106 – 108), and filling (to depths of 0.1 – 0.3 m in the vicinity of Bores 101 – 111, 113, 116 and 118), overlying very stiff to hard clay (to depths of 1.5 m and 2.0 m in the vicinity of Bores 108 and 112 respectively).

The methods used in the drilling of the bores provide an indication and guide to the excavatability of the materials to be removed in bulk. Following demolition of concrete pavements, topsoil, existing asphalt, filling, natural soils and bedrock up to very low to low strength should be readily removed using a conventional medium sized dozer or excavator fitted with a toothed bucket possibly with some light ripping in the weathered bedrock. These conditions were generally encountered to depths

ranging between 0.5 m (in the vicinity of Bore 105) to 4.5 m (in the vicinity of Bore 103). Below these depths though, bulk excavation will be in low and medium strength siltstone to depths ranging between 1.2 m (in the vicinity of Bore 113) to 12.1 m (in the vicinity of Bore 116) and will likely require medium to heavy ripping (D8 – D9 or equivalent), rock sawing, rock grinding and/or rock breaking equipment to assist in bulk removal, with potential for low production rates. The underlying medium to high strength siltstone will likely require heavy ripping (D10 – D11, or alternatively 45 – 80 tonne excavators using 5 or 8 tonne hammers), rock sawing and/or rock grinding to assist in bulk removal, with potential for very low production rates. These conditions are expected to be encountered in the vicinity of Bores 101, 103, 106 and 116.

9.3.2 Cancer Treatment Centre

Within the 6 m depth of excavation, a wide range of materials will be encountered comprising filling (to depths of 1.9 – 2.6 m), overlying very stiff to hard clay (to depths of 2.8 – 4.0 m) then low strength shale.

The methods used in the drilling of the bores provide an indication and guide to the excavatability of the materials to be removed in bulk. Topsoil, existing asphalt, filling, natural soils and bedrock up to very low to low strength should be readily removed using a conventional medium sized dozer or excavator fitted with a toothed bucket possibly with some light ripping in the weathered bedrock. These conditions were generally encountered to depths ranging between 2.6 m (in the vicinity of Bore 39) and 5.6 m (in the vicinity of Bore 114). Bulk excavation to depths ranging between 3.9 m (in the vicinity of Bore 40) and 4.5 m (in the vicinity of Bore 39) will encounter low strength siltstone which is likely require light to medium ripping (D7 – D8 or equivalent), rock sawing, rock grinding and/or rock breaking equipment to assist in bulk removal.

9.3.3 General

The presence of the existing structures in the immediate vicinity of the excavation areas will need to be considered in assessing suitable excavation equipment, as the noise and ground vibration resulting from the excavation may cause damage to sensitive medical equipment, the underground services or other infrastructure. An assessment of vibration must be undertaken before work begins in selecting appropriate equipment. As the work will be undertaken within 20 m of what are likely vibration-sensitive structures, vibration trials must be undertaken prior to construction. If the monitoring indicates unacceptable levels of vibration, then the use of non-percussive (i.e. rock sawing and ripping) excavation methods will be required. This requirement, however, will need to be determined once the details of the bulk earthworks and proposed excavation equipment are known. Further information regarding excavation induced vibrations is provided in Section 9.5. Notwithstanding the above, vibration monitoring will also be required during construction.

Assessment of excavation difficulties however, is best determined by intending contractors based on inspection of core samples, consideration of the equipment they have at their disposal and the experience of the operators.

9.4 Groundwater Inflow into Excavation

There is potential for groundwater inflow into the excavation through open bedding planes or joints in the bedrock or along the residual soil/bedrock interface as indicated by standing water levels at around RL 76.3 – 84.3 (Bores 3, 5 and 6 during the period 8 – 21 September 1998) in the vicinity of the CSB which will have a bulk excavation level of RL 82.3 and RL 77.4 – 78.9 (Bore 1 during the period

8 – 21 September 1998) in the vicinity of the CTC which will have a bulk excavation level of RL 78.0. It is noted that groundwater levels can fluctuate with seasonal climatic changes and variability in the permeability of the subsurface strata.

Whilst the extent of groundwater inflow would be dependent on prior weather conditions, short-term inflow rates through the rock would be expected to be controlled from sumps within the excavation. In the longer-term, however, given the depth of the basement, the requirements for drainage behind perimeter walls (including any shotcrete walls) and under-floor drainage will need to be included. These could include discharge via a permanent pump system to stormwater or sewer, subject to confirmation of inflow rates and approval by the regulator or tanking of the basement. It is suggested however that the final design also takes into account observations of inflow during excavation.

9.5 Vibrations Induced by Excavation Plant

The proposed excavation areas of the CSB and CTC structures (refer Drawing 1) will adjoin existing hospital structures at several locations. Vibration and noise associated with rock excavation, particularly the use of rock hammers, may be unacceptable to patients, staff, vibration-sensitive equipment or other structures and operating restrictions are likely to be required. It is recommended that dilapidation (condition) surveys be carried out on adjoining structures and other nearby structures that potentially may be susceptible to vibration damage.

During excavation, it will be necessary to use methods and equipment to keep ground vibrations at adjacent buildings within acceptable limits. There are three aspects of vibrations which need to be assessed; effects on structures; effects of architectural finishes; and effects on humans.

From current information it is considered that the structures adjacent to the site can withstand vibration levels higher than those required to maintain the comfort of their occupants. A human comfort criterion is therefore indicated and the vector sum peak particle velocity (VSPPV) is proposed as the control parameter. It is recommended that a Provisional Allowed Vibration Limit of 8.0 mm/sec (VSPPV) be set during normal working hours, at foundation level of the potentially affected building/s. It is noted that if vibration-sensitive equipment are located immediately adjacent the excavation, then a reduced limit of 5.0 mm/sec may be appropriate. Additional guidelines considered appropriate for management of ground vibrations generated by the proposed works are given in Appendix D.

DP maintains a database of vibration trial results (generally VSPPV versus distance) which can provide guidance for the selection of plant. Trial data is dependent on site conditions and equipment, hence actual vibration levels may differ from predictions and a specific trial is recommended at the commencement of rock excavation. The database suggests buffer distance ranges, such as those shown for selected plant in Table 5 which should be maintained between excavation plant and adjacent buildings. These estimates should be examined in relation to the distances between adjacent buildings and the proposed excavation footprint, in order to select suitable plant.

Table 5: Approximate Buffer Distances for Selected Plant (Provisional Allowed Limit 8 mm/s)

Excavation Plant	Distance from plant by which vibration would attenuate to the Provisional Allowed Limit	
	From DP trial maxima [1]	From DP trial averages
Rock Saw on Excavator [2]	1 m	0.6 m
Ripper on 6 – 36 t Excavators	3 m	1.2 m
Rock Hammer <500 kg operating weight	7 m	3.0 m
Rock Hammer 501 – 1000 kg operating weight	8 m	3.3 m
Rock Hammer 1001 – 2000 kg operating weight	13 m	5.2 m
Rock Hammer > 2000 kg operating weight	7 m	4.9 m

Note: (1) Smaller distances can generally be determined from individual trials, as indicated by those from trial averages;
(2) Buffer distances for rock hammers may be reduced by prior saw cutting along, or parallel to, excavation boundaries;
(3) Loading effects from adjacent buildings may reduce vibration levels, to enable boundary saw cuts with few exceedances.

It is noted that people may find vibration levels above about 3 – 5 mm/s as being strongly perceptible to disturbing, even though they may not cause structural damage to structures. Hence, complaints from neighbours are possible and some reassurance, possibly by vibration monitoring, is likely to be necessary. Consequently, the excavation process should include:

- Notification of neighbouring occupiers of the proposed timing of the excavation so that any vibration sensitive items can be secured;
- Excavation of loose or rippable blocks by bucket or single tyne attachments prior to commencement of rock hammering;
- Progressive breakage from open excavated faces;
- Use of rock hammers in short bursts to prevent generation of resonant frequencies;
- The movement of large blocks away from the structures prior to breaking up for transport from site;
- Commencement of excavation as far away from other structures as possible and monitor vibration whilst working towards these buildings;
- The use of rock sawing or grinding equipment adjacent to the site boundaries, noting that this equipment also reduces impact damage, overbreak and loosening of the rock mass, typically resulting in reduced requirement for rock support measures.

Given the possible vibration sensitivity of parts of the site, further work is needed prior to work starting to determine appropriate excavation equipment and methodology. This would involve trials of different equipment types, excavation methods and the allowable proximity to the neighbouring structures these options can be utilised.

9.6 Disposal of Excavated Materials

Under the Protection of the Environment Operation Act (1997), the burden of proof that materials received by a landfill or fill site meet the environmental criteria for proposed land use rests on the waste/fill receiving site. This includes Virgin Excavated Natural Materials (VENM), such as will be removed below the filling from this site. Accordingly, environmental testing may need to be carried out

to classify the spoil. The type and extent of testing undertaken would depend on final use or destination of the spoil and requirements of the receiving site. As a minimum, allowance should be made during bulk excavation to stockpile fill materials separately from the underlying residential soils, to enable the best possible waste classification of the natural soils/rock to be achieved. Reference must be made to DP's Detailed Site Investigation (Project 34275.09) for further details relating to disposal of excavated materials.

9.7 Batter Slopes

Conceptual design drawings indicate the excavation for the proposed CSB building would be battered along the upper 7 – 8 m of its southern edge (based on conceptual elevation drawings) where space permits within the bulk excavation area. As such, the batters could be constructed to the slopes suggested in Table 6.

Table 6: Suggested Batter Slopes

Material	Temporary	Permanent
Stiff to hard clay, extremely weathered shale and compacted filling	1H:1V	2H:1V
Very low to low strength rock	0.75H:1V	1H:1V*
Medium or greater strength rock	Vertical*	0.25H:1V*

* These batter slope angles are subject to inspection by a qualified geotechnical engineer or engineering geologist.

Where batters greater than 4 m in height are required, the inclusion of a 3 m wide intermediate bench every 4 m in height is recommended to reduce the effects of scour and erosion. The indicative batter slopes in rock in Table 6 are largely dependent on joint orientation and would be subject to verification after an inspection by a qualified engineering geologist during the excavation process.

As shale cut faces are likely to fret and have blocks loosen over time when exposed to weathering, maintenance of long-term batters will include periodic cleaning of debris which may block any toe drains. As such, this will require the acceptance of periodic maintenance by the site owner and operator. Alternatively, a 50 mm thick shotcrete lining could be applied to minimise the need for any long term maintenance.

Where the slopes are to be vegetated to prevent erosion, a maximum final batter slope of 3(H):1(V) is recommended.

9.8 Excavation Support

9.8.1 Clinical Services Building

The proposed CSB basement footprint will be located within the existing on-grade southern carpark adjacent the southern edge of Building B. This northern edge of the proposed CSB basement will require up to approximately 5.0 – 7.5 m and will be constructed directly adjacent Building B, whilst the southern edge of the CSB basement will require excavations in the order of 14 m. Given the proximity

to Building B the northern edge of the CSB will require full-depth vertical cuts, however, the southern edge of the CSB basement is to be supported by 6 – 7 m of vertical cuts, with the upper 7 – 8 m of cut being battered where space permits.

Figure 2 shows the conceptual western elevation of the CTC link structure and CSB

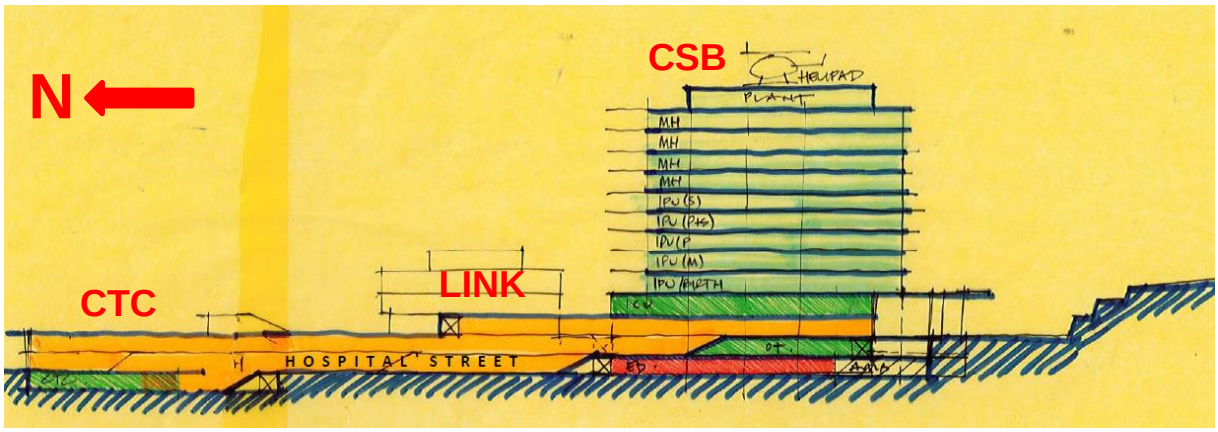

Figure 2: Conceptual western elevation (CTC at northern end and CSB at southern end)

The design of shoring will need to take account of the lateral loads due to adjacent structures. Where adjacent structures are within the zone of influence of the excavation (which will be the case along the northern boundary), it will be necessary to establish the nature and founding levels of the footings to the adjacent buildings to determine underpinning requirements (if any) and to ensure that an appropriate construction methodology is established. Feasible options would include either anchored soldier piles (drilled at maximum 2.4 m spacings) with close shuttering/shotcrete infill panels or anchored contiguous piling. In the absence of details of adjacent footings being available, contiguous piling must be allowed for adjacent to neighbouring buildings.

Excavation of panels for shotcreting should be staged to allow a hit and miss alternate approach with the first panel extending no more than 1.0 m below the base of the adjacent building foundation, including the reinforcement overlap. The next row of panels should not exceed 1.5 m with subsequent panels not exceeding 2 m in height. Drainage behind all permanent linings will be required to ensure long-term dissipation of groundwater pressures and could include vertical drainage strips at maximum 2 m horizontal spacing's. The sprayed concrete wall should provide adequate structural support, however installation of a false wall (single brickwork or block work) could be considered for aesthetic purposes and to avoid dampness.

Care should be exercised in construction to ensure that anchors are installed progressively with excavation (and stressed up) and that the shotcreting is carried out at regular intervals to limit the exposed sections. The first row of anchors should be installed as high as possible and stressed up to 80% of its working load prior to excavation of the next row of panels.

Where piers have been included within the retaining wall design and are to provide support to adjacent boundaries and structures, anchoring will be required as a cantilever system may not prove to be sufficiently rigid to avoid surface (lateral) deflections. A high torque piling rig will be required to penetrate the medium and high strength rock. Where piers refuse in the medium or high strength rock above the excavation levels (possibly RL 84.9 – 88.8 in the vicinity of Bores 101, 103, 105, 106, 110 and 116) additional anchors will need to be installed in the toe of each pier to provide lateral toe support.

As a result of predominantly moderately to steeply-inclined jointing and potential for 'wedge-type' failures within the batters, allowance will also need to be made for the support of the fractured rock where contiguous walling is not installed. As the support requirements will depend on a number of factors including extent of disturbance during excavation, orientation (bearing), persistence (lateral continuity) and spacing (horizontal separation) of jointing, clay infilling of open jointing and groundwater, detailed design can only be undertaken following inspection of the excavated faces at every 1 m to 2 m of drop in the excavation level.

As a guide, in addition to the soldier piles, preliminary design of infilled panel sections should allow for the application of a steel mesh-reinforced shotcrete layer with a minimum nominal thickness of 150 mm where permanent support is required or 75 mm for temporary support. The installation of a grid of rock bolts of nominal 1.5 m spacing (vertically and horizontally) will also be a likely requirement as the 'fractured zone' is expected to extend depths of 3 – 5 m along the northern boundary and 1 – 2 m along the southern boundary.

Due to the slightly fractured nature of the remaining rock stratum, the installation of a rock bolts will likely take the form of spot bolting based on inspections carried out by an engineering geologist. The final required bolt lengths can only be determined following assessment of fracture characteristics observed in the face. The fractured, medium and high strength siltstone may also be self-supporting provided that all inclined jointing is tight and free of clay infilling.

Where a 'wet-wall' is proposed within the underlying massive siltstone (i.e.: no lining), allowance will need to be made for the inclusion of a toe-drain to collect and discharge seepage to the sump and pump system. Furthermore, as on-going fretting of the face will occur, the requirement for periodic maintenance of the face and clearing out of loose debris from the toe drains must be accepted. Allowance must be made in the design detail to the provision of shotcrete facing in conjunction with drainage to protect the face from ongoing erosion will be required. It is noted however, that the feasibility of a 'wet-wall' is best determined on site during inspection of the cut face by an experienced engineering geologist.

9.8.2 Cancer Treatment Centre

Within the excavation, a wide range of materials will be encountered comprising filling (to depths of 1.9 – 2.6 m), overlying very stiff to hard clay (to depths of 2.8 – 4.0 m) then low strength shale. The soils exposed in cut to depths ranging from approximately 5 – 6 m will not be able to stand vertically without support over extended periods of time.

As excavation is expected to extend to the existing structures to the south, east and west (precluding batters) either temporary shoring or the progressive construction of permanent walls designed to shore up the boundaries will be necessary. There is also potential for progressive collapse of the filling and clay, and therefore no excavation is to be left unsupported.

The design of shoring will need to take account of the lateral loads due to adjacent structures. Where adjacent structures are within the zone of influence of the excavation (which is likely the case along all but the northern boundary), it will be necessary to establish the nature and founding levels of the footings to the adjacent buildings to determine underpinning requirements (if any) and to ensure that an appropriate construction methodology is established. Feasible options would include either anchored soldier piles (drilled at maximum 2.4 m spacing's) with close shuttering/shotcrete infill panels or contiguous piling. In the absence of details of adjacent footings being available, contiguous piling must be allowed for adjacent to neighbouring buildings.

Excavation of panels for shotcreting should be staged to allow a hit and miss approach with the first panel extending no more than 1 m below the base of the adjacent building foundation, including the reinforcement overlap. The next row of panels should not exceed 1.5 m with subsequent panels not exceeding 2 m in height. Drainage behind all permanent linings will be required to ensure long-term dissipation of groundwater pressures and could include vertical drainage strips at maximum 2 m horizontal spacing's. The sprayed concrete wall should provide adequate structural support, however installation of a false wall (single brickwork or block work) could be considered for aesthetic purposes and to avoid dampness.

Care should be exercised in construction to ensure that anchors are installed progressively with excavation (and stressed up) and that the shotcreting is carried out at regular intervals to limit the exposed sections. The first row of anchors should be installed as high as possible and stressed up to 80% of its working load prior to excavation of the next row of panels.

Where piers have been included within the retaining wall design and are to provide support to adjacent boundaries and structures, anchoring will be required as a cantilever system may not prove to be sufficiently rigid to avoid surface (lateral) deflections.

As a result of predominantly moderately to steeply-inclined jointing and potential for 'wedge-type' failures within the batters, allowance will also need to be made for the support of the fractured rock where contiguous walling is not installed. As the support requirements will depend on a number of factors including extent of disturbance during excavation, orientation (bearing), persistence (lateral continuity) and spacing (horizontal separation) of jointing, clay infilling of open jointing and groundwater, detailed design can only be undertaken following inspection of the excavated faces at every 1 m to 2 m of drop in the excavation level.

As a guide, in addition to the soldier piles, preliminary design of infilled panel sections should allow for the application of a steel mesh-reinforced shotcrete layer with a minimum nominal thickness of 150 mm where permanent support is required or 75 mm for temporary support. The installation of a grid of rock bolts of nominal 1.5 m spacing (vertically and horizontally) will also be a likely requirement as the 'fractured zone' is expected to extend the full depth (5 – 6 m) of excavation below the overlying soils. If soldier piers refuse in the medium or high strength rock above the excavation levels additional anchors will need to be installed in the toe of each pier to provide lateral toe support.

9.9 Anchor Design

The anchoring of soldier or contiguous piles may be achieved by pre-stressed type anchors. It is suggested that these be inclined as steeply as possible, but not exceeding 30°, to allow anchoring in the stronger rock. The design of temporary anchors for support of piled wall systems be carried out on the basis of the ultimate bond stresses given in Table 7.

Table 7: Bond Stresses for Anchor Design

Material	Rock Class	Maximum Ultimate Average Bond Stress[1,2] (τ_{ult}, kPa)
Very stiff clay	-	50
Very low strength siltstone	V	100
Low strength siltstone	IV	300
Medium strength siltstone	III	1,000
High strength siltstone	II	3,000

Notes: (1) Values are for straight shaft boreholes;
(2) Ultimate values with no reduction factor.

Reference should be made to Table 1 with respect to the depths and reduced levels of the various grades of rock in the individual boreholes.

Ground anchors should be designed to have a free length at least equal to their height above the base of the excavation and provide a minimum 3 m bond length beyond the line of a possible 45° dipping joint paralleling the face to be anchored. Where anchor inclination must be increased to provide appropriate bond conditions, the anchor capacity should be increased as shown in Table 8.

Table 8: Increased Capacity Requirements for Steeper Anchors

Angle of Installation (below horizontal)	Required Percentage Increase in Capacity
10^o	0%
15^o	5%
20^o	14%
25^o	22%

Ultimately, it is the contractor's responsibility to ensure that appropriate design values (specific to the anchor system and method of installation) are used and that the anchor holes are cleaned out prior to grouting. After anchors have been installed, it is recommended that they be tested to 125% of nominal working load and then locked off at between 60% and 80% of their working loads and 100% of the working load for 'at rest' pressure conditions. Checks should be carried out, however, to ensure that the load is maintained in the anchors throughout the construction period and is not lost due to creep effects or to other causes.

The parameters given above can only be safely adopted on the condition that anchor holes are clean and adequately flushed, with grouting and other installation procedures carried out carefully in accordance with normal, good anchoring practice.

In normal circumstances, the building will restrain the basement excavation over the long-term and therefore ground anchors are expected to be temporary only. The use of permanent anchors would generally require careful attention to corrosion protection. Further advice on design and specification should be sought from the geotechnical engineer if permanent anchors are to be employed at this site.

9.10 Retaining Structures

Earth pressures acting on multi-anchored shoring structures and retaining walls can be estimated on the basis of a trapezoidal pressure distribution (i.e. triangular to 0.25 H, uniform from 0.25 H to 0.75 H and triangular decreasing to zero from 0.75 H to H) with depth using appropriate values of unit weight and active (K_a) or 'at rest' (K_0) earth pressure coefficients as set out in Table 9. Further guidance on earth pressure estimation is given in Appendix E.

Table 9: Suggested Lateral Earth Pressure Design Parameters – Retaining Structures

Retained Material	Bulk Density (kN/m^3)	K_0 (1)	K_p (1)	K_a (1)	
				Short Term	Long Term
Filling, clay and extremely weathered rock	20	0.6	2	0.25	0.3
Very low strength siltstone	22	0.4	400 kPa	0.2	0.25
Medium strength siltstone	22	-	4,000 kPa	10 kPa (2)	10 kPa (2)

Notes: (1) Ultimate values with no reduction factor.

(2) A uniform pressure of 10 kPa should be adopted for the support of the medium to high strength sandstone to account for possible defects, but subject to inspection during the early stages of excavation to confirm bedding/jointing and revision of lateral restraint, if appropriate.

'At rest' pressure coefficients are appropriate where movement intolerant services or adjacent structures are present. Note that surcharge lateral pressure due to the adjacent building footings will also need to be taken into account where these footings found on low strength or weaker rock and where unfavourably orientated jointing underlies the footings of the adjacent buildings.

Where appropriate, lateral restraint may also be developed by embedding piles below the base of the excavation developing passive pressure. Suggested ultimate passive resistance values given in Table 9 may be adopted below one pile diameter beneath the bulk excavation level and should incorporate a factor of safety to limit wall movement.

Where soldier piles terminate above the bulk excavation level or found on rock benches, allowance must be made for an end bearing pressure reduction factor of 0.5. It is noted however, that stability will be governed primarily by rock jointing (spacing and orientation) and as such, detailed inspection must be undertaken by an engineering geologist or geotechnical engineer during excavation to assess the additional requirement for anchor/support measures in weathered or fractured zones below the pile.

If a drainage medium is not provided behind retaining walls, then full hydrostatic pressures must be incorporated within the design with soil parameters reduced to their buoyant values.

9.11 Foundations

9.11.1 Design Parameters

Based on the results of the field investigation and laboratory testing, building footings and retaining wall footings could be proportioned using the maximum design parameters presented in Table 10. The footing recommendations and design parameters for any given strata will need to be confirmed following the completion of design stage when the final excavation depth and design loads are known, however, Sections 9.11.2 to 9.11.5 provide preliminary comment on likely foundation conditions at each of the proposed structures.

Table 10: Estimated Design Parameters

Material	Ultimate Base Bearing Pressures (kPa) (1)	Ultimate Shaft Adhesion Pressures (kPa) (2)	Allowable Base Bearing Pressures (kPa) (3)	Allowable Shaft Adhesion Pressures (kPa)	Allowable Lateral Resistance (kPa)
Class V Shale	3,000	100	700	70	200
Class IV Shale	6,000	150	1,000	100	300
Class III Shale	20,000	750	3,500	350	1,000
Class II Shale	70,000	1,000	6,000	600	1,500

Notes (1) The values are in accordance with Pells et al- 1998 (Ref 3);
(2) Ultimate values occur at large settlements (generally >5% of the minimum footing width);
(3) Values can only be adopted for clean sockets of roughness category R2 or better. Values may need to be reduced to account for smear;
(4) Value for rock based on settlements of <1% of minimum footing width.

Base bearing and shaft adhesion values have also been provided for Limit State design. A geotechnical strength reduction factor (Φg) of 0.45 must be applied in accordance with AS 2159 – 2009, Table 4.3.2 based on the available information. Pile testing will be required in accordance with AS 2159 – 2009 where adopting values of Φg>0.45.

If the higher design values are required for construction, daily site inspections will be required (as a minimum) for Class III rock, whilst coring or spoon testing will be required in the base of 50% of footings should Class II rock be required.

9.11.2 Clinical Services Building

Following excavation to RL 82.3, and based on the results of the subsurface investigations, the base is likely to expose Class II/III (eastern two-thirds) and Class IV rock (western third). As such, construction will likely comprise a footing system consisting of either high-level pad/strip footings and/or piled footings should higher strength rock result in a more economic footing design.

- Allowable base bearing pressure (ABBP) for a mixed pad/strip and shallow piled footing system founded in Class II/III bedrock (at levels below RL 79.9 – 82.3) 3,500 kPa
- Allowable shaft adhesion in Class II/III rock 350 kPa

Localised areas of Class IV rock can adopt an ABBP of 1,000 kPa for design.

Settlements adopting the above parameters are not expected to exceed a few millimetres.

Reference should be made to Table 1 with respect to the depths and reduced levels of the various grades of rock in the individual boreholes.

9.11.3 Cancer Treatment Centre

Following excavation to RL 78.0, and based on the results of the subsurface investigations, the base is likely to expose Class IV rock. As such, construction will likely comprise a footing system consisting of either high-level pad/strip footings and/or shallow piled footings.

Footings could be proportioned using the parameters nominated below:

- Allowable base bearing pressure for pad/strip footings founded in Class IV bedrock (at levels below RL 77.9 – 78.0) 1,000 kPa
- Allowable shaft adhesion in Class IV rock 100 kPa

Settlements adopting the above parameters are not expected to exceed a few millimetres.

Reference should be made to Table 1 with respect to the depths and reduced levels of the various grades of rock in the individual boreholes.

9.11.4 Link Building

Survey data indicates that the Link Building is approximately at current ground level RL 83.7. As such, based on the results of the subsurface investigations variable sub-surface conditions exists ranging from uncontrolled filling (north-west corner) to near-surface Class IV rock (south-east end). As such, construction will likely comprise a mixed footing system consisting of high-level pad/strip footings and piled footings founded on rock.

Footings could be proportioned using the parameters nominated below:

- Allowable base bearing pressure on Class IV bedrock (at levels below RL 75.7 – 83.7) 1,000 kPa
- Allowable shaft adhesion in Class IV rock 100 kPa

Settlements adopting the above parameters are not expected to exceed a few millimetres.

Reference should be made to Table 1 with respect to the depths and reduced levels of the various grades of rock in the individual boreholes.

9.11.5 Pedestrian Link

Design details on the pedestrian link structure were not determined. Based on the results of the subsurface investigations construction will likely comprise a footing system consisting of high-level pad/strip footings (e.g. towards the south) and/or piled footings (e.g. towards the north).

Footings could be proportioned using the parameters nominated below:

- Allowable base bearing pressure for a mixed pad/strip and piled footing system founded in Class IV bedrock (at levels below RL 74.6 – 93.0) 1,000 kPa
- Allowable shaft adhesion in Class IV rock 100 kPa

Settlements adopting the above parameters are not expected to exceed a few millimetres.

Reference should be made to Table 1 with respect to the depths and reduced levels of the various grades of rock in the individual boreholes.

9.11.6 General

The use of bored piers is considered feasible for this site. Alternatively, auger grouted piles are also considered suitable for the site, provided installation is undertaken by an experienced contractor. It is noted that in order to achieve sockets into medium to high strength rock, it would be necessary to employ a high torque boring rig for pier construction or alternatively, install pile groups at closely spaced centres with pile caps. The choice between the alternative pile systems will be dependent on relative costs and on suitability in relation to proposed construction.

Where footing systems are proposed adjacent to services, batters or located near retaining walls, local deepening of the footings or alternatively the inclusion of piles will most likely be required. Founding levels are to be below the zone of influence of the service trenches, batters and any retaining walls, with the zone of influence defined as an imaginary line extending from the base of the trench to the ground surface inclined at 45° (i.e.: 1 horizontal:1 vertical).

9.12 Ground Slabs

Following preparation to design levels, the prepared subgrade could be expected to provide adequate support for the floor slabs, provided allowance is made for differential movement between the slab-on-grade and walls. Based on field observation, floor slab design could be based on the following subgrade conditions:

- CBR of 3.0% for the clayey and controlled filling (If encountered) – likely for the north-western portion of the proposed link structure, proposed structure between Buildings A and D and the southern end of the pedestrian link;
- CBR of 7% for rock of at least very low strength (If encountered) – likely for the south-western portion of the proposed link structure, CSB and CTC.

Subfloor drainage should be provided and possibly connected to a pump system. Allowance will need to be made for water-proofing the basement and uplift due to water pressure with design on a fully tanked basement if drainage cannot be provided.

10. Geotechnical Review

Once more detailed design has been carried out, it is recommended the plans be reviewed by Douglas Partners for compliance with recommendations given in this report. This is considered necessary given the number of assumptions that have been made in preparing this report, it will be necessary to review the extent of the geotechnical investigation and, if required, to get some supplementary information in order to confirm the advice given in this report.

If high bearing pressures (i.e. 3,500 kPa) are required, additional investigations should be undertaken to prove the rock quality. Supplementary investigations would comprise:

- Coring to depths of at least 4 times the width of footings below proposed footing founding levels at 50% of footing locations for Class II shale; or
- Coring to depths of at least 4 times the width of footings below proposed footing founding levels in a 10 m x10 m grid, or at all footing locations for Class I shale.

As the site is highly sensitive to vibrations, vibration trials should be undertaken well in advance of work starting in order for the excavation contractor to determine appropriate excavation equipment, methodologies and safe working distances.

11. Geotechnical Requirements During Construction

Geotechnical and environmental inputs that are discussed in this report and will require input during construction are summarised as follows:

- Dilapidation surveys of adjacent properties be undertaken to provide a base line condition of structures;
- Vibration monitoring of field trials and during excavation including foundation construction.
- Inspection during anchor installation by a geotechnical engineer to provide validation of the shaft adhesion and site conditions encountered are consistent with the anchor design.
- Inspection and environmental testing of excavated materials (i.e. waste classification) prior to disposal.
- Inspection of excavations within slightly fractured rock (i.e. where piles terminate on medium to high strength slightly fractured rock above basement level) to be made by an experienced engineering geologist or geotechnical engineer during the course of bulk excavation work at maximum depth intervals of 2 m.
- Inspection during foundation construction by a geotechnical consultant to provide validation of the bearing pressures and site conditions encountered are consistent with the foundation design.
- Working platform assessments for mobile crane lifts.

Notwithstanding the above mentioned items, the client and the building contractor should also be aware of any conditions in the development consent that require professional input during design and construction.

12. References

1. Geology of 1:100 000 Wollongong - Port Hacking Geological Series Sheet No 9029 - 9129, Dept. of Mines, (1985).
2. Foundations on Shales and Sandstones in the Sydney Region, Pells *et al*, Australian Geomechanics Journal (1998).
3. Australian Standard AS 2159 - 2009 "*Piling - Design and Installation*".
4. AS 1170.4 - 2007, "Structural Design Actions - Part 4: Earthquake Actions in Australia".

13. Limitations

Douglas Partners Pty Ltd (DP) has prepared this report for the proposed Campbelltown Hospital Stage 2 Redevelopment at Therry Road, Campbelltown in accordance with DP's proposal MAC170234 Rev2 (Variations 2 and 4) and acceptance received from Mrs Margo Kouvaris of Health Infrastructure. The work was carried out under DP's conditions of engagement. This report is provided for the exclusive use of Health Infrastructure for this project only and for the purposes as described in the report. It should not be used for other projects or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations.

This report must be read in conjunction with all of the attached 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 unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical and groundwater components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

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Appendix A

Notes About This Report
Drawings 1 – 5
BLP Conceptual Proposed Building Cross-sections

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.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

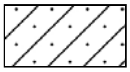
Soils


Topsoil

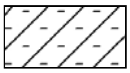

Peat


Clay

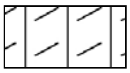

Silty clay

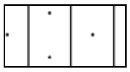

Sandy clay

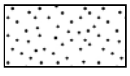

Gravelly clay

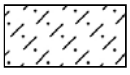

Shaly clay

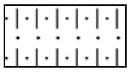

Silt


Clayey silt


Sandy silt

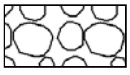

Sand

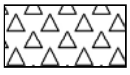

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

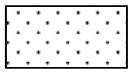

Talus

Sedimentary Rocks

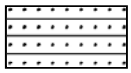

Boulder conglomerate

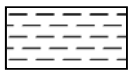

Conglomerate


Conglomeratic sandstone

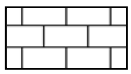

Sandstone


Siltstone


Laminite

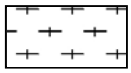

Mudstone, claystone, shale

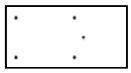

Coal


Limestone

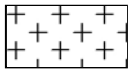
Metamorphic Rocks

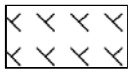

Slate, phyllite, schist

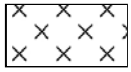

Gneiss

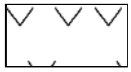

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

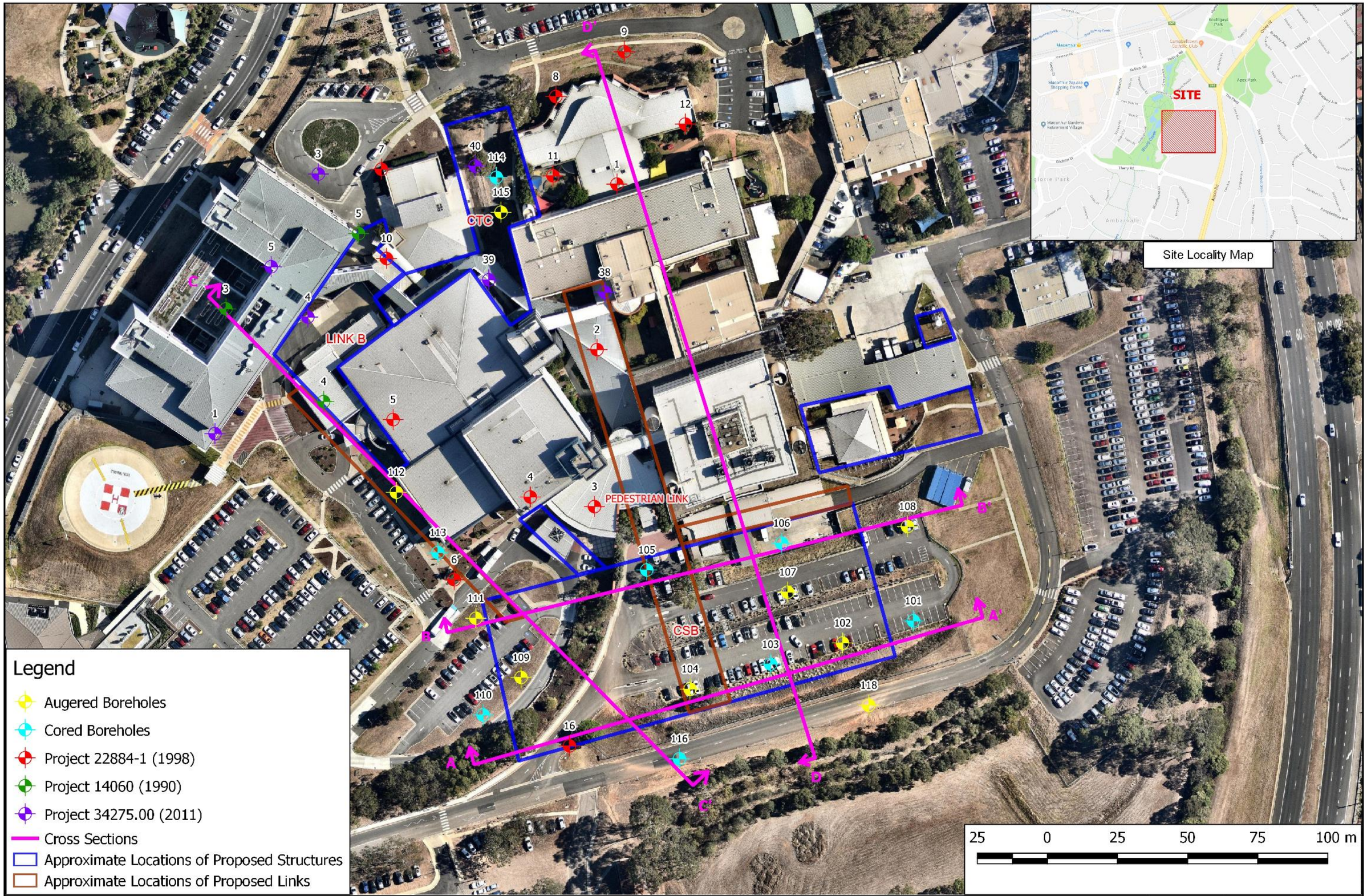
$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m



Legend

- Augered Boreholes
- Cored Boreholes
- Project 22884-1 (1998)
- Project 14060 (1990)
- Project 34275.00 (2011)
- Cross Sections
- Approximate Locations of Proposed Structures
- Approximate Locations of Proposed Links

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Health Infrastructure		
OFFICE: Macarthur	DRAWN BY: IKA / TOM	
SCALE: 1:1,250	DATE: 31.07.2018	

TITLE: **Borehole Locations**
Stage 2 Redevelopment
Therry Road, Campbelltown, NSW

N MGA

PROJECT No:	34275.08
DRAWING No:	1
REVISION:	2

A

A'

ELEVATION (mAHD)

100
95
90
85
80
75

110
Offset 13.6m
VL-L
refusal
M
H
M
Bottom Depth 10.1 m

22884-16
Offset - 4.6m
Bottom Depth 2.1 m

116
Offset - 21.4m
refusal
VL-L
VL
refusal
L
M
H
Bottom Depth 22.95 m

104
Offset 3.2m
VL-L
refusal
Bottom Depth 2 m

103
Offset 7.1m
refusal
VL-L
refusal
M
H
Bottom Depth 18.8 m

118
Offset - 20.8m
VL-L
refusal
L
L-M
refusal
Bottom Depth 2.7 m

102
Offset 3.4m
VL-L
refusal
refusal
Bottom Depth 2.5 m

101
Offset 2.9m
refusal
L
EL
M
L
M
EL
M
EL
M
L
M
H
M
Bottom Depth 20.8 m

0 20 40 60 80 100 120 140 160 180

DISTANCE ALONG PROFILE (m)

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Asphaltic Concrete
- Filling
- Siltstone
- Clay

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

TESTS / OTHER
N - Standard penetration test value
▽ - Water level
PP - Pocket penetrometer test value

0 11
Horizontal Scale (metres)

Vertical Exaggeration = 3.7

STANDARD CROSS-SECTION 34275.08.L.001.REV0.LOGS.GPJ DPTEMPLATE2012_V1 SYDMET.GDT 26/4/18

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CLIENT: Health Infrastructure		TITLE: **Cross-section A**	PROJECT No: 34275.08
OFFICE: Macarthur	DRAWN BY: TOM	**Campbelltown Hospital Stage 2 Redevelopment**	DRAWING No: 2
SCALE: 1:550 (H) 1:150 (V) @ A3	DATE: 26.04.2018	**Therry Road, Campbelltown**	REVISION: 1

B

B'

ELEVATION (mAHD)

92
90
88
86
84
82
80
78
76
74

22884-06
Offset 17.7m
N = 32
N = 14
111
Offset 1.2m
refusal
EL-VL
VL-L
refusal
L
VL
L
VL
VL
EL
VL
L
VL
L
VL
L
VL
L
VL
L-M
VL
L-M
VL
L-M
VL
M
VL
M
VL
M
VL
M-H
H
Bottom Depth
7 m
Bottom Depth
2 m

105
Offset 1.3m
VL-L
refusal
L
M
M-H
Bottom Depth
12.18 m

106
Offset 2.1m
VL
M
M
M
M
H
Bottom Depth
13.6 m

107
Offset - 17.1m
VL-L
L-M
refusal
Bottom Depth
1 m

108
Offset - 3.2m
N = 34
VL-L
refusal
L-M
Bottom Depth
3.1 m

0
20
40
60
80
100
120
140
160
180

DISTANCE ALONG PROFILE (m)

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Concrete
- Filling
- Shale
- Siltstone
- Silty Clay
- Topsoil

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

TESTS / OTHER
N - Standard penetration test value
▽ - Water level
PP - Pocket penetrometer test value

0 11
Horizontal Scale (metres)

Vertical Exaggeration = 5.5

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Health Infrastructure		TITLE: **Cross-section B**	PROJECT No: 34275.08
OFFICE: Macarthur	DRAWN BY: TOM	**Campbelltown Hospital Stage 2 Redevelopment**	DRAWING No: 3
SCALE: 1:550 (H) 1:100 (V) @ A3	DATE: 26.04.2018	**Therry Road, Campbelltown**	REVISION: 1

STANDARD CROSS-SECTION 34275.08.L.001.REV0 LOGS.GPJ DPTEMPLATE2012_V1_SYDMET.GDT 26/4/18

C

C'

ELEVATION (mAHD)

96
94
92
90
88
86
84
82
80
78
76
74
72

34275.00-5
Offset 24.6m
N = 12
N = 25
N = 30
EL
VL-L
M
M
Bottom Depth 10 m

14060-3
Offset 4.0m
EL
L-M
Bottom Depth 3.5 m

34275.00-4
Offset 24.9m
N = 12
N = 27
N = 20
EL
M
M
Bottom Depth 8.78 m

14060-4
Offset 4.9m
EL
L-M
Bottom Depth 3 m

22884-05
Offset 18.0m
N = 20
N = 13
refusal
EL-VL
VL
EL
L
EL
EL
VL
L
VL
M
VL
M
VL
M
VL
M
VL
M
EL
L
VL
M
EL
M
VL
M
Bottom Depth 7 m

112
Offset - 1.3m
N = 24
refusal
VL-L
L-M
Bottom Depth 4 m

113
Offset - 5.7m
refusal
VL-L
L
refusal
M
Bottom Depth 9 m

22884-06
Offset - 8.0m
N = 32
N = 14
refusal
EL-VL
L
VL
VL
VL
EL
VL
L
VL
L
VL
L
VL
L-M
VL
L-M
VL
M
VL
M
VL
M-H
H
Bottom Depth 7 m

111
Offset - 13.1m
refusal
VL-L
L-M
Bottom Depth 2 m

110
Offset - 36.0m
refusal
VL-L
M
H
M
M
Bottom Depth 10.1 m

22884-16
Offset - 21.5m
Bottom Depth 2.1 m

116
Offset 2.2m
refusal
VL-L
refusal
VL
L
M
H
Bottom Depth 22.95 m

0 20 40 60 80 100 120 140 160 180 200 220 240 260

DISTANCE ALONG PROFILE (m)

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Filling
- Shale
- Siltstone
- Silty Clay
- Topsoil

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

TESTS / OTHER
N - Standard penetration test value
▽ - Water level
PP - Pocket penetrometer test value

0 15
Horizontal Scale (metres)

Vertical Exaggeration = 6.0

STANDARD CROSS-SECTION 34275.08.L.001.REV0 LOGS.GPJ DPTEMPLATE2012_V1_SYDMET.GDT 26/4/18

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Health Infrastructure		TITLE: **Cross-section C**	PROJECT No: 34275.08
OFFICE: Macarthur	DRAWN BY: TOM	**Campbelltown Hospital Stage 2 Redevelopment**	DRAWING No: 4
SCALE: 1:750 (H) 1:125 (V) @ A3	DATE: 26.04.2018	**Therry Road, Campbelltown**	REVISION: 1

D

D'

ELEVATION (mAHD)

100
95
90
85
80
75

0 20 40 60 80 100 120 140 160 180 200 220 240 260

DISTANCE ALONG PROFILE (m)

118
Offset - 27.4m
VL-L
refusal
L
refusal
L-M
Bottom Depth 2.7 m

102
Offset - 23.5m
VL-L
refusal
Bottom Depth 2.5 m

103
Offset 0.2m
refusal
refusal
VL-L
refusal
M
H
Bottom Depth 18.8 m

107
Offset - 12.5m
VL-L
L-M
refusal
Bottom Depth 1 m

106
Offset - 11.3m
VL
M
M
M
M
H
Bottom Depth 13.6 m

22884-03
Offset 48.4m
EL-VL
N = 35
Bottom Depth 7 m

22884-02
Offset 30.8m
N = 33
N = 27
N = 19
N = 45
EL-VL
refusal
Bottom Depth 8.2 m

34275.00-38
Offset 27.9m
EL
L
Bottom Depth 2.9 m

22884-01
Offset 6.2m
N = 6
N = 12
N = 16
N = 13
N = 20
Bottom Depth 9.2 m

22884-11
Offset 27.3m

22884-12
Offset 23.3m
Bottom Depth 2.1 m
Bottom Depth 2.3 m

22884-09
Offset - 11.1m
Bottom Depth 2.1 m

22884-08
Offset 17.5m
Bottom Depth 1.5 m

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Concrete
- Filling
- Shale
- Shaly Clay
- Siltstone
- Silty Clay
- Topsoil

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

TESTS / OTHER
N - Standard penetration test value
▽ - Water level
PP - Pocket penetrometer test value

0 15
Horizontal Scale (metres)

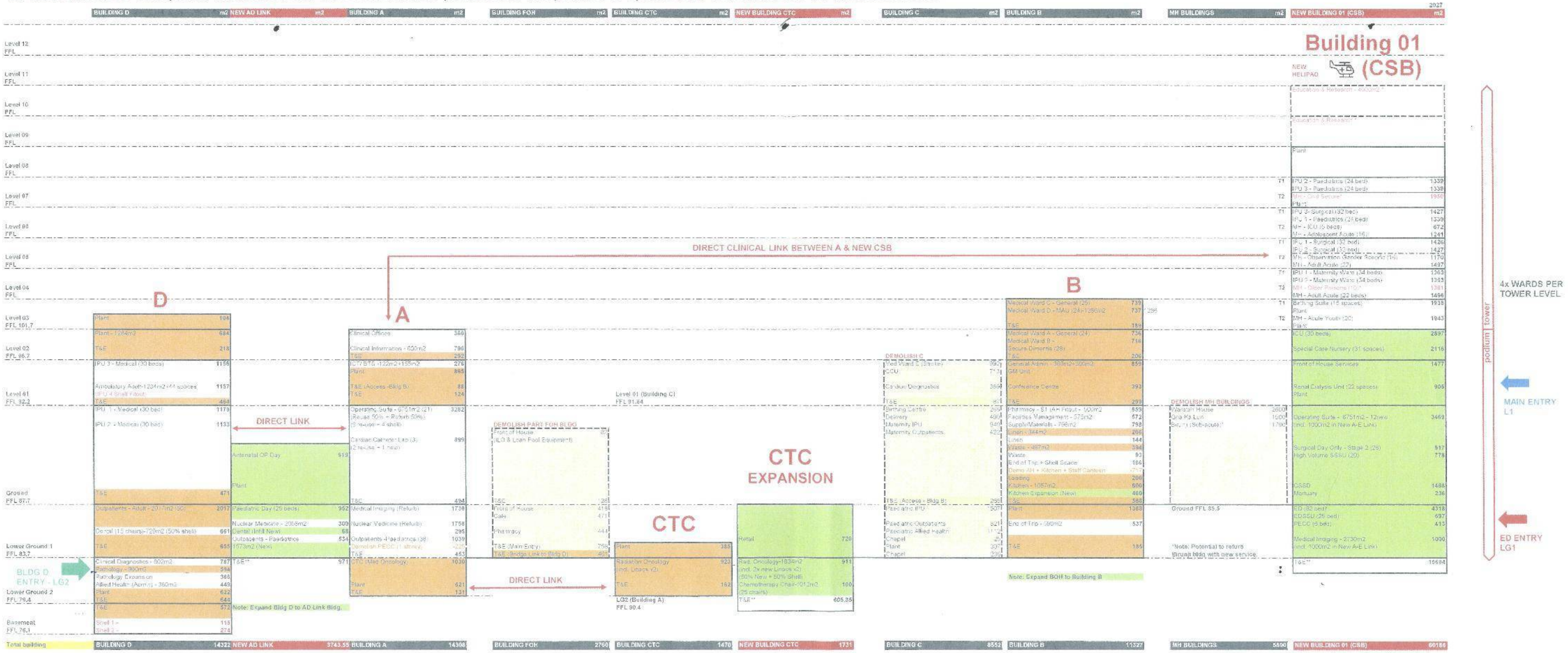
Vertical Exaggeration = 5.0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Health Infrastructure		TITLE: **Cross-section D**	PROJECT No: 34275.08
OFFICE: Macarthur	DRAWN BY: TOM	**Campbelltown Hospital Stage 2 Redevelopment**	DRAWING No: 5
SCALE: 1:750 (H) 1:150 (V) @ A3	DATE: 26.04.2018	**Therry Road, Campbelltown**	REVISION: 1

STANDARD CROSS-SECTION 34275.08.L.001.REV0.LOGS.GPJ DPTEMPLATE2012_V1_SYDMET.GDT 26/4/18

OPTION 1.1: NEW CSB (CLINICAL SERVICES INCL THEATRES (NEW & RE-USE) AND IPU'S) AND REFURBISHMENT TO 2026 HORIZON



Key Option Items:
Single substantial new build with new integral links - single stage
50:50 New & Refurbished Theatres
IPU capacity
Demolish Block C & MH Buildings
Maintain & refurb Buildings A, B, D & CTC
Revised areas based on SoA V.05 - 14.12.17
Aligned with Cost Plan Options Master Rev.H.2
4 x IPUs / Tower Level

Revision V8 - 15.12.2017

- Do Nothing
- Refurb - major
- Refurb - minor
- DEMOLITION
- NEW BUILD - Tower
- NEW BUILD - Podium
- NEW Shell Space not in Cost Plan

Appendix B

Current Borehole Logs (Bores 101 – 116 and 118)
Project 34275.00 Borehole Logs (Bores 1, 3 – 5 and 38 – 40)
Project 22884-1 Borehole Logs (Bores 1 – 12 and 16)
Project 14060 Borehole Logs (Bores 3 – 5)
Photoplates 1 – 4
Table B1: Summary Table – Groundwater Levels

Douglas Partners Pty Ltd

Campbelltown Hospital Stage 2 Redevelopment,
Campbelltown Hospital

BORE: 101 DEPTH: 2.55 m – 20.80 m PROJECT: 34275.08-2 March 2017

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 95.7 mAHD
EASTING: 297663
NORTHING: 6226977
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 34275.08
DATE: 2/3/2018
SHEET 1 OF 3

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)	Type	Core Rec. %	RQD %	Test Results & Comments
95	0.05	ASPHALTIC CONCRETE										
	0.3	FILLING - grey crushed sandstone (roadbase), moist										
		SILTSTONE - low strength, moderately weathered, grey siltstone							U			
	1											
									S			14,20/90mm,- refusal
94	2							Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
93		- becoming extremely low strength, extremely weathered below 2.5m										
	3	- becoming medium strength, moderately weathered below 2.6m						2.9m: J, 65°, sv, pl, ro, cln 20mm long 2.92m: J, 65°, sv, pl, ro, cln 20mm long 2.94m: J, 65°, sv, pl, ro, fe stn 30mm long 3.23m: J, 30°, sh, pl, ro, fe stn 20mm long 3.27m: J, v, cu, fe stn 90mm long 3.41m: J, v, pl, he, fe stn 30mm	C	100	30	PL(A) = 0.34 PL(A) = 0.29
92		- 150mm thick low strength, highly weathered band at 3.5m										
	4	- 30mm thick extremely low strength, extremely weathered band at 4.1m										
		- becoming fresh below 4.4m						3.45m: J, 60°, sv, sm, fe stn 30mm 3.66m: J, 30°, sh, pl, he, fe stn 10mm 3.68m: J, 30°, sh, pl, he, fe stn 10mm 3.72m: J, 30°, sh, pl, he, fe stn 10mm 3.75m: J, 30°, sh, pl, he, fe stn 10mm 3.81m: J, 30°, sh, pl, he, fe stn 10mm 3.87m: J, 30°, sh, pl, he, fe stn 10mm 3.92m: J, 70°, sv, pl, sm, fe stn 20mm long 4.6m: J, 70°, sv, pl, ro, cln 20mm long	C	100	62	PL(A) = 0.36 PL(A) = 0.36 PL(A) = 0.26
91	5	- 40mm thick extremely low strength, extremely weathered band at 4.71m										
90	6											
89		- becoming low strength below 6.5m										
	7							4.62m: J, 70°, sv, pl, ro, cln 120mm long 5.1m: J, 70°, sv, pl, sm, cln 20mm long 5.52m: J, 60°, sv, pl, sm, cly co 150mm long 5.75m: fg zone 90mm thick 5.84m: J, v, cu, pl, he 70mm long 6.16m: J, 65°, sv, pl, ro, fe stn 40mm long 6.25m: J, 75°, sv, pl, cln 20mm long 6.4m: J, v, cu, pl, fe stn 110mm long	C	100	86	PL(A) = 0.19 PL(A) = 0.46
88		- becoming fresh below 7.78m										
87	8	- becoming medium strength below 8.5m										
	9							6.57m: J, 70°, sv, pl, cly co 30mm long 6.64m: J, v, un, sm, fe stn 70mm long, B, h, pl, ro, fe stn 6.71m: J, 70°, sv, pl, sm,	C	100	99	PL(A) = 0.35
86												

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.5m

TYPE OF BORING: 110mm diameter auger to 2.5m, NMLC coring to 20.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 95.7 mAHD
EASTING: 297663
NORTHING: 6226977
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 34275.08
DATE: 2/3/2018
SHEET 2 OF 3

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)	Type	Core Rec. %	RQD %	Test Results & Comments
85		SILTSTONE - medium strength, fresh, grey siltstone *(continued)*						cln 70mm long 6.8m: J, v, st, ro, fe stn 60mm long, B, h, pl, ro, fe stn 7.17m: J, 65°, sv, pl, sm, cln 30mm long 7.32m: J, 60°, sv, pl, sm, cly co 20mm long 7.43m: J, 20°, sh, pl, sm, cln 20mm long 7.61m: J, v, st, sm, cln 30mm, B, h, pl, ro, cln 7.67m: J, v, cu, sm, cln 40mm long 7.75m: fg zone 30mm thick 9.21m: J, 15°, sh, pl, sm, cln 9.47m: fg zone 50mm thick 10.31m: Cs 10mm thick 12.1m: J, 30°, sh, pl, sm, cln 120mm long 12.87m: J, 70°, sv, pl, sm, cln 40mm thick 13.46m: J, 65°, sv, pl, ro, cln 170mm thick 15.44m: fg zone 30mm thick 16.6m: J, 65°, sv, pl, sm, cln 80mm long 17.85m: J, 65°, sv, un, sm, cln 70mm long 17.9m: J, v, cu, pl, sm, cln 40mm long 18.49m: J, 30°, sh, pl, sm, cln 29mm long 18.51m: J, 70°, sv, pl, sm, cln 40mm long				
	11								C	100	99	PL(A) = 0.59
84		- becoming high strength below 11.5m										PL(A) = 2.01
	12											
83		- becoming medium strength below 12.7m										PL(A) = 1.1
	13								C	100	100	
82												PL(A) = 0.99
	14											PL(A) = 0.99
81												
	15											
80												PL(A) = 0.55
	16								C	100	98	PL(A) = 0.63
79												
	17											PL(A) = 0.75
78												
	18											
77												PL(A) = 0.66
	19								C	100	99	
76												PL(A) = 0.94

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.5m

TYPE OF BORING: 110mm diameter auger to 2.5m, NMLC coring to 20.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 95.7 mAHD
EASTING: 297663
NORTHING: 6226977
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 34275.08
DATE: 2/3/2018
SHEET 3 OF 3

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
75		SILTSTONE - medium strength, fresh, grey siltstone *(continued)*							C	100	99	PL(A) = 0.73
	20.8	Bore discontinued at 20.8m - limit of investigation										
74	21											
	22											
73	23											
72	24											
71	25											
70	26											
69	27											
68	28											
67	29											
66												

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.5m

TYPE OF BORING: 110mm diameter auger to 2.5m, NMLC coring to 20.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 94.7 mAHD
EASTING: 297637
NORTHING: 6226970
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 34275.08
DATE: 5/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
94	0.05	ASPHALTIC CONCRETE							
	0.3	FILLING - grey crushed sandstone (roadbase), dry							
		SILTSTONE - very low to low strength, moderately to slightly weathered, grey siltstone							
	1			S	1.0 1.14		20/140mm,-,- refusal		
93		- with medium strength bands below 1.5m							
	2								
92	2.5	Bore discontinued at 2.5m - limit of investigation		S	2.5 2.61		20.110mm,-,- refusal		
	3								
91									
	4								
90									
	5								
89									
	6								
88									
	7								
87									
	8								
86									
	9								
85									

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** N/A

TYPE OF BORING: 110mm diameter auger to 2.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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

Douglas Partners Pty Ltd

Campbelltown Hospital Stage 2 Redevelopment,
Campbelltown Hospital

BORE: 103 DEPTH: 4.50 m – 18.80 m PROJECT: 34275.08-2 March 2017

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 93.3 mAHD
EASTING: 297613
NORTHING: 6226967
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 34275.08
DATE: 5/3/2018
SHEET 1 OF 2

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
93	0.05	ASPHALTIC CONCRETE										
	0.3	FILLING - grey crushed sandstone (roadbase), moist										
		SILTSTONE - very low to low strength, moderately to slightly weathered, grey siltstone										
92	1								S			20/110mm,-,- refusal
91	2								S			20/50mm,-,- refusal
90	3							Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
89	4											
		- becoming medium strength, fresh below 4.5m						4.64m: J, 70°, sv, pl, fe, fe stn 60mm long	C	100	90	PL(A) = 0.34
88	5											PL(A) = 0.71
87	6								C	100	99	PL(A) = 0.39
86	7											PL(A) = 0.57
85	8											PL(A) = 0.47
84	9							9.31m: J, v, un, sm, clay co 100mm long, B, h, pl, sm, cly co 9.42m: J, v, un, sm, cly co 70mm long	C	100	95	PL(A) = 0.34

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 4.2m

TYPE OF BORING: 110mm diameter auger to 4.2m, NMLC coring to 18.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 93.3 mAHD
EASTING: 297613
NORTHING: 6226967
DIP/AZIMUTH: 90°/--

BORE No: 103
PROJECT No: 34275.08
DATE: 5/3/2018
SHEET 2 OF 2

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)	Type	Core Rec. %	RQD %	Test Results & Comments
83		SILTSTONE - medium strength, fresh, grey siltstone *(continued)*										
		becoming high strength below 10.2m										PL(A) = 1.3
	11							10.85m: J, 80°, sv, pl, sm, cln 170mm long	C	100	95	
82												PL(A) = 1.42
								11.56m: J, v, pl, sm, cln 60mm long				
	12											
81												PL(A) = 1.16
	13								C	100	100	PL(A) = 0.93
80								13.43m: J, v, cu, sm, cln 300mm long				
	14											PL(A) = 1.33
79												
	15											PL(A) = 1.03
78								15.67m: J, 75°, sv, pl, sm, cln 40mm long				
	16								C	100	98	PL(A) = 1.4
77												
	17							16.75m: J, 65°, sv, pl, sm, cln 20mm long 16.86m: fg zone 40mm thick 16.93m: J, 60°, sv, pl, sm, cly inf 5mm thick 17m: J, 75°, sv, pl, sm, cln 70mm long				PL(A) = 1.46
76												
	18							17.45m: J, 75°, sv, pl, sm, cln 60mm long	C	100	100	PL(A) = 0.81
75	18.8	Bore discontinued at 18.8m - limit of investigation										
	19											
74												

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 4.2m

TYPE OF BORING: 110mm diameter auger to 4.2m, NMLC coring to 18.8m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 92.0 mAHD
EASTING: 297589
NORTHING: 6226956
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 34275.08
DATE: 5/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
92	0.05	ASPHALTIC CONCRETE							
	0.4	FILLING - grey crushed sandstone (roadbase), moist							
		SILTSTONE - very low to low strength, moderately to slightly weathered, grey siltstone							
91	1	- with medium strength bands below 1.0m		S	1.0 1.11		20/110mm,-,- refusal		
90	2	2.0 Bore discontinued at 2.0m - limit of investigation							
89	3								
88	4								
87	5								
86	6								
85	7								
84	8								
83	9								

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 4.2m

TYPE OF BORING: 110mm diameter auger to 2.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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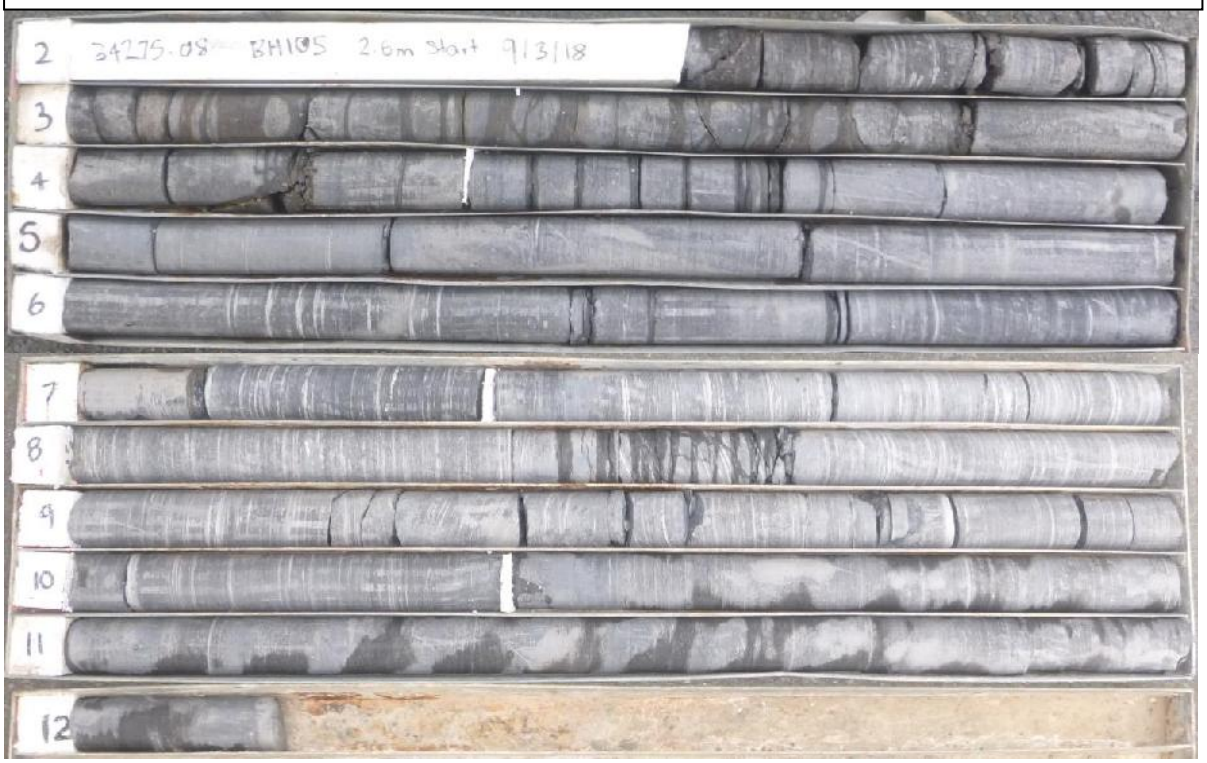
Campbelltown Hospital

BORE: 105 DEPTH: 2.55 m – 12.18 m PROJECT: 34275.08-2 March 2017



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 87.4 mAHD
EASTING: 297564
NORTHING: 6226992
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 34275.08
DATE: 9/3/2018
SHEET 1 OF 2

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
	0.05	ASPHALTIC CONCRETE										
	0.3	FILLING - grey crushed sandstone (roadbase), moist										
87		SILTSTONE - very low to low strength, moderately to slightly weathered, grey siltstone with medium strength bands										
	1	- becoming low strength, slightly weathered with medium strength bands below 0.85m							S			20/130mm,-,-refusal
86								Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
	2											
85		- becoming medium strength below 2.55m						2.55m: J, 60°, sv, pl, sm, cly co 50mm long				PL(A) = 0.42
	3								C	100	82	PL(A) = 0.42
84								3.56m: J, 65°, sv, pl, he, cly co 30mm long 3.7m: J, 60°, sv, pl, sm, cly co 20mm long, B, h, pl, sm, cly co				
	4	- becoming fresh stained below 3.7m						4.14m: J, 75°, sv, pl, ro, fe stn 80mm long				
83		- becoming fresh below 4.35m										PL(A) = 0.67
	5											
82												PL(A) = 0.61
	6								C	100	87	
81												PL(A) = 0.69
	7											
80		- becoming medium to high strength below 7.35m										PL(A) = 1.2
	8											PL(A) = 1.04
79								8.47m: Bedded zone, aug 0.15mm spacing, B, h, pl, sm, cly co 180mm thick	C	100	89	
	9											
78												PL(A) = 0.96
								9.72m: J, 70°, sv, pl, ro, cln 50mm long				

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 4.2m

TYPE OF BORING: 110mm diameter auger to 2.55m, NMLC coring to 12.18m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 87.4 mAHD
EASTING: 297564
NORTHING: 6226992
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 34275.08
DATE: 9/3/2018
SHEET 2 OF 2

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
77		SILTSTONE - medium to high strength, fresh, grey siltstone *(continued)*							C	100	89	
	11											PL(A) = 1.33
76									C	100	100	
	12											PL(A) = 0.97
	12.18											PL(A) = 0.92
75		Bore discontinued at 12.18m - limit of investigation										
	13											
74												
	14											
73												
	15											
72												
	16											
71												
	17											
70												
	18											
69												
	19											
68												

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 4.2m

TYPE OF BORING: 110mm diameter auger to 2.55m, NMLC coring to 12.18m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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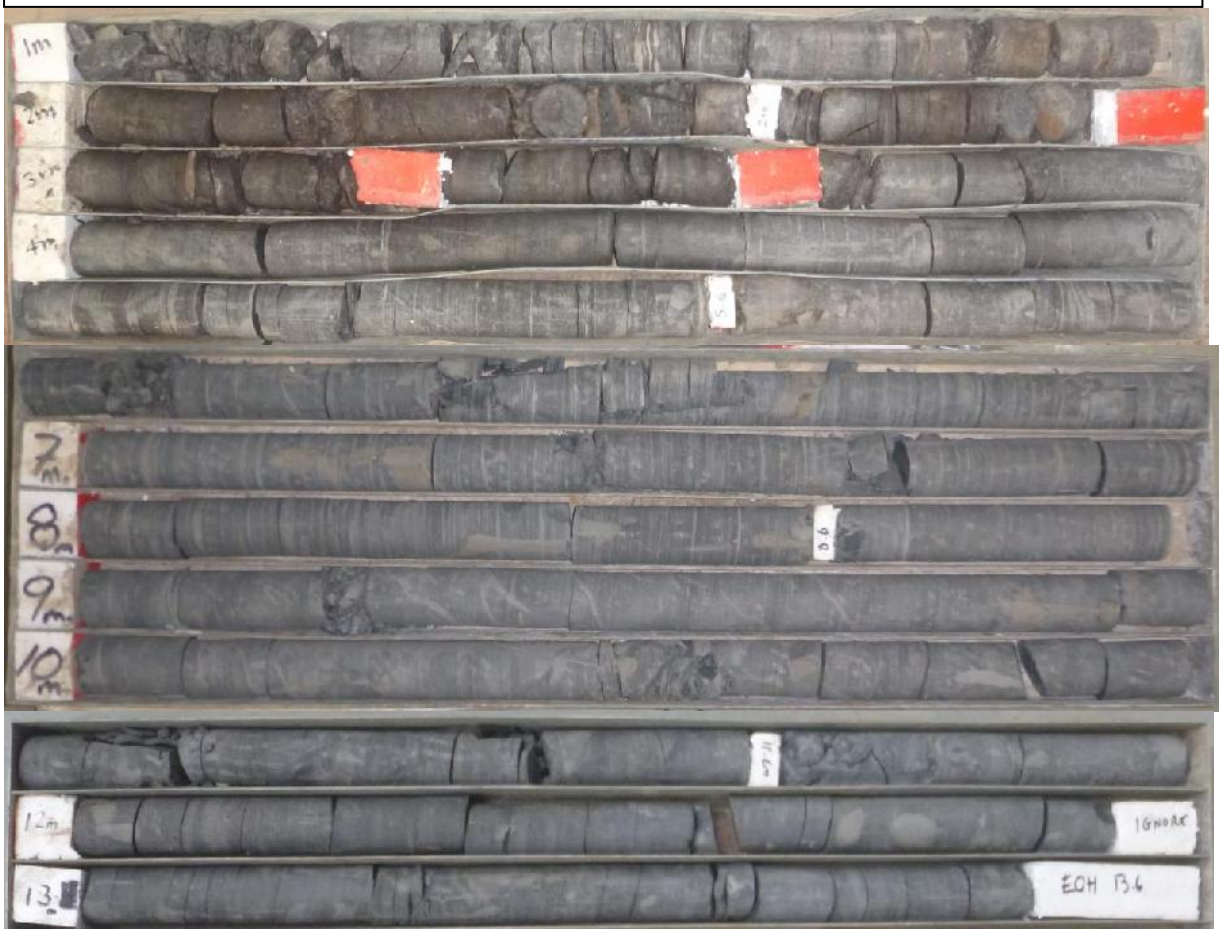
Campbelltown Hospital Stage 2 Redevelopment,
Campbelltown Hospital

BORE: 106 DEPTH: 1.00 m – 13.60 m PROJECT: 34275.08-2 March 2017



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 87.5 mAHD
EASTING: 297613
NORTHING: 6227005
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 34275.08
DATE: 20/3/2018
SHEET 1 OF 2

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)	Type	Core Rec. %	RQD %	Test Results & Comments
		CONCRETE										
87	0.37	SILTSTONE - very low strength, highly weathered, grey siltstone						Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
86	1	- becoming medium strength, slightly weathered below 1.0m						1m: fg zone 140mm thick 1.28m: J, 60°, sv, pl, ro, fe stn 40mm long	C	100	57	PL(A) = 0.45
85	2							2.09m: J, 70°, sv, pl, ro, fe stn 100mm long 2.39m: fg zone 170mm thick				PL(A) = 0.34
84	2.91 3 3.0 3.3 3.66	- becoming fresh below 3.72m						2.91m: CORE LOSS: 90mm 3.06m: J, 30°, sh, pl, ro, fe stn 30mm long 3.1m: J, 30°, sh, pl, ro, fe stn 30mm long 3.26m: CORE LOSS: 40mm 3.59m: CORE LOSS: 70mm	C	99	87	PL(A) = 0.66 PL(A) = 0.92 PL(A) = 0.64
83	4											
82	5											
81	6	- becoming high strength below 6.3m										PL(A) = 1.34
80	7							7.05m: J, 75°, sv, pl, sm, cln 50mm long 7.31m: J, 85°, sv, pl, sm, cln 290mm long	C	100	100	PL(A) = 2.41
79	8											PL(A) = 2.06
78	9								C	100	100	PL(A) = 1.63

RIG: Hanjin DB8 **DRILLER:** Terratest **LOGGED:** IKA/EMG **CASING:** HWT to 1.0m

TYPE OF BORING: 200mm concrete core to 0.37m, 110mm diameter auger to 1.00m, NMLC coring to 13.60m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 87.5 mAHD
EASTING: 297613
NORTHING: 6227005
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 34275.08
DATE: 20/3/2018
SHEET 2 OF 2

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
77	11	SILTSTONE - high strength, fresh, grey siltstone *(continued)*						10.47m: J, 70°, sv, pl, sm, cln 40mm long 11m: J, v, pl, sm, cln 100mm long 11.33m: J, v, pl, sm, cln 70mm long 11.6m: J, v, pl, sm cln 150mm long	C	100	100	PL(A) = 1.76 PL(A) = 1.7
76	12								C	100	100	PL(A) = 1.75
75	13											
74	13.6	Bore discontinued at 13.6m - limit of investigation										PL(A) = 2.25
73	14											
72	15											
71	16											
70	17											
69	18											
68	19											

RIG: Hanjin DB8 **DRILLER:** Terratest **LOGGED:** IKA/EMG **CASING:** HWT to 1.0m

TYPE OF BORING: 200mm concrete core to 0.37m, 110mm diameter auger to 1.00m, NMLC coring to 13.60m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 91.6 mAHD
EASTING: 297620
NORTHING: 6226987
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 34275.08
DATE: 5/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
91	0.03	ASPHALTIC CONCRETE							
		CONCRETE							
	0.48	SILTSTONE - very low to low strength, highly to moderately weathered, grey siltstone		D	0.48 0.8				
1	1.0	Bore discontinued at 1.0m - refusal on low to medium strength siltstone		S	1.0 1.15		20/150mm,-,- refusal		
90	2								
89	3								
88	4								
87	5								
86	6								
85	7								
84	8								
83	9								
82									

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** N/A

TYPE OF BORING: 110mm diameter auger to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 92.8 mAHD
EASTING: 297655
NORTHING: 6227010
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 34275.08
DATE: 21/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
92	0.04	ASPHALTIC CONCRETE							
		CONCRETE							
	0.55	SILTY CLAY - very stiff to hard, grey mottled red and brown silty clay, MC~PL		D	0.55				
					0.9				
	1			S	1.0		pp = 150-300 9,17,17 N = 34		1
	1.45	SILTSTONE - very low to low strength, highly to moderately weathered, grey siltstone			1.45				
91	2								2
				S	2.5 2.51		10/20mm,-,- refusal		
90	3								3
	3.1	Bore discontinued at 3.1m - refusal on low to medium strength siltstone							
89	4								4
88	5								5
87	6								6
86	7								7
85	8								8
84	9								9
83									

RIG: Hanjin DB8 **DRILLER:** Terratest **LOGGED:** IKA/EMG **CASING:** N/A

TYPE OF BORING: 110mm diameter auger to 3.1m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 84.7 mAHD
EASTING: 297519
NORTHING: 6226957
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 34275.08
DATE: 6/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
84	0.1	FILLING - brown clayey silt with a trace of rootlets, dry (topsoil)							
		SILTSTONE - very low to low strength, moderately to slightly weathered, grey siltstone		B	0.3 0.5				
83	1			S	1.0 1.06		20/60mm,-,- refusal		
	2	- with medium strength bands below 2.0m							
82	2.5	Bore discontinued at 2.5m - refusal on low to medium strength siltstone							
81	3								
80	4								
79	5								
78	6								
77	7								
76	8								
75	9								

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** N/A

TYPE OF BORING: 110mm diameter auger to 2.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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Campbelltown Hospital Stage 2 Redevelopment,
Campbelltown Hospital

BORE: 110 DEPTH: 2.55 m – 10.10 m PROJECT: 34275.08-2 March 2017

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 85.1 mAHD
EASTING: 297506
NORTHING: 6226943
DIP/AZIMUTH: 90°/--

BORE No: 110
PROJECT No: 34275.08
DATE: 6/3/2018
SHEET 1 OF 2

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
85	0.1	FILLING - brown clayey silt with a trace of rootlets, dry (topsoil)										
		SILTSTONE - very low to low strength, moderately to slightly weathered, grey siltstone										
84	1								S			20/141mm,-,- refusal
83	2	- with medium strength bands below 2.0m						Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
		- becoming medium strength below 2.55m										PL(A) = 0.36
82	3							2.8m: J, v, pl, sm, cly vn 40mm long, B, h, pl, sm, cly co 2.98m: Cs 30mm thick 3.14m: B, h, pl, sm, cly int 10mm thick 3.15m: J, 60°, sv, pl, sm, fe stn 30mm long 3.53m: J, 30°, sh, pl, sm, cly co 20mm long 3.91m: J, 30°, sh, pl, sm, cly co 20mm long	C	100	64	PL(A) = 0.45
		- becoming slightly weathered below 3.53m										
81	4	- becoming fresh stained below 4.09m										
												PL(A) = 0.66
80	5	- becoming high strength, fresh below 5.3m										PL(A) = 1.42
79	6								C	100	100	
												PL(A) = 1.37
78	7											
								7.57m: J, v, pl, ro, cln 600mm long B, h, pl, sm, cln				PL(A) = 1.22
77	8							8.21m: J, v, pl, ro, cln 120m long, B, h, pl, ro, cln	C	100	97	
												PL(A) = 1.09
76	9	- becoming medium strength below 8.86m						8.86m: J, v, st, ro, cln 240mm long, B, h, pl, ro, cln				
												PL(A) = 0.92

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.5m

TYPE OF BORING: 110mm diameter auger to 2.55m, NMLC coring to 10.10m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 85.1 mAHD
EASTING: 297506
NORTHING: 6226943
DIP/AZIMUTH: 90°/--

BORE No: 110
PROJECT No: 34275.08
DATE: 6/3/2018
SHEET 2 OF 2

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
75	10.1	SILTSTONE - medium strength, fresh stained, grey siltstone *(continued)*										
		Bore discontinued at 10.1m - limit of investigation										
74	11											
73	12											
72	13											
71	14											
70	15											
69	16											
68	17											
67	18											
66	19											

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.5m

TYPE OF BORING: 110mm diameter auger to 2.55m, NMLC coring to 10.10m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 83.8 mAHD
EASTING: 297504
NORTHING: 6226977
DIP/AZIMUTH: 90°/--

BORE No: 111
PROJECT No: 34275.08
DATE: 7/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
83	0.1	FILLING - brown clayey silt with a trace of rootlets, dry (topsoil)							
		SILTSTONE - very low to low strength, highly to moderately weathered, grey siltstone - becoming slightly weathered with medium strength bands below 0.5m		S	1.0 1.11		20/110mm,-,- refusal		
82	2.0	Bore discontinued at 2.0m - refusal on low to medium strength siltstone							
81									
80									
79									
78									
77									
76									
75									
74									

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** N/A

TYPE OF BORING: 110mm diameter auger to 2.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 83.6 mAHD
EASTING: 297475
NORTHING: 6227022
DIP/AZIMUTH: 90°/--

BORE No: 112
PROJECT No: 34275.08
DATE: 7/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
83	0.3	FILLING - brown clayey silt with a trace of rootlets, moist (topsoil)							
		SILTY CLAY - very stiff to hard, red mottled grey silty clay with a trace of ironstone gravel, MC<PL							
	1			S	1.0		pp >600 8,11,13 N = 24		
					1.45				
82	2								
	2.0	SILTSTONE - very low to low strength, highly to moderately weathered, grey siltstone							
81				S	2.5		9,16,20/130mm refusal		
	3				2.95				
80		- becoming moderately to slightly weathered with medium strength bands below 3.5m							
	4								
	4.0	Bore discontinued at 4.0m - refusal on low to medium strength siltstone							
79	5								
78	6								
77	7								
76	8								
75	9								
74									

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** N/A

TYPE OF BORING: 110mm diameter auger to 4.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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Campbelltown Hospital

BORE: 113 DEPTH: 2.60 m – 9.00 m PROJECT: 34275.08-2 March 2017

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 83.5 mAHD
EASTING: 297488
NORTHING: 6227003
DIP/AZIMUTH: 90°/--

BORE No: 113
PROJECT No: 34275.08
DATE: 7/3/2018
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)	Type	Core Rec. %	RQD %	Test Results & Comments
83	0.3	FILLING - brown clayey silt, dry (topsoil)										
		SILTSTONE - very low to low strength, highly to moderately weathered, grey siltstone							S			20/130mm,-,- refusal
82	1											
	2							Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
81									S			20/70mm,-,- refusal
		- becoming low strength, slightly weathered below 2.6m										PL(A) = 0.3
	3							3.13m: J, 70°, sv, pl, ro, fe stn 150mm long 3.22m: J, 75°, sv, pl, ro, cln 50mm long 3.35m: J, 70°, sv, pl, sm, cln 30mm long 3.85m: J, 70°, sv, pl, sm, cln 50mm long	C	100		PL(A) = 0.48
80		- becoming medium strength, fresh stained below 3.6m										
	4											
79												PL(A) = 0.45
	5											
78												PL(A) = 0.48
	6								C	100	94	
77		- becoming fresh below 6.5m										PL(A) = 0.63
	7											
76												PL(A) = 1.36
	8								C	100	100	
75								8.39m: J, 60°, sv, st, ro, cln 20mm long				PL(A) = 0.99
	9	9.0 Bore discontinued at 9.0m - limit of investigation										
74												

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.6m

TYPE OF BORING: 110mm diameter auger to 2.60m, NMLC coring to 9.00m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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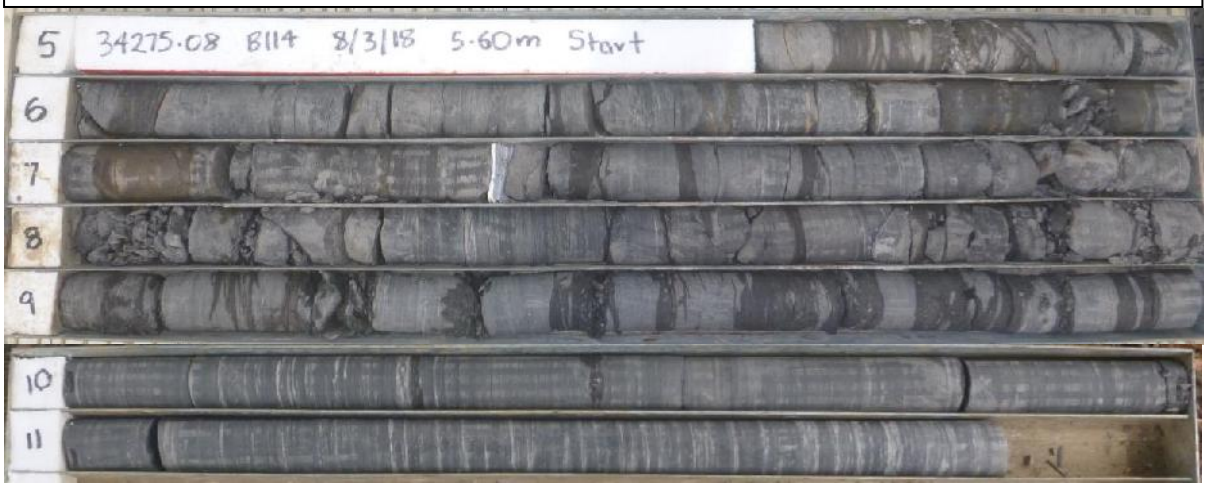
Campbelltown Hospital

BORE: 114 DEPTH: 5.60 m – 11.85 m PROJECT: 34275.08-2 March 2017



BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 81.9 mAHD
EASTING: 297509
NORTHING: 6227139
DIP/AZIMUTH: 90°/--

BORE No: 114
PROJECT No: 34275.08
DATE: 8/3/2018
SHEET 1 OF 2

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)	Type	Core Rec. %	RQD %	Test Results & Comments
81	0.05	ASPHALTIC CONCRETE										
	0.25	FILLING - grey crushed sandstone (roadbase), dry										
		FILLING - brown and red silty clay with some siltstone cobbles, MC~PL										5,7,7 N = 14
	1								S			
		- with medium strength bands below 1.5m							E			
80	1.8	SILTY CLAY - very stiff to hard, red mottled light brown and grey silty clay with some ironstone gravel, MC<PL										
	2								S			pp >600 9,13,16 N = 29
79	3											
78		- becoming grey with extremely low strength, extremely weathered shale bands below 3.7m										
	4								S			7,20,20/130mm refusal
	4.0	SILTSTONE - very low to low strength, highly to moderately weathered, grey siltstone with extremely low strength, extremely weathered bands						Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
77	5	- becoming very low to low strength, moderately weathered with medium strength, slightly weathered bands below 5.0m										
									S			20/110mmm,-,- refusal
		- becoming low strength, moderately to slightly weathered below 5.6m						5.63m: J, 30°, sh, pl, ro, fe stn 20mm long 5.78m: Cs 20mm thick 5.82m: J, 70°, sv, pl, sm, cly inf 2mm thick 40mm long 5.86m: B, h, pl, ro, fe stn 5.96m: B, h, pl, sm, cly co 6m: J, 65°, sv, pl, ro, fe stn 30mm long 6.56m: Cs 15mm thick 6.88m: fg zone, 50mm thick	C	100	46	PL(A) = 0.18 PL(A) = 0.16
76	6											
75	7	- 200mm thick extremely low strength, extremely weathered band at 6.76m - becoming medium strength, slightly weathered below 6.96m - 50mm thick extremely low strength, extremely weathered band at 7.04m						7.13m: J, 60°, sv, pl, ro, fe stn 30mm long 7.63m: J, 15°, sh, pl, sm, cln 20mm long 7.81m: fg zone 130mm thick 8m: fg zone, 130mm thick 8.16m: J, 80°, sv, pl, sm, cln 60mm long 8.23m: J, 60°, sv, pl, sm, cln 60mm long 8.56m: J, 60°, sv, pl, sm, cly co 30mm long 8.59m: J, 60°, sv, pl, ro, fe stn 20mm long 8.73m: fg zone, 140mm thick	C	100	40	PL(A) = 0.42 PL(A) = 0.51
74	8	- becoming fresh stained below 8.0m										
73	9								C	100	80	PL(A) = 0.32
72												

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 5.5m

TYPE OF BORING: 110mm diameter auger to 5.60m, NMLC coring to 11.85m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 81.9 mAHD
EASTING: 297509
NORTHING: 6227139
DIP/AZIMUTH: 90°/--

BORE No: 114
PROJECT No: 34275.08
DATE: 8/3/2018
SHEET 2 OF 2

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
71	11	- becoming fresh below 10.0m SILTSTONE - medium strength, fresh, grey siltstone *(continued)*						8.87m: J, v, pl, sm, cln 70mm thick 8.94m: J, v, pl, sm, cln 60mm long 9.22m: fg zone, 50mm thick 9.79m: J, 35°, sh, pl, sm, fe stn 30mm long	C	100	80	PL(A) = 0.56 PL(A) = 0.68
70	11.85 12	Bore discontinued at 11.85m - limit of investigation										
69	13											
68	14											
67	15											
66	16											
65	17											
64	18											
63	19											
62												

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 5.5m

TYPE OF BORING: 110mm diameter auger to 5.60m, NMLC coring to 11.85m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 82.3 mAHD
EASTING: 297511
NORTHING: 6227121
DIP/AZIMUTH: 90°/--

BORE No: 115
PROJECT No: 34275.08
DATE: 8/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
82	0.05	ASPHALTIC CONCRETE							
	0.3	FILLING - grey crushed sandstone (roadbase), dry							
		FILLING - brown and red silty clay with a trace of siltstone gravel, MC~PL		E	0.5				
81	1			S	1.0		6,9,14 N = 23		
					1.45				
	1.9	SILTY CLAY - very stiff to hard, red mottled grey silty clay with a trace of ironstone gravel, MC~PL							
80	2	- becoming grey with extremely low strength, extremely weathered bands below 2.3m							
	2.5	SILTSTONE - very low to low strength, highly to moderately weathered, grey siltstone with extremely low strength, extremely weathered bands		S	2.5		11,16,20/140mm refusal		
79	3				2.94				
		- becoming very low to low strength, highly to moderately weathered with medium strength bands below 3.8m		S	4.0 4.11		20/110mm,-,- refusal		
78	4								
	5.0	Bore discontinued at 5.0m - refusal on low to medium strength siltstone							
77	5								
76	6								
75	7								
74	8								
73	9								

RIG: Commacchio Geo 205 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** N/A

TYPE OF BORING: 110mm diameter auger to 5.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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Campbelltown Hospital Stage 2 Redevelopment,
Campbelltown Hospital

BORE: 116 DEPTH: 2.55 m – 20.80 m PROJECT: 34275.08-2 March 2017

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 96.1 mAHD
EASTING: 297577
NORTHING: 6226927
DIP/AZIMUTH: 90°/--

BORE No: 116
PROJECT No: 34275.08
DATE: 14/3/2018
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
96	0.05	ASPHALTIC CONCRETE										
	0.3	FILLING - grey crushed sandstone (roadbase), moist										
		SILTSTONE - very low to low strength, highly weathered to moderately weathered, grey siltstone										
95	1								S			20/130mm,-,- refusal
94	2							Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°	S			20/130mm,-,- refusal
		- becoming very low strength and highly weathered below 2.63m										PL(A) = 0.06
93	3	- becoming low strength and slightly weathered below 2.72m						3.06m: Cs 20mm thick 3.23m: J, 70°, sv, pl, fe fe stn 40mm long 3.27m: J, 70°, sv, pl, ro, fe stn 40mm long 3.62m: B, h, pl, sm, cly inf 5mm thick 3.63m: J, 65°, sv, pl, sm, cly co 40mm long				PL(A) = 0.25
92	4	- highly weathered band (200mm thick) at 4.25m							C	100	75	PL(A) = 0.17
91	5							4.84m: J, 65°, sv, pl, sm, cly co 40mm long 4.85m: J, 70°, sv, pl, sm, cly co 40mm long 5.08m: J, 65°, sv, cu, he, fe stn 30mm long				PL(A) = 0.43 PL(A) = 0.3
90	6							6.14m: B, h, pl, sm, cly inf 5mm thick 6.36m: J, v, cu, ro, fe stn 690mm long				PL(A) = 0.21
89	7	- becoming medium strength and fresh stained below 7.29m - becoming fresh below 7.70m						7.41m: J, 30°, sh, pl, he, fe stn 20mm long 7.46m: J, 30°, sh, pl, he, fe st 20mm long	C	100	99	PL(A) = 0.94
88	8											PL(A) = 0.41
87	9								C	100	99	PL(A) = 0.54

RIG: Hanjin DB8 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.7m

TYPE OF BORING: 110mm diameter auger to 2.63m, NMLC coring to 22.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 96.1 mAHD
EASTING: 297577
NORTHING: 6226927
DIP/AZIMUTH: 90°/--

BORE No: 116
PROJECT No: 34275.08
DATE: 14/3/2018
SHEET 2 OF 3

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)	Type	Core Rec. %	RQD %	Test Results & Comments
86		SILTSTONE - medium strength, fresh, grey siltstone *(continued)*										
								10.56m: J, 30°, sh, pl, sm, cln 20mm long	C	100	99	PL(A) = 0.49
85	11											
												PL(A) = 0.85
84	12											PL(A) = 0.75
		- with high strength bands below 12.50m						12.7m: J, 30°, sh, pl, sm, cln 20mm long				
83	13							12.98m: J, 30°, sh, pl, sm, cln 20mm long	C	100	100	
												PL(A) = 1.06
82	14											PL(A) = 0.55
								14.88m: Cs 20mm thick				
81	15	SILTSTONE - medium strength, fresh, grey siltstone *(continued)*										
												PL(A) = 1.09
80	16								C	100	100	
								16.29m: J, 70°, sv, pl, sm, cln 90mm long				
												PL(A) = 0.77
79	17											
												PL(A) = 0.81
78	18											
												PL(A) = 0.7
									C	100	97	
77	19											
												PL(A) = 0.57

RIG: Hanjin DB8 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.7m

TYPE OF BORING: 110mm diameter auger to 2.63m, NMLC coring to 22.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 96.1 mAHD
EASTING: 297577
NORTHING: 6226927
DIP/AZIMUTH: 90°/--

BORE No: 116
PROJECT No: 34275.08
DATE: 14/3/2018
SHEET 3 OF 3

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
76		SILTSTONE - medium strength, fresh, grey siltstone *(continued)*							C	100	97	
								20.42m: J, 30°, sh, pl, sm, un, cln 20mm long				PL(A) = 1.02
75	21											PL(A) = 1.17
									C	100	95	
74	22											PL(A) = 0.86
								22.38m: J, 70°, sv, pl, sm, cly co 60mm long 22.47m: B, h, pl, sm, cly inf 10mm thick				
73	23 22.95	Bore discontinued at 22.95m - limit of investigation										PL(A) = 2.06
72	24											
71	25											
70	26											
69	27											
68	28											
67	29											

RIG: Hanjin DB8 **DRILLER:** Terratest **LOGGED:** IKA **CASING:** HWT to 2.7m

TYPE OF BORING: 110mm diameter auger to 2.63m, NMLC coring to 22.95m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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: Campbelltown Hospital Stage 2 Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 100.9 mAHD
EASTING: 297648
NORTHING: 6226948
DIP/AZIMUTH: 90°/--

BORE No: 118
PROJECT No: 34275.08
DATE: 13/3/2018
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	VWP Construction Details
100.85	0.05	ASPHALTIC CONCRETE							
100.5	0.4	FILLING - brown, crushed sandstone (roadbase), moist							
		SILTSTONE - very low to low strength, highly weathered to moderately weathered grey siltstone		S	1.0 1.2		12,20/50,- refusal		
		- becoming low strength and moderately weathered to slightly weathered, with medium strength bands below 2.0m		S	2.5		18,20/50,- refusal		
98.2	2.7	Bore discontinued at 2.7m - refusal on low to medium strength siltstone			2.7				

RIG: Hanjin DB8 **DRILLER:** Terratest **LOGGED:** IKA/EMG **CASING:** N/A

TYPE OF BORING: 110mm diameter auger to 2.63m, NMLC coring to 2.70m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. MC = moisture content; PL = plastic limit

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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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 81.9 mAHD
EASTING: 297401
NORTHING: 6227040
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 34275.00
DATE: 17 - 18/3/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		B - Bedding J - Joint; S - Shear F - Fault	EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00					
81	1	FILLING - grey brown mottled orange brown clayey fine to coarse grained siltstone gravel filling with some gravelly clay bands, dry							A			
									A			
									A			
									S			9,10,8 N = 18
80	2											
									S			3,5,3 N = 8
79	3											
78	3.7	SILTY CLAY - hard, grey brown silty clay with trace fine grained ironstone gravel and ash, mc>pl										
	4								S			3,9,8 N = 17 pp = 430->600
	4.3	SILTY CLAY - hard, red brown mottled grey silty clay with trace fine grained ironstone gravel and rootlets, mc>pl							S			
77	4.9	SHALE - extremely low strength, extremely weathered, grey shale						Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
	5											
	5.3	- coring started at 5.3m						5.3m: CORE LOSS: 260mm				
	5.56	SILTSTONE - medium strength, fresh stained, highly fractured, dark grey siltstone										
76	6							5.9m: Cs, sh, pl, 13mm.t 6.04m: Ds, h, pl, 4mm.t 6.14m: 2xJ, 65°, un, st 6.28m: J, sv, un, sm	C	80	80	PL(A) = 0.41
												PL(A) = 0.58
75	7							6.73m: Cs, 0-35°, 36mm.t 6.8m: J, sv, un, ro 6.95m: J, 45°, pl, ro, cly vn 7m: J, 55°m pl, ro 7.05m: Cs, 0-55°, 36mm.t 7.14m: J, 60°, pl, ro, st 7.23m: Ds, sh, pl, 4mm.t 7.25m: Cs, sh, pl, 12mm.t 7.28m: B, 20°, pl, sm, cly inf 3mm.t 7.42m: B, 15°, pl, sm, cly inf 3mm.t 7.6m: J, 60°, p, ro, clay co 7.64m: J, 80°, pl, sm 7.71m: J, 40°, pl, sm 7.79m: J, 70°, pl, sm 8.26m: J, 30°, pl, sm 8.42m: J, 25°, pl, sm 9.35m: J, 70-80°, un, ro	C	100	20	
74	8	- becoming slightly fractured below 8.26m										
73	8.95	SILTSTONE - medium strength, fresh stained, slightly fractured, dark grey siltstone with some light gray laminae bedding at 0-10°							C	100	100	PL(A) = 0.7 PL(A) = 0.58 PL(A) = 0.41
	9											
72	9.7	Bore discontinued at 9.7m										

RIG: Bobcat **DRILLER:** SY **LOGGED:** TOM **CASING:** HW to 4.0m

TYPE OF BORING: NMLC

WATER OBSERVATIONS: No free groundwater observed whilst augering, 95% return, Groundwater observed at 6.85m on 22/3/11

REMARKS: Location coordinates are in MGA94 Zone 56. Screen 6.7 - 9.7m, casing 0 - 6.7m, sand 5.7 - 9.7m, bentonite 4.5 - 5.7m, backfilled and finished with concrete and gatic

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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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 79.7 mAHD
EASTING: 297438
NORTHING: 6227140
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 34275.00
DATE: 18/3/2011
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)	Type	Core Rec. %	RQD %	Test Results & Comments
79	0	FILLING - brown silty fine to coarse grained shale gravel filling with some gravelly clay bands, dry							A			
	1								A			
78									S			6,17,18 N = 35
	2											
	2.5	SILTY CLAY - hard, red brown silty clay with trace coarse grained sand, mc~pl							S			10,13,19 N = 32 pp > 600
77	3							Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
76	4											
	4.0							4m: CORE LOSS: 200mm				
	4.2							4.2m: Ds, h, 40mm				
	4.29	SHALE - extremely low strength, extremely weathered, light grey shale with some siltstone bands						4.45m: J, 30°, pl, sm, fe stn				
75		SILTSTONE - medium strength, fresh stained, fractured, dark grey siltstone						4.53m: J, 20°, pl, sm, fe stn	C	86	17	PL(A) = 0.43
	5							4.8m: J, 20°, pl, sm, fe stn 5m: J, 25°, pl, sm, fe stn 5.08m: Cs, sh, pl, 3mm.t 5.1m: J, 30°, un, sm, fe stn				
74								5.2m: J, 50°, pl, st, fe stn 5.27m: J, 25°, pl, sm, st 5.35m: 2xJ, 15-35°, pl, sm, st	C	100	83	
	6							5.39m: Cs, h, pl, 8mm.t				PL(A) = 0.43
73		- becoming slightly fractured below 6.71m						5.51m: J, 50°, pl, sm, fe stn 5.63m: J, 15°, pl, ro 5.81m: J, 30°, pl, ro, fe stn 5.84m: J, 60°, pl, sm, fe stn				
	7							5.92m: Cs, h, pl, 36mm.t 5.96m: 3xJ, sv, pl, sm, fe stn 6.07m: J, 30°, pl, ro 6.09m: J, sv, pl, sm, partially he	C	100	80	PL(A) = 0.32
72	8	- becoming unbroken below 8.3m						6.96m: Cs, sh, 17mm.t 7.64m: 2xJ, 30°, pl, sm 7.72m: J, 70°, pl, sm 8.22m: J, 40°, pl, sm 8.3m: J, 40°, pl, sm	C	100	100	PL(A) = 0.64 PL(A) = 0.74
71	9											
	9.1	Bore discontinued at 9.1m										
70												

RIG: Bobcat **DRILLER:** SY **LOGGED:** TOM **CASING:** HW to 2.5m

TYPE OF BORING: NMLC

WATER OBSERVATIONS: No free groundwater observed whilst augering, 95% return, Groundwater observed at 3.60m on 22/3/11

REMARKS: Location coordinates are in MGA94 Zone 56. Screen 6.1 - 9.1m, casing 0 - 6.1m, gravel 5.5 - 9.1m, bentonite 4.0 - 5.5m, backfilled and finished with concrete and gatic

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: Campbelltown Hospital Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 83.1 mAHD
EASTING: 297445
NORTHING: 6227088
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 34275.00
DATE: 21/3/2011
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)	Type	Core Rec. %	RQD %	Test Results & Comments
83	0.4	FILLING - brown silty fine to coarse grained sandy fine to coarse grained igneous gravel filling, moist							A			
		FILLING - brown fine to coarse grained igneous and siltstone gravelly clay filling with trace steel, brick and concrete fragments, mc~pl							A			
82	1								S			6,5,7 N = 12
									A			
81	2											
									S			8,13,14 N = 27
80	3											
	3.8	SILTY CLAY - hard, red brown mottled light grey silty clay with trace rootlets, mc>pl						Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°	S			4,8,12 N = 20
79	4											PL(A) = 1.64
	4.5	SHALE - extremely low strength extremely weathered, light grey shale with some iron indurated bands										
	4.85	SILTSTONE - medium strength, highly weathered, fractured, dark grey siltstone with some iron indurated bands						4.92m: J, 40°, pl, sm, cln 5.04m: Cs, h, 50mm.t 5.12m: J, 55°, pl, sm, cly co 5.25m: Ds, h, pl, 5mm.t 5.45m: Ds, h, pl, 16mm.t 5.5m: J, 45°, pl, sm, cly inf 8mm.t 5.6m: Cs, h, p, 70mm.t 5.7m: Ds, h, 190mm.t 5.9m: CORE LOSS: 300mm 6.26m: Cs, h, pl, 60mm.t 6.32m: Cs, h, pl, 20mm.t 6.34m: Cs, h, pl, 20mm.t 6.36m: B, 20°, pl, sm, fe stn 6.37m: B, 20°, pl, sm, fe stn 6.38m: Cs, 20°, pl, 8mm.t 6.44m: Cs, h, pl, 40mm.t 7.59m: Cs, 0-20°, pl, sm, cly inf 1-6mm.t 7.86m: Ds, 0-15°, 70mm.t 7.95m: J, h-v, cu, sm, fe stn 8m: Ds, h, pl, 12mm.t 8.07m: Ds, 0-20°, un, 12mm.t 8.25m: J, 70°, pl, sm, fe stn 8.41m: J, 80°, pl, sm, fe stn 8.62m: Cs, h, pl, 15mm.t	C	82	48	
78	5											
77	6											
	6.2	SILTSTONE - medium strength, slightly weathered, fractured, dark grey siltstone with some iron indurated bands - becoming slightly fractured below 6.44m							C	100	82	PL(A) = 0.61
76	7											
75	8	- becoming fractured below 7.86m										PL(A) = 0.61
	8.78	Bore discontinued at 8.78m										
74	9											

RIG: Bobcat **DRILLER:** SY **LOGGED:** TOM **CASING:** HW to 2.5m

TYPE OF BORING: NMLC

WATER OBSERVATIONS: No free groundwater observed whilst augering, 90% return at 4.5m, 70% at 5.5m

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Campbelltown Hospital Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 82.1 mAHD
EASTING: 297420
NORTHING: 6227112
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 34275.00
DATE: 22/3/2011
SHEET 1 OF 2

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
82	0	FILLING - brown fine to coarse grained shale and igneous gravelly clay filling with some grey bands, mc>pl - becoming mc<pl below 0.4m							A			
81	1								A			
									S			5,5,7 N = 12
80	2								A			
									S			11,11,14 N = 25
79	3											
78	4								S			13,13,17 N = 30
77	4.9 5	SHALE - extremely low strength, extremely weathered, light grey shale with grey very low strength bands						Unless otherwise stated, rock is fractured along smooth to rough planar bedding dipping at 0°-10°				
	5.65 5.73	SILTSTONE - very low to low strength, moderately weathered, fractured, dark grey siltstone						5.65m: CORE LOSS: 80mm 5.73m: J, sv, pl, sm 5.89m: J, 65°, pl, sm 6.02m: Cs, h, pl, 3mm,t 6.07m: Cs, h, pl, 4mm.t 6.14m: Cs, h, pl, 40mm.t 6.21m: Cs, h, pl, 10mm.t 6.27m: J, sv, pl, sm 6.35m: Cs, h, pl, 56mm.t 6.42m: Cs, h, pl, 4mm.t 6.45m: Ds, h, pl, 8mm.t 6.61m: Ds, sh, pl, 18mm.t 6.67m: J, 35°, pl, sm 6.71m: Ds, sh, un, 25mm.t 6.73m: J, h-v, cu, sm 6.74m: J, h-v, cu, sm 6.81m: Ds, h, pl, 40mm.t 6.85m: Cs, sh, pl, 30mm.t 6.96m: J, 30°, pl, sm 7m: J, sv, un, sm 7.08m: J, 2v, ir, sm 7.18m: Ds, sh, pl, 26mm.t 7.21m: J, 45°, un, sm 7.56m: J, 30°, pl, sm 7.62m: J, 45°, un, sm 7.65m: J, 45°, un, sm 7.66m: J, 75°, un, sm	C	97	50	PL(A) = 0.4
76	6											
75	7 7.24	SILTSTONE - medium strength, fresh stained, fractured, dark grey siltstone										
74	8	- becoming slightly fractured below 8.54m							C	100	100	PL(A) = 0.43 PL(A) = 0.36
73	9											
	10.0	Bore discontinued at 10.0m										

RIG: Bobcat **DRILLER:** SY **LOGGED:** TOM **CASING:** HW to 2.5m

TYPE OF BORING: NMLC

WATER OBSERVATIONS: No free groundwater observed whilst augering, 70% return at 5.65m

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Campbelltown Hospital Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 82.1 mAHD
EASTING: 297420
NORTHING: 6227112
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 34275.00
DATE: 22/3/2011
SHEET 2 OF 2

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
72												PL(A) = 0.17
								7.7m: Ds, h pl, 4mm.t 7.98m: J, 20°, pl, sm 8.32m: Cs, sh, pl, 12mm.t 8.47m: Cs, sh, pl, 16mm.t 8.54m: J, sv, pl, ro 9.68m: Cs, sh, pl, 10mm.t				
71	11											
70	12											
69	13											
68	14											
67	15											
66	16											
65	17											
64	18											
63	19											

RIG: Bobcat **DRILLER:** SY **LOGGED:** TOM **CASING:** HW to 2.5m

TYPE OF BORING: NMLC

WATER OBSERVATIONS: No free groundwater observed whilst augering, 70% return at 5.65m

REMARKS: Location coordinates are in MGA94 Zone 56.

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: Campbelltown Hospital Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 83 mAHD
EASTING: 297544
NORTHING: 6227093
DIP/AZIMUTH: 90°/--

BORE No: 38
PROJECT No: 34275.00
DATE: 30/3/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
83	0.03	ASPHALTIC CONCRETE - 30mm thick							
	0.1								
	0.2	FILLING - green grey silty, fine to coarse grained sandy fine to medium grained igneous gravel (roadbase) filling, moist		A	0.5		pp = 160-180		
	0.8	FILLING - light brown silty, fine to coarse grained sandy fine to coarse grained sandstone gravel (crushed sandstone) filling, moist		A	1.0				
82	1	SHALY CLAY - stiff, light grey mottled orange brown shaly clay, mc>pl							
		SHALE - extremely low strength, extremely weathered, light grey shale with dark grey low strength bands							
81	2	- becoming low strength, slightly weathered, with some light grey extremely low strength shale below 1.6m		A	2.0				
	2.9	Bore discontinued at 2.9m		A	3.0				
80	3	- TC-bit refusal on low strength shale							
79	4								
78	5								
77	6								
76	7								
75	8								
74	9								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Kubota KX41-3V **DRILLER:** JB **LOGGED:** TOM **CASING:** N/A

TYPE OF BORING: 150mm diameter SFA

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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: Campbelltown Hospital Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 82.5 mAHD
EASTING: 297507
NORTHING: 6227094
DIP/AZIMUTH: 90°/--

BORE No: 39
PROJECT No: 34275.00
DATE: 30/3/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
82	0	FILLING - brown grey clayey, fine to coarse grained shale gravel filling with some fine to coarse grained sand, moist		A	0.5				
81	1			A	1.5				
80	2			A	2.0				
	2.6	Bore discontinued at 2.6m - TC-bit refusal on suspected shale bedrock		A	2.6				
79	3								
78	4								
77	5								
76	6								
75	7								
74	8								
73	9								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Kubota KX41-3V **DRILLER:** JB **LOGGED:** TOM **CASING:** N/A

TYPE OF BORING: 150mm diameter SFA

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Campbelltown Hospital Redevelopment
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 81.9 mAHD
EASTING: 297508
NORTHING: 6227131
DIP/AZIMUTH: 90°/--

BORE No: 40
PROJECT No: 34275.00
DATE: 30/3/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
81	0.04	ASPHALT - 40mm thick asphalt							
		FILLING - brown fine to coarse grained shale gravelly clay filling with some fine to coarse grained sand, mc>pl		A	0.5				
	1			A	1.0				
				A	1.5				
80	2								
	2.0	SILTY CLAY - very stiff, red brown grading to light grey silty clay, mc>pl		A	2.0		pp = 210-320		
		- becoming light grey, mc~pl below 2.5m							
79	2.8	SHALE - low strength, highly weathered, grey shale with extremely low strength bands							
	3			A	3.0				
78	4								
	4.5	Bore discontinued at 4.5m		A	4.5				
77		- TC-bit refusal on low strength shale							
	5								
76	6								
75	7								
74	8								
73	9								
72									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Kubota KX41-3V **DRILLER:** JB **LOGGED:** TOM **CASING:** N/A

TYPE OF BORING: 150mm diameter SFA

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 83.0 mAHD
EASTING: 297554
NORTHING: 6227133
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 22884-1
DATE: 3/9/1998
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
83		FILLING - red brown to grey clay and crushed shale filling										
82	1								S			2,3,3 N = 6
81	2								S			3,5,7 N = 12
	2.3	SILTY CLAY - stiff to very stiff, light yellow brown silty clay										
80	3								S			5,7,9 N = 16
79	4	- traces of peat below 4.0m							S			4,6,7 N = 13
78	5								S			4,8,12 N = 20
	5.1	CLAY - very stiff, red brown mottled grey clay with ironstone gravel										
	5.5	CLAY - very stiff to hard, grey brown clay with ironstone bands										
77	6											
								6.2m: CORE LOSS: 600mm				
	6.8	CLAY - hard, grey mottled yellow brown clay with low strength ironstone bands (extremely weathered shale)										pp >400
76	7								C	80	0	pp >400 pp >400 pp >400
75	8											pp >400
	8.4	SHALE - low and medium strength, highly weathered, fragmented to highly fractured, dark grey shale with very low strength band										
74	9											
	9.2	Bore discontinued at 9.2m - limit of investigation										

RIG: B40 **DRILLER:** Chittleburgh **LOGGED:** Parmar **CASING:** GL to 6.0m

TYPE OF BORING: SFA to 5.5m, rotary to 6.2m, NMLC coring to 9.2m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 86.9 mAHD
EASTING: 297547
NORTHING: 6227074
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 22884-1
DATE: 2/9/1998
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
86	0.2	TOPSOIL - dark brown loamy soil										
	0.6	FILLING - roadbase filling										
	1	FILLING - dark grey black crushed shale and ash filling							S			12,17,16 N = 33
85	2								S			17,16,11 N = 27
84	3								S			3,6,13 N = 19
	3.3	SHALY CLAY - very stiff to hard, grey shaly clay										
83	4								S			14,20,25 N = 45
	4.0	SHALE - extremely low to very low strength, extremely to highly weathered, light brown grey shale, slightly ironstained										
82	5								S			16,25/50mm,- refusal
	5.5							5.4m: CORE LOSS: 100mm				
	5.68	SHALE - low and medium strength, moderately and slightly weathered, fractured, dark grey black shale with very low strength bands along bedding planes (Note: fractures along bedding planes at 0-10° and joints at 30-50°)							C	96	0	PL(A) = 0.7 PL(A) = 0.5 PL(A) = 0.3
81	6											
80	7											
79	8											
	8.2	Bore discontinued at 8.2m - limit of investigation										
78	9											
77												

RIG: B40 **DRILLER:** Chittleburgh **LOGGED:** Parmar **CASING:** GL to 6.0m

TYPE OF BORING: SFA to 5.4m, NMLC coring to 8.2m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 87.5 mAHD
EASTING: 297546
NORTHING: 6227019
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 22884-1
DATE: 3/9/1998
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
87	0.1	TOPSOIL - black topsoil FILLING - sand and gravel filling										
	0.8	FILING - coal and shale filling										
	0.95	SILTY CLAY - very stiff to hard, light grey brown silty clay										
86	1.15	SHALE - extremely low strength, extremely weathered, brown grey shale							S			3,13,22 N = 35
	2.2	SHALE - very low and low strength, highly weathered, fragmented to fractured, light brown grey shale with extremely low strength seams						2.1m: CORE LOSS: 100mm				
85	3.29	SHALE - low and medium strength moderately and slightly weathered, fractured, dark grey black shale with extremely low and very low strength bands along bedding planes (Note: fractures along bedding planes at 0-10° and joints at 30-50°)							C	97	0	PL(A) = 0.8 PL(A) = 0.6
84												
83												
82												PL(A) = 0.4
81									C	100	21	PL(A) = 0.8
80	7.0	Bore discontinued at 7.0m - limit of investigation										PL(A) = 0.8
79												
78												

RIG: B40 **DRILLER:** Chittleburgh **LOGGED:** Parmar **CASING:** GL to 2.5m

TYPE OF BORING: SFA to 2.1m, NMLC coring to 7.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 86.5 mAHD
EASTING: 297523
NORTHING: 6227022
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 22884-1
DATE: 2/9/1998
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
86	0.05	BITUMEN										
	0.1	FILLING - roadbase filling										
		FILLING - crushed sandstone filling										
	0.6	FILLING - sand and brown clay filling										
85	1								S			5,6,14 N = 20
	1.3	SHALE - extremely low strength, extremely weathered, light grey shale										
84	2											
	2.1	SHALE - medium strength, slightly weathered, fractured, dark grey black shale with very low strength bands (Note: fractures along bedding planes at 0-10° and joints at 30-60°)										PL(A) = 0.5
83	3											PL(A) = 0.6
									C	100	15	PL(A) = 0.4
	3.9	SHALE - medium and medium high strength, slightly weathered, fractured to slightly fractured, dark grey black shale with a high strength band										PL(A) = 0.6
82	4											
												PL(A) = 1.7
81	5											PL(A) = 1
									C	100	87	
80	6											PL(A) = 0.8
	7.0	Bore discontinued at 7.0m - limit of investigation										
79	7											
78	8											
77	9											

RIG: B40 **DRILLER:** Chittleburgh **LOGGED:** Parmar **CASING:** GL to 2.5m

TYPE OF BORING: SFA to 2.1m, NMLC coring to 7.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 83.0 mAHD
EASTING: 297474
NORTHING: 6227050
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 22884-1
DATE: 4/9/1998
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
83	0.05	BITUMEN										
	0.15	FILLING - roadbase filling										
	0.3	FILLING - crushed sandstone filling										
		FILLING - red brown and grey clay, ash and shale filling							S			5,7,13 N = 20
82	1											
									S			4,6,7 N = 13
81	2											
	2.15	SILTY CLAY - stiff, light yellow and red brown silty clay										
	2.8	SHALE - extremely low to very low strength, extremely to highly weathered, light brown grey shale with ironstone bands							S			13,25/150mm,- refusal
80	3											
79	4											
	4.0	SHALE - very low strength, highly weathered, fragmented to fractured, dark grey shale with low strength bands										
	4.65	- 30mm clay band at 4.34n										
		SHALE - low and medium strength, highly and moderately weathered, fractured, dark grey black shale with very low strength bands (Note: fractures along bedding planes at 0-10° and jin6ts at 30-50°)							C	100	0	PL(A) = 0.4 PL(A) = 0.5 PL(A) = 0.3
78	5											
77	6											
76	7											
	7.0	Bore discontinued at 7.0m - limit of investigation										
75	8											
74	9											

RIG: B40 **DRILLER:** Chittleburgh **LOGGED:** Parmar **CASING:** GL to 4.5m

TYPE OF BORING: SFA to 4.0m, NMLC coring to 7.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 87.0 mAHD
EASTING: 297496
NORTHING: 6226992
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 22884-1
DATE: 4/9/1998
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
87	0.3	TOPSOIL - brown silty clay										
		FILLING - dark grey crushed shale filling							S			9,15,17 N = 32
86	1											
									S			6,7,7 N = 14
85	2											
	2.3	SILTY CLAY - stiff, light red brown silty clay										
	2.8	SHALE - extremely low to very low strength, extremely to highly weathered, light grey shale							S			13,25/100mm,- refusal
84	3											
	3.85	SHALE - low and very low strength, highly and moderately weathered, fragmented to highly fractured, dark grey black shale							C	100	0	PL(A) = 0.2
83	4											
82	5											PL(A) = 0.3
	5.25	SHALE - low to medium strength, highly and moderately weathered, fractured, dark grey black shale (Note: fractures along bedding planes at 0-10° and joints at 30-45°)										PL(A) = 0.5
81	6								C	100	30	
	6.25	SHALE - medium to high then high strength, slightly weathered, fractured to slightly fractured, dark grey black shale										PL(A) = 1
80	7											PL(A) = 1.1
	7.0	Bore discontinued at 7.0m - limit of investigation										
79	8											
78	9											

RIG: B40 **DRILLER:** Chittleburgh **LOGGED:** Parmar **CASING:** GL to 4.5m

TYPE OF BORING: SFA to 3.85m, NMLC coring to 7.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 79.0 mAHD
EASTING: 297470
NORTHING: 6227139
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 22884-1
DATE: 31/8/1998
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
79	0.25	TOPSOIL - dark brown silty clay topsoil			0.2		pp = 280		
		CLAY - hard, red brown clay			0.4		pp = 430		
				A	0.5		PID=5		
	0.7	CLAY - very stiff, grey mottled orange brown clay with some shale		B					
78	1				0.9		pp = 375		1
	1.1			A	1.0		PID=6		
		SHALE - very low to low strength, dark grey shale							
				A	1.5		PID=4		
	1.7	SHALE - low strength, dark grey shale							
77	2			A	2.0		PID=4		2
	2.1	Bore discontinued at 2.1m - limit of investigation							
76	3								3
75	4								4
74	5								5
73	6								6
72	7								7
71	8								8
70	9								9

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Long **CASING:** N/A

TYPE OF BORING: 250mm diamieter spiral flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 78.9 mAHD
EASTING: 297532
NORTHING: 6227165
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 22884-1
DATE: 31/8/1998
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
78	0.2	FILLING - dark brown silty clay with some gravel and plastic noted		A	0.2				
				A	0.4		pp = 410		
	0.6	FILLING - hard, red brown clay with some basalt gravel and metal pieces			0.5		pp = 250 PID=3		
		FILLING - very stiff, brown clay with some shale gravel		B					
	1			A	1.0		PID=4		1
	1.5			A	1.5		PID=3		
77		Bore discontinued at 1.5m - refusal on sandstone rubble in filling							
	2								2
76	3								3
75	4								4
74	5								5
73	6								6
72	7								7
71	8								8
70	9								9
69									

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Long **CASING:** N/A

TYPE OF BORING: 250mm diamieter spiral flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 80.9 mAHD
EASTING: 297557
NORTHING: 6227181
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 22884-1
DATE: 31/8/1998
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
80	0.35	TOPSOIL - dark brown silty clay topsoil			0.1		pp = 310		
					0.3		pp = 420		
		CLAY - very stiff to hard, orange brown clay		A	0.5		PID=3		
				B					
79	1			A	1.0		PID=5		
					1.4		pp = 380		
				A	1.5		PID=4		
78	2			A	2.0		PID=3		
	2.1	Bore discontinued at 2.1m - limit of investigation							
77	3								
76	4								
75	5								
74	6								
73	7								
72	8								
71	9								

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Long **CASING:** N/A

TYPE OF BORING: 250mm diamieter spiral flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 80.5 mAHD
EASTING: 297472
NORTHING: 6227107
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 22884-1
DATE: 31/8/1998
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
80	0.25	TOPSOIL - brown silty clay topsoil			0.2		pp = 320		
		CLAY - hard, red brown mottled grey clay			0.3		pp = 420		
				A	0.5		PID=4		
	0.75			B					
	0.95	SHALE - extremely low to very low strength, dark grey shale with some clay		A	1.0		PID=5		
79		SHALE - very low strength, dark grey shale		A	1.5		PID=4		
	1.8			A	1.8		PID=4		
		Bore discontinued at 1.8m - refusal on low stregth dark grey shale							

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Long **CASING:** N/A

TYPE OF BORING: 250mm diamieter spiral flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 81.8 mAHD
EASTING: 297531
NORTHING: 6227136
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 22884-1
DATE: 31/8/1998
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
81	0.2	FILLING - very stiff, brown silty clay			0.2		pp = 220		
		FILLING - very stiff, orange brown clay with shale gravel			0.4		pp = 280		
				A	0.5		PID=3		
	0.6	SILTY CLAY - very stiff, brown silty clay		B					
80	1.0	CLAY - very stiff, orange brown clay		A	1.0		PID=4		
		- becoming red brown at approximately 1.3m		A	1.5		PID=3		
					1.8		pp = 420		
	2.3			A	2.0		PID=2		
		Bore discontinued at 2.3m - limit of investigation							

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Long **CASING:** N/A

TYPE OF BORING: 250mm diamieter spiral flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 82.2 mAHD
EASTING: 297578
NORTHING: 6227155
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 22884-1
DATE: 31/8/1998
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
82	0	FILLING - very stiff, brown silty clay with some basalt gravel and shale			0.2		pp = 260		
				A	0.5		PID=5		
				U_{50}	0.6				
81	1				0.9		pp = 420		1
				A	1.0		PID=4		
				A	1.4 1.5		pp >450 PID=2		
	1.8	CLAY - hard, orange brown clay with minor fragments of shale (possibly filling)							
	2			A	2.0		PID=2		2
80	2.1	Bore discontinued at 2.1m - limit of investigation							
	3								3
79									
	4								4
78									
	5								5
77									
	6								6
76									
	7								7
75									
	8								8
74									
	9								9
73									

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Long **CASING:** N/A

TYPE OF BORING: 250mm diamieter spiral flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: South Western Sydney Area Health Service
PROJECT: Macarthur Project - Campbelltown Hospital
LOCATION: Therry Road, Campbelltown

SURFACE LEVEL: 91.8 mAHD
EASTING: 297537
NORTHING: 6226933
DIP/AZIMUTH: 90°/--

BORE No: 16
PROJECT No: 22884-1
DATE: 31/8/1998
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
91	0.9	FILLING - very stiff, brown silty clay filling			0.25		pp = 350		
				A	0.5		PID=6		
				U_{50}	0.6				
	1	FILLING - very low strength, dark grey shale with some clay filling		A	0.95 1.0		PID=4		1
				A	1.5		PID=3		
90	1.8	CLAY - very stiff, red brown clay			1.8		pp = 320		
	2			A	2.0		PID=3		2
	2.1	Bore discontinued at 2.1m - limit of investigation							
89	3								3
88	4								4
87	5								5
86	6								6
85	7								7
84	8								8
83	9								9
82									

RIG: Bobcat **DRILLER:** Ellis **LOGGED:** Long **CASING:** N/A

TYPE OF BORING: 250mm diamieter spiral flight auger

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Location coordinates are in MGA94 Zone 56. Level has been interpolated from survey plan

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: Taylor Lauder Consultants
PROJECT: Campbelltown Hospital
LOCATION: Campbelltown

SURFACE LEVEL: 77.9 mAHD
EASTING: 297414
NORTHING: 6227089
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 14060
DATE: 26/7/1990
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
77	0.25	TOPSOIL - dark brown fine grained silty sand							
	1	CLAY - very stiff to hard, clay		A	0.5				
	1.0			A	1.0				
		CLAY - very stiff to hard, light grey and brown clay		A	1.2				
	1.3	SHALE - extremely low strength, light grey and brown shale with some low to medium strength bands		A	1.5				
76	2			A	2.0				
	2.2	SHALE - low to medium strength, dark grey shale		A	2.5				
75	3			A	3.0				
	3.5	Bore discontinued at 3.5m - limit of investigation							
74	4								
73	5								
72	6								
71	7								
70	8								
69	9								
68									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Pengo **DRILLER:** Austin **LOGGED:** **CASING:** N/A

TYPE OF BORING: 300mm diameter auger

WATER OBSERVATIONS: No free groundwater observed after 3 hours

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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: Taylor Lauder Consultants
PROJECT: Campbelltown Hospital
LOCATION: Campbelltown

SURFACE LEVEL: 80.3 mAHD
EASTING: 297449
NORTHING: 6227056
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 14060
DATE: 26/7/1990
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
80	0.2	TOPSOIL - dark brown fine grained silty sand							
		CLAY - hard, red brown clay with some light grey mottling		A	0.5				
					0.6				
				U_{50}					
	0.9				0.95				
79	1	SHALE - extremely low strength, light grey and brown shale with some low to medium strength bands		A	1.0				
	1.6			A	1.5				
78	2	SHALE - low to medium strength, dark grey shale with some extremely low strength layers to 2.6m		A	2.0				
		- 100mm high strength sideritic shale nodule at 2.2m		A	2.5				
	3.0			A	3.0				
77	3	Bore discontinued at 3.0m - limit of investigation							
76	4								
75	5								
74	6								
73	7								
72	8								
71	9								

RIG: Pengo **DRILLER:** Austin **LOGGED:** **CASING:** N/A

TYPE OF BORING: 300mm diameter auger

WATER OBSERVATIONS: No free groundwater observed after 1 hour

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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: Taylor Lauder Consultants
PROJECT: Campbelltown Hospital
LOCATION: Campbelltown

SURFACE LEVEL: 79.3 mAHD
EASTING: 297462
NORTHING: 6227116
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 14060
DATE: 26/7/1990
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
79	0.2	TOPSOIL - dark brown fine grained silty sand							
		CLAY - hard, red brown clay with some light grey mottling		A	0.5				
	0.6	SHALE - extremely low strength, light grey and brown shale with some low to medium strength bands		A	1.0				
78	1			A	1.5				
	1.7	SHALE - low to medium strength, dark grey shale		A	2.0				
77	2			A	2.5				
	3			A	3.0				
76	3.0	Bore discontinued at 3.0m - limit of investigation							
75	4								
74	5								
73	6								
72	7								
71	8								
70	9								

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Pengo **DRILLER:** Austin **LOGGED:** **CASING:** N/A

TYPE OF BORING: 300mm diameter auger

WATER OBSERVATIONS: No free groundwater observed after 3½ hours

REMARKS: Location coordinates are in MGA94 Zone 56.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

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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Photo 1 - Looking west across southern-most terrace of car park (southern edge of proposed CSB)

Photo 2 - Looking est across loading dock (northern edge of proposed CSB)

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Stage 2 Redevelopment** **Campbelltown Hospital**	PROJECT: 34275.08-2 PLATE No: 1 REV: 0
	CLIENT: Health Infrastructure	DATE: 1-May-18

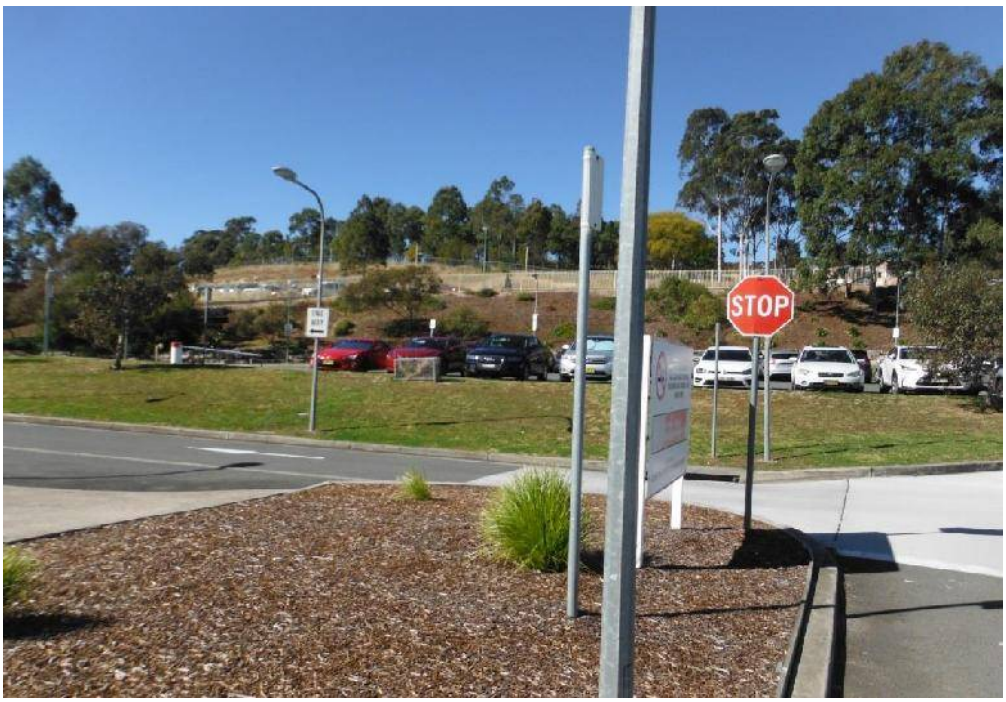


Photo 3 - Looking south-east across western edge of the proposed CSB site

Photo 4 - Looking south across western edge of the proposed CSB site

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Stage 2 Redevelopment** **Campbelltown Hospital**	PROJECT: 34275.08-2 PLATE No: 2 REV: 0
	CLIENT: Health Infrastructure	DATE: 1-May-18

Photo 5 - Looking south-east across proposed link structure site (northern end)

Photo 6 - Looking south-east across proposed link structure site (southern end)

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Stage 2 Redevelopment** **Campbelltown Hospital**	PROJECT: 34275.08-2 PLATE No: 3 REV: 0
	CLIENT: Health Infrastructure	DATE: 1-May-18

Photo 7 - Looking north-east across proposed link builing site (between Buildings A and D)

Photo 8 - Looking east at existing CTC (western side)

Douglas Partners Geotechnics / Environment / Groundwater	**Site Photographs** **Stage 2 Redevelopment** **Campbelltown Hospital**	PROJECT: 34275.08-2 PLATE No: 4 REV: 0
	CLIENT: Health Infrastructure	DATE: 1-May-18

Table B1: Summary Table - Groundwater Levels

Bore No.	Fieldwork Date	Reduced Level (mAHD)	GW Elevation (mAHD)	GW Depth (m)
34275.00-1	22-Mar-11	81.9	75.1	6.8
34275.00-3	22-Mar-11	79.7	76.1	3.6
22884-1	8-Sep-98	83.0	78.9	4.1
	10-Sep-98	83.0	78.7	4.3
	11-Sep-98	83.0	77.4	5.6
	14-Sep-98	83.0	78.0	5.0
	15-Sep-98	83.0	78.0	5.0
	16-Sep-98	83.0	78.0	5.0
	18-Sep-98	83.0	77.9	5.1
	21-Sep-98	83.0	77.8	5.2
22884-3	8-Sep-98	87.5	81.8	5.7
	10-Sep-98	87.5	81.7	5.8
	11-Sep-98	87.5	80.6	6.9
	14-Sep-98	87.5	80.7	6.8
	15-Sep-98	87.5	80.7	6.8
	16-Sep-98	87.5	80.7	6.8
	18-Sep-98	87.5	80.6	6.9
	21-Sep-98	87.5	80.7	6.8
22884-5	8-Sep-98	83.0	76.3	6.7
	10-Sep-98	83.0	76.4	6.6
	11-Sep-98	83.0	76.3	6.7
	14-Sep-98	83.0	76.3	6.7
	15-Sep-98	83.0	76.3	6.7
	16-Sep-98	83.0	76.3	6.7
	18-Sep-98	83.0	76.3	6.7
	21-Sep-98	83.0	76.3	6.7
22884-6	8-Sep-98	87.5	84.3	3.2
	10-Sep-98	87.5	83.9	3.6
	11-Sep-98	87.5	81.0	6.5
	14-Sep-98	87.5	81.2	6.3
	15-Sep-98	87.5	81.0	6.5
	16-Sep-98	87.5	81.0	6.5
	18-Sep-98	87.5	80.9	6.6
	21-Sep-98	87.5	80.9	6.6

Appendix C

Laboratory Test Results
Project 34275.00 Laboratory Test Results
Project 22884-1 Laboratory Test Results
Table C1: Summary Table – Laboratory Tests and Assessments

Material Test Report

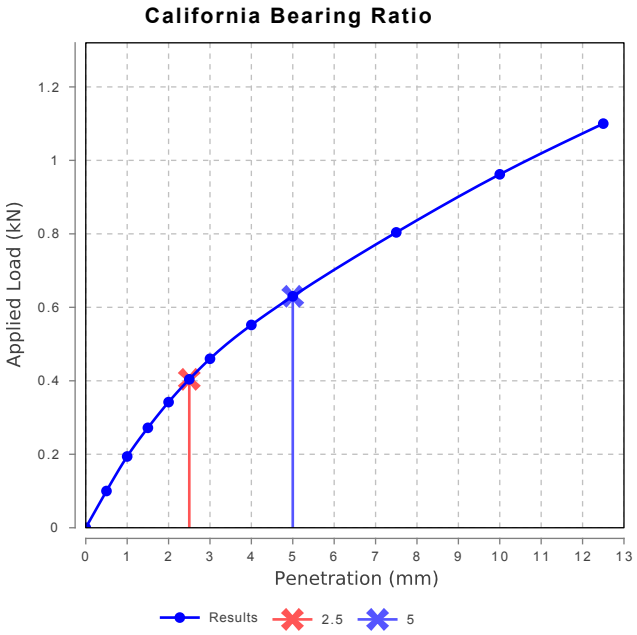
Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: tim.white@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
Lab manager
NATA Accredited Laboratory Number: 828

Report Number: **34275.08-3**
Issue Number: 1
Date Issued: 27/04/2018
Client: Health Infrastructure (ABN 89600377397)
PO Box 1060, North Sydney NSW 2059
Contact: Margo Kouvaris
Project Number: 34275.08
Project Name: Stage 2 Redevelopment Campbelltown Hospital
Project Location: Campbelltown Hospital, Campbelltown
Work Request: 320
Sample Number: 18-320A
Date Sampled: 06/03/2018
Sampling Method: Sampled by Engineering Department
Sample Location: **BH 109 (0.3m - 0.5m)**
Material: SILTSTONE - grey siltstone

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS1289.5.1.1		
Method used to Determine Plasticity	Visual Assessment		
Maximum Dry Density (t/m^3)	1.88		
Optimum Moisture Content (%)	8.0		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	101.0		
Dry Density after Soaking (t/m^3)	1.85		
Field Moisture Content (%)	6.8		
Moisture Content at Placement (%)	8.3		
Moisture Content Top 30mm (%)	14.7		
Moisture Content Rest of Sample (%)	16.0		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	48.0		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: tim.white@douglaspartners.com.au

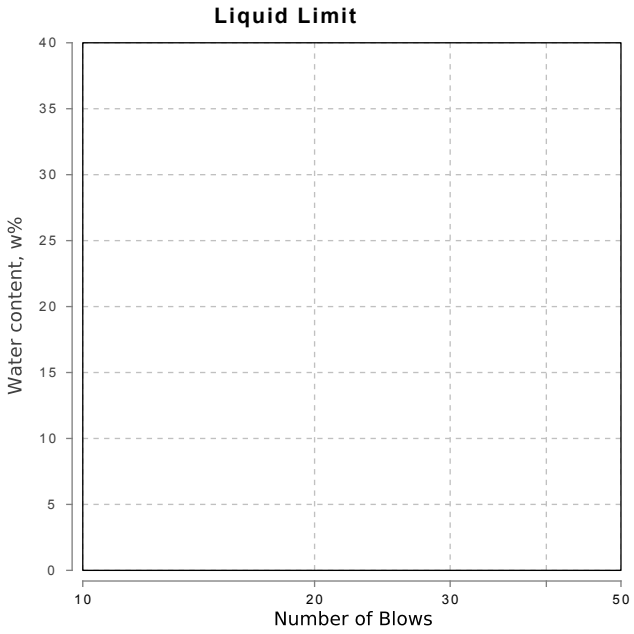
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
Lab manager
NATA Accredited Laboratory Number: 828

Report Number: **34275.08-3**
Issue Number: 1
Date Issued: 27/04/2018
Client: Health Infrastructure (ABN 89600377397)
PO Box 1060, North Sydney NSW 2059
Contact: Margo Kouvaris
Project Number: 34275.08
Project Name: Stage 2 Redevelopment Campbelltown Hospital
Project Location: Campbelltown Hospital, Campbelltown
Work Request: 320
Sample Number: 18-320B
Date Sampled: 06/03/2018
Sampling Method: Sampled by Engineering Department
Remarks: Field moisture content = 13.0%
Sample Location: **BH 114 (1.00m - 1.45m)**
Material: FILLING - brown red silty clay filling

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	40		
Plastic Limit (%)	19		
Plasticity Index (%)	**21**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	11.0		
Cracking Crumbling Curling	None		



Material Test Report

Douglas Partners
Geotechnics / Environment / Groundwater
Douglas Partners Pty Ltd
Macarthur Laboratory
18 Waler Crescent Smeaton Grange NSW 2567
Phone: (02) 4647 0075
Fax: (02) 4646 1886
Email: tim.white@douglaspartners.com.au

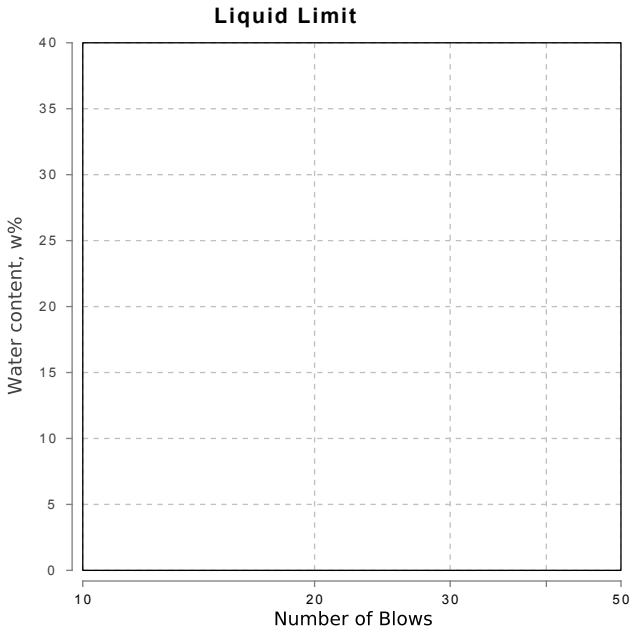
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Tim White
Lab manager
NATA Accredited Laboratory Number: 828

Report Number:	**34275.08-3**
Issue Number:	1
Date Issued:	27/04/2018
Client:	Health Infrastructure (ABN 89600377397) PO Box 1060, North Sydney NSW 2059
Contact:	Margo Kouvaris
Project Number:	34275.08
Project Name:	Stage 2 Redevelopment Campbelltown Hospital
Project Location:	Campbelltown Hospital, Campbelltown
Work Request:	320
Sample Number:	18-320C
Date Sampled:	06/03/2018
Sampling Method:	Sampled by Engineering Department
Remarks:	Field moisture content = 14.4%
Sample Location:	**BH 115 (1.00m - 1.45m)**
Material:	SILTY CLAY - red mottled grey silty clay

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	39		
Plastic Limit (%)	20		
Plasticity Index (%)	**19**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Linear Shrinkage (%)	9.0		
Cracking Crumbling Curling	None		



Envirolab Services Pty Ltd
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 188800

Client Details

Client	Douglas Partners Pty Ltd Smeaton Grange
Attention	Tom Mrdjen
Address	18 Waler Crescent, Smeaton Grange, NSW, 2567

Sample Details

Your Reference	**34275.08, Campbelltown**
Number of Samples	24 soil
Date samples received	05/04/2018
Date completed instructions received	05/04/2018

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.

Report Details

Date results requested by	12/04/2018
Date of Issue	12/04/2018

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Jacinta Hurst, Laboratory Manager

Misc Inorg - Soil						
Our Reference		188800-1	188800-2	188800-3	188800-4	188800-5
Your Reference	UNITS	BH101	BH101	BH101	BH101	BH110
Depth		3.5	8.5	16.5	20.5	3.5
Date Sampled		02/03/2018	02/03/2018	02/03/2018	02/03/2018	06/03/2018
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Date analysed	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
pH 1:5 soil:water	pH Units	7.4	7.7	9.4	9.5	7.5
Electrical Conductivity 1:5 soil:water	µS/cm	87	88	110	130	98
Chloride, Cl 1:5 soil:water	mg/kg	50	[NA]	[NA]	<10	[NA]
Sulphate, SO4 1:5 soil:water	mg/kg	10	[NA]	[NA]	<10	[NA]

Misc Inorg - Soil						
Our Reference		188800-6	188800-7	188800-8	188800-9	188800-10
Your Reference	UNITS	BH110	BH110	BH113	BH113	BH113
Depth		5.5	10.0	3.5	5.5	9.0
Date Sampled		06/03/2018	06/03/2018	07/03/2018	07/03/2018	07/03/2018
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Date analysed	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
pH 1:5 soil:water	pH Units	8.3	8.0	9.5	9.5	6.2
Electrical Conductivity 1:5 soil:water	µS/cm	170	83	110	120	370
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	[NA]	<10	[NA]	420
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	[NA]	<10	[NA]	34

Misc Inorg - Soil						
Our Reference		188800-11	188800-12	188800-13	188800-14	188800-15
Your Reference	UNITS	BH105	BH105	BH105	BH116	BH116
Depth		3.5	5.5	10.0	3.5	8.5
Date Sampled		09/03/2018	09/03/2018	09/03/2018	14/03/2018	14/03/2018
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Date analysed	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
pH 1:5 soil:water	pH Units	9.4	9.4	9.2	8.3	9.4
Electrical Conductivity 1:5 soil:water	µS/cm	140	120	87	120	120

Misc Inorg - Soil						
Our Reference		188800-16	188800-17	188800-18	188800-19	188800-20
Your Reference	UNITS	BH116	BH116	BH103	BH103	BH103
Depth		16.5	20.5	5.0	10.0	15.0
Date Sampled		14/03/2018	14/03/2018	05/03/2018	05/03/2018	05/03/2018
Type of sample		soil	soil	soil	soil	soil
Date prepared	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Date analysed	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018	10/04/2018
pH 1:5 soil:water	pH Units	9.3	9.3	9.5	9.7	9.3
Electrical Conductivity 1:5 soil:water	µS/cm	92	85	140	200	98

Misc Inorg - Soil					
Our Reference		188800-21	188800-22	188800-23	188800-24
Your Reference	UNITS	BH103	BH114	BH114	BH114
Depth		18.5	3.5	6.0	10.0
Date Sampled		05/03/2018	08/03/2018	08/03/2018	08/03/2018
Type of sample		soil	soil	soil	soil
Date prepared	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018
Date analysed	-	10/04/2018	10/04/2018	10/04/2018	10/04/2018
pH 1:5 soil:water	pH Units	9.3	6.0	7.2	9.0
Electrical Conductivity 1:5 soil:water	µS/cm	74	170	150	110
Chloride, Cl 1:5 soil:water	mg/kg	[NA]	230	[NA]	29
Sulphate, SO4 1:5 soil:water	mg/kg	[NA]	22	[NA]	10

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	188800-4
Date prepared	-			10/04/2018	1	10/04/2018	10/04/2018		10/04/2018	10/04/2018
Date analysed	-			10/04/2018	1	10/04/2018	10/04/2018		10/04/2018	10/04/2018
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	7.4	7.3	1	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	87	88	1	95	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	50	56	11	88	93
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	10	20	67	99	94

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	[NT]
Date prepared	-			[NT]	11	10/04/2018	10/04/2018		10/04/2018	[NT]
Date analysed	-			[NT]	11	10/04/2018	10/04/2018		10/04/2018	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	11	9.4	9.5	1	102	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	11	140	130	7	95	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	[NT]	[NT]	[NT]	[NT]	90	[NT]
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	[NT]	[NT]	[NT]	[NT]	[NT]	102	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	10/04/2018	10/04/2018		[NT]	[NT]
Date analysed	-			[NT]	21	10/04/2018	10/04/2018		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	21	9.3	9.3	0	[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	21	74	75	1	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

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.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

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 batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Douglas Partners
Geotechnics / Environment / Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No:	34275.08	**Suburb:**	Campbelltown	**To:**	Envirolab Services
Project Name:	Stage 2 Redevelopment Campbelltown Hospital	**Order Number**	1		12 Ashley Street, Chatswood NSW 2067
Project Manager:	TOM	**Sampler:**	IKA	**Attn:**	Tania Notaras
Emails:	tom.mrdjen@douglaspartners.com.au			**Phone:**	(02) 9910 6200 **Fax:** (02) 9910 6201
Date Required:	Same day ☐ 24 hours ☐ 48 hours ☐ 72 hours ☐ Standard ☑			**Email:**	tnotaras@envirolabservices.com.au
Prior Storage:	☐ Esky ☐ Fridge ☑ Shelved	Do samples contain 'potential' HBM?	Yes ☐	No ☑	(If YES, then handle, transport and store in accordance with FPM HAZID)

Sample ID	Lab ID	Date Sampled	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: pH	EC	Choride	Sulphate						Notes/preservation
BH101/3.5	1	02/03/18	S	P	x	x	x	x						
BH101/8.5	2	02/03/18	S	P	x	x								
BH101/16.5	3	02/03/18	S	P	x	x								
BH101/20.5	4	02/03/18	S	P	x	x	x	x						
BH110/3.5	5	06/03/18	S	P	x	x								
BH110/5.5	6	06/03/18	S	P	x	x								
BH110/10.0	7	06/03/18	S	P	x	x								
BH113/3.5	8	07/03/18	S	P	x	x	x	x						
BH113/5.5	9	07/03/18	S	P	x	x								
BH113/9.0	10	07/03/18	S	P	x	x	x	x						
BH105/3.5	11	09/03/18	S	P	x	x								
BH105/5.5	12	09/03/18	S	P	x	x								
BH105/10.0	13	09/03/18	S	P	x	x								
BH116/3.5	14	14/03/18	S	P	x	x								
BH116/8.5	15	14/03/18	S	P	x	x								
PQL (S) mg/kg					x	x								**ANZECC PQLs req'd for all water analytes** ☐

ENVIROLAB SERVICES
12 Ashley St
CHATSWOOD NSW 2067
Ph: (02) 9910 6200
Job No: 188800
Date Received: 5.4.18
Time Received: 14:25
Received by: JE
Temp: Cool/Ambient 26°C
Cooling: Ice/Icepack
Security: Intact/Broken/None

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No:

Total number of samples in container: 12 **Relinquished by:** IKA **Transported to laboratory by:**

Send Results to: Douglas Partners Pty Ltd **Address:** 18 Waler Cresent, Smeaton Grange 2567 NSW **Phone:** (02)46470075 **Fax:** (02)46461886

Signed: J. Kelly **Received by:** ELS JE **Date & Time:** 5/4 14:25

Douglas Partners
Geotechnics | Environment | Groundwater

CHAIN OF CUSTODY DESPATCH SHEET

Project No: 34275.08	**Suburb:** Campbelltown	**To:** Envirolab Services	
Project Name: Stage 2 Redevelopment Campbelltown Hospital	**Order Number** 1	12 Ashley Street, Chatswood NSW 2067	
Project Manager: TOM	**Sampler:** IKA	**Attn:** Tania Notaras	
Emails: tom.mrdjen@douglaspartners.com.au		**Phone:** (02) 9910 6200	**Fax:** (02) 9910 6201
Date Required: Same day ☐ 24 hours ☐ 48 hours ☐ 72 hours ☐ Standard ☐		**Email:** tnotaras@envirolabservices.com.au	
Prior Storage: ☐ Esky ☐ Fridge ☐ Shelved	Do samples contain 'potential' HBM? Yes ☐	No ☐ (If YES, then handle, transport and store in accordance with FPM HAZID)	

Sample ID	Lab ID	Sampling Date	Sample Type (S - soil, W - water)	Container Type (G - glass, P - plastic)	Analytes: pH	EC	Choride	Sulphate						Notes/preservation
BH116/16.5	16	14/03/18	S	P	x	x								
BH116/20.5	17	14/03/18	S	P	x	x								
BH103/5.0	18	05/03/18	S	P	x	x								
BH103/10.0	19	05/03/18	S	P	x	x								
BH103/15.00	20	05/03/18	S	P	x	x								
BH103/18.5	21	05/03/18	S	P	x	x								
BH114/3.5	22	08/03/18	S	P	x	x	x	x						
BH114/6.0	23	08/03/18	S	P	x	x								
BH114/10.0	24	08/03/18	S	P	x	x	x	x						
PQL (S) mg/kg														ANZECC PQLs req'd for all water analytes ☐

PQL = practical quantitation limit. If none given, default to Laboratory Method Detection Limit

Metals to Analyse: 8HM unless specified here:

Lab Report/Reference No: 188800

Total number of samples in container: | **Relinquished by:** IKA | **Transported to laboratory by:**

Send Results to: Douglas Partners Pty Ltd | **Address** 18 Waler Cresent, Smeaton Grange 2567 NSW | **Phone:** (02)46470075 **Fax:** (02)46461886

Rec: ELS JE 5/4

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 53964

Client:
Douglas Partners
96 Hermitage Rd
West Ryde
NSW 2114

Attention: Tom Mrdjen

Sample log in details:

Your Reference:	**34275, Campbelltown Hospital**
No. of samples:	3 soils
Date samples received / completed instructions received	07/04/11 / 07/04/11

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:	14/04/11 / 14/04/11
Date of Preliminary Report:	Not issued

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Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Nick Sarlamis
Inorganics Supervisor

Miscellaneous Inorg - soil				
Our Reference:	UNITS	53964-1	53964-2	53964-3
Your Reference	----------	13/0.5	38/0.5	41/1.5
Date Sampled	----------	23/03/2011	30/03/2011	30/03/2011
Type of sample		Soil	Soil	Soil
Date prepared	-	14/4/2011	14/4/2011	14/4/2011
Date analysed	-	14/4/2011	14/4/2011	14/4/2011
pH 1:5 soil:water	pH Units	5.3	5.1	5.2
Chloride, Cl 1:5 soil:water	mg/kg	4	94	1,300
Sulphate, SO4 1:5 soil:water	mg/kg	26	22	9

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA 21st ED, 4500-H+.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA 21st ED, 4110-B.

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			14/4/2011	[NT]	[NT]	LCS-1	14/4/2011
Date analysed	-			14/4/2011	[NT]	[NT]	LCS-1	14/4/2011
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	LCS-1	100%
Chloride, Cl 1:5 soil:water	mg/kg	2	Inorg-081	<2	[NT]	[NT]	LCS-1	98%
Sulphate, SO4 1:5 soil:water	mg/kg	2	Inorg-081	<2	[NT]	[NT]	LCS-1	102%

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.

Douglas Partners
Geotechnics · Environment · Groundwater

CHAIN OF CUSTODY

Project Name: Campbelltown Hospital Redevelopment		**To:**	Envirolab Services
Project No: #34275	**Sampler:** TOM		12 Ashley St Chatswood 2067
Project Mgr: CCK	**Mob. Phone:** 0447 447 404	**Attn:**	Tania Notaras
Email: tom.mrdjen@douglaspartners.com.au		**Phone:** (02) 9910 6200	**Fax:** (02) 9910 6201
Date Required: Standard		**Email:**	tnotaras@envirolabservices.com.au

Sample ID	Lab ID	Sampling Date	Sample Type (S - soil, W – water)	Container type (G – glass, P - plastic)	Analytes: Sulphates	Chlorides	pH							Notes/preservation
1 13 / 0.5		23/3	S	P	X	X	X							
2 38 / 0.5		30/3	S	P	X	X	X							
3 41 / 1.5		30/3	S	P	X	X	X							

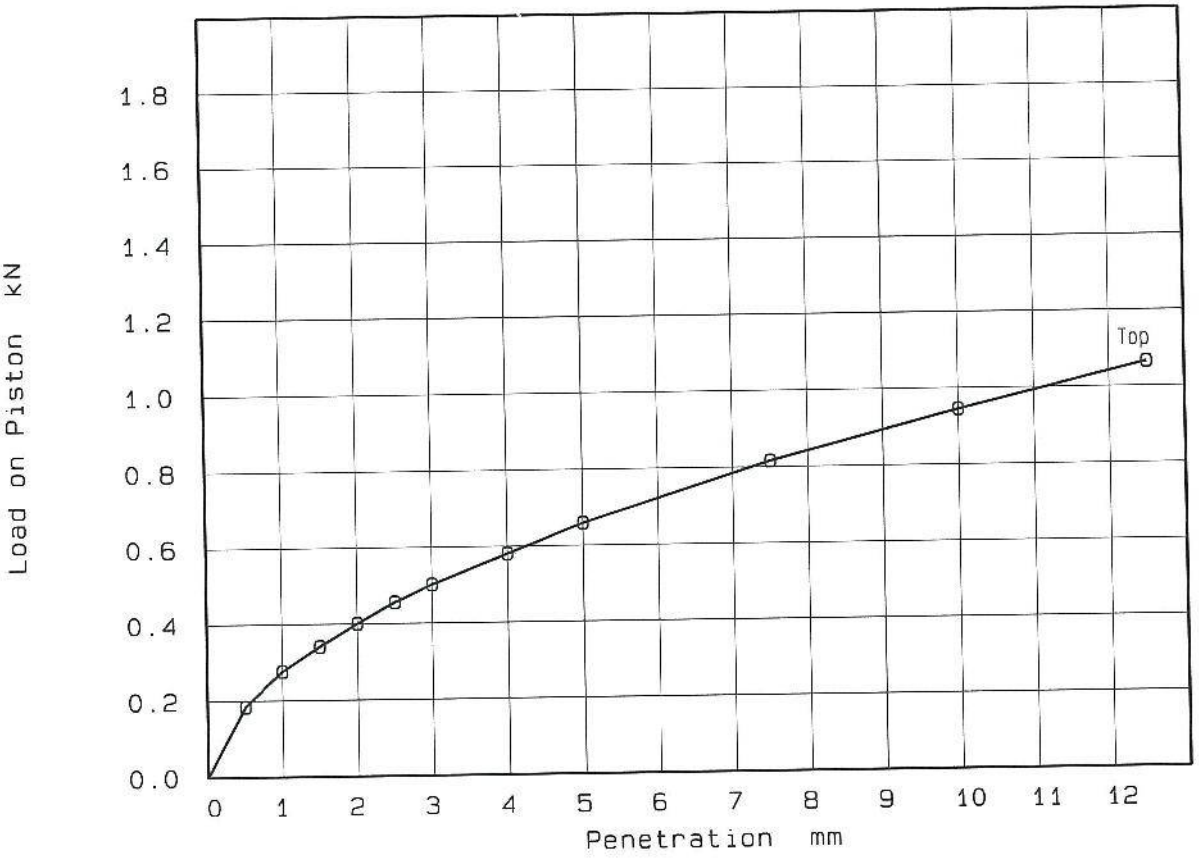
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: 9910 6200

Job No: 53964
Date received: 7/4
Time received: 7:00
Received by:
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

Lab Report No:		
Send Results to: Douglas Partners PL	**Address:** 5/50 Topham Road Smeaton Grange	**Phone:** (02) 4647 0075 **Fax:** (02) 4646 1886
Relinquished by: TOM		**Transported to laboratory by:**
Signed:	**Date & Time:** 7/4/11	**Received By:** 7/4

RESULTS OF CALIFORNIA BEARING RATIO TEST

CLIENT	SOUTH WESTERN SYDNEY AREA HEALTH SERVICE	DATE	15/09/1998
PROJECT	MACARTHUR STRATEGY PROJECT - CAMPBELLTOWN HOSPITAL	PROJECT No.	22884
LOCATION	THERRY ROAD, CAMPBELLTOWN	TEST LOC.	BH 7
		DEPTH	0.5 - 1.0



DESCRIPTION CLAY - red-brown and grey mottled orange brown clay with some shale

PREPARATION Remoulded to approximatly 100% of Standard maximum dry density and Optimum moisture content, then soaked for four days prior to testing

LEVEL OF COMPACTION 100 % Standard

SURCHARGE 4.5 kg

SWELL 2.0 %

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m^3
At Compaction	21.6	1.67
After Soaking	24.7	1.64
After Test Top 30mm	28.7	-
- Remainder	23.7	-
Field Values	22.3	-
Standard Compaction	19.9	1.68

RESULTS		
Type	Penetration	CBR (%)
Top	- 2.5 mm	3.5
	- 5.0 mm	3.5

TEST METHOD AS 1289.F1.1

TESTED DC

CHECKED MMK

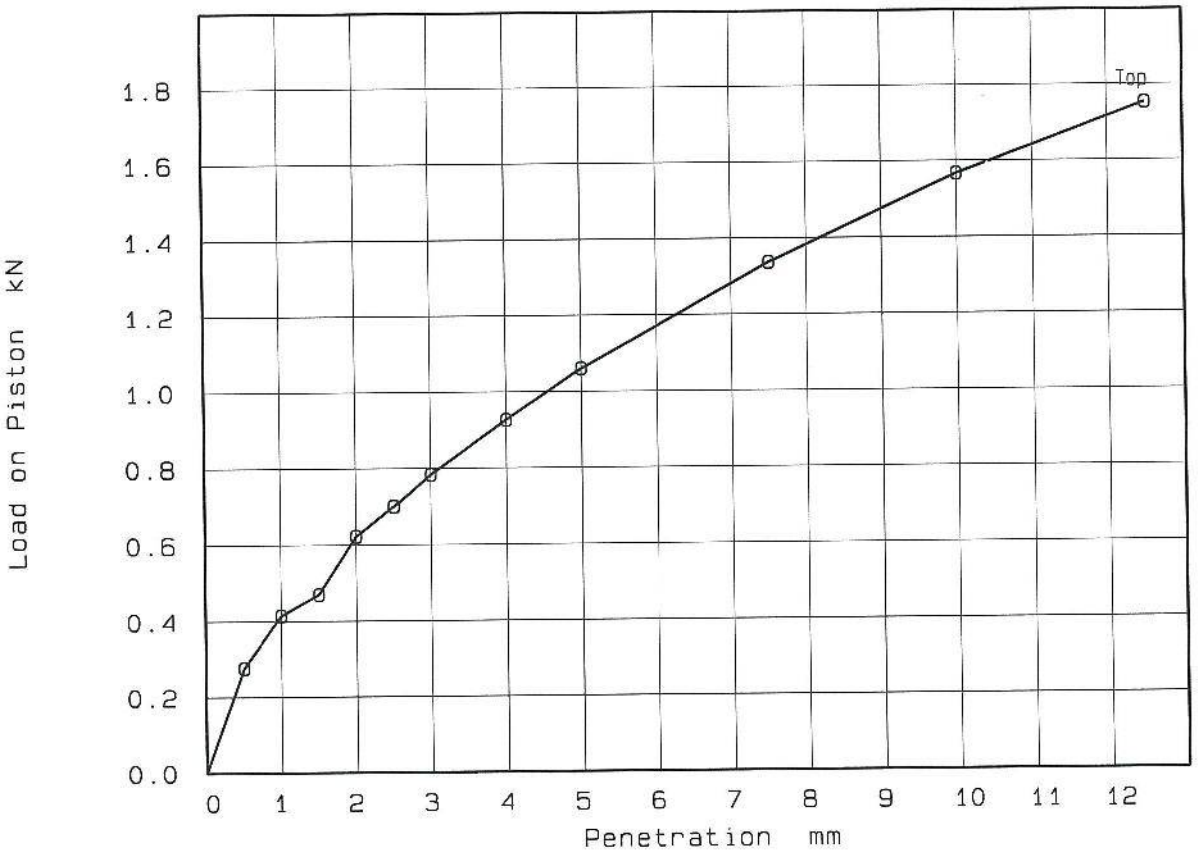
LABORATORY Campbelltown 10715 REPORT No C98062A

SIGNED

M. M. KHAN

RESULTS OF CALIFORNIA BEARING RATIO TEST

CLIENT	SOUTH WESTERN SYDNEY AREA HEALTH SERVICE	DATE	15/09/1998
PROJECT	MACARTHUR STRATEGY PROJECT - CAMPBELLTOWN HOSPITAL	PROJECT No.	22884
LOCATION	THERRY ROAD, CAMPBELLTOWN	TEST LOC.	BH 8
		DEPTH	0.5 - 1.0



DESCRIPTION FILLING - red-brown and brown clay with some shale, gravel and rubble particles

PREPARATION Remoulded to approximatly 100% of Standard maximum dry density and Optimum moisture content, then soaked for four days prior to testing

LEVEL OF COMPACTION 101 % Standard

SURCHARGE 4.5 kg

SWELL 0.8 %

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m^3
At Compaction	20.6	1.64
After Soaking	23.3	1.63
After Test Top 30mm	25.6	-
- Remainder	22.5	-
Field Values	23.2	-
Standard Compaction	21.1	1.62

RESULTS		
Type	Penetration	CBR (%)
Top	- 2.5 mm	5
	- 5.0 mm	5

TEST METHOD AS 1289.F1.1

TESTED IS
CHECKED MMK

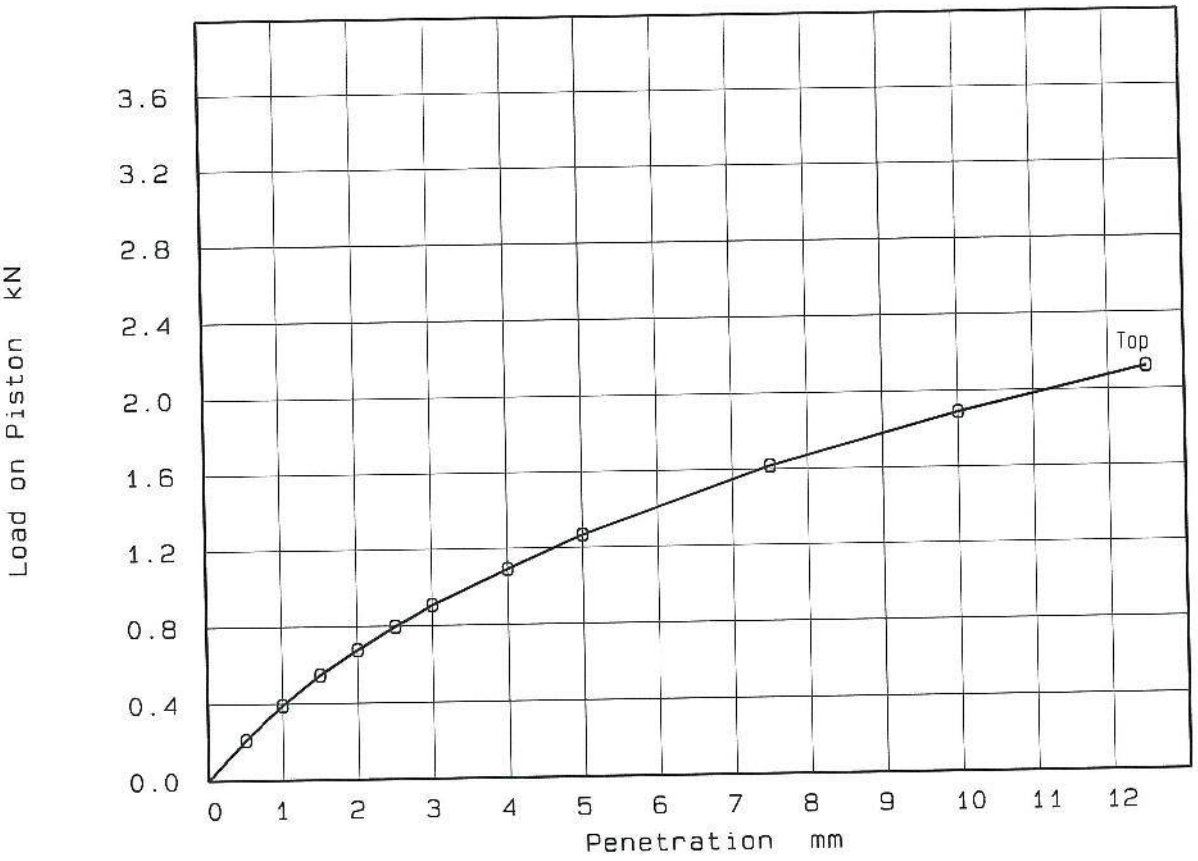
LABORATORY Campbelltown 10715 REPORT No C98062B

SIGNED

M. M. KHAN

RESULTS OF CALIFORNIA BEARING RATIO TEST

CLIENT	SOUTH WESTERN SYDNEY AREA HEALTH SERVICE	DATE	15/09/1998
PROJECT	MACARTHUR STRATEGY PROJECT - CAMPBELLTOWN HOSPITAL	PROJECT No.	22884
LOCATION	THERRY ROAD, CAMPBELLTOWN	TEST LOC. DEPTH	BH 9 0.5 - 1.0



DESCRIPTION CLAY - orange-brown clay

PREPARATION Remoulded to approximatly 100% of Standard maximum dry density and Optimum moisture content, then soaked for four days prior to testing

LEVEL OF COMPACTION 102 % Standard

SURCHARGE 4.5 kg

SWELL 1.0 %

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m^3
At Compaction	18.7	1.76
After Soaking	20.4	1.75
After Test Top 30mm	21.8	-
- Remainder	19.7	-
Field Values	18.9	-
Standard Compaction	18.7	1.74

RESULTS		
Type	Penetration	CBR (%)
Top	- 2.5 mm	6
	- 5.0 mm	6

TEST METHOD AS 1289.F1.1

TESTED IS
CHECKED MMK

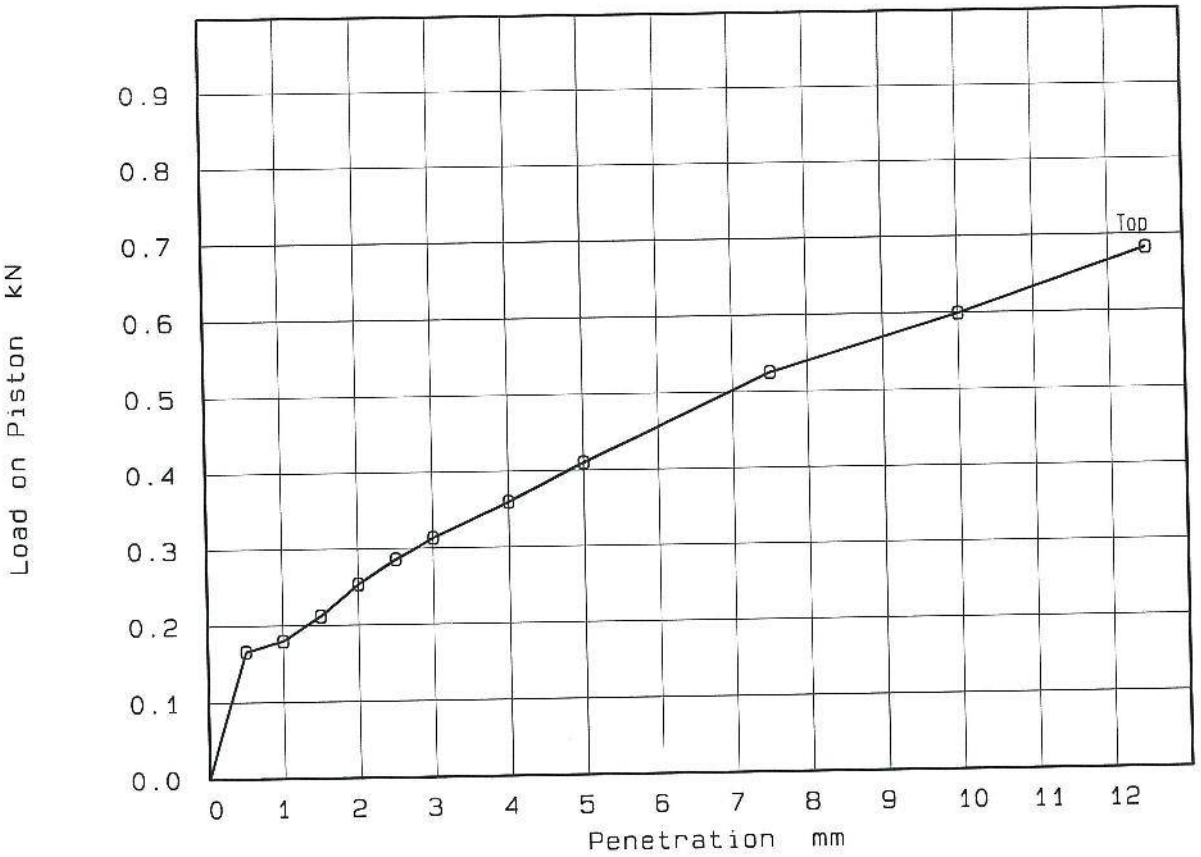
LABORATORY Campbelltown 10715 REPORT No C98062C

SIGNED

M. M. KHAN

RESULTS OF CALIFORNIA BEARING RATIO TEST

CLIENT	SOUTH WESTERN SYDNEY AREA HEALTH SERVICE	DATE	15/09/1998
PROJECT	MACARTHUR STRATEGY PROJECT - CAMPBELLTOWN HOSPITAL	PROJECT No.	22884
LOCATION	THERRY ROAD, CAMPBELLTOWN	TEST LOC. DEPTH	BH 10 0.5 - 1.0



DESCRIPTION CLAY & SHALE - red-brown mottled grey clay and very low to low strength dark grey shale

PREPARATION Remoulded to approximatly 100% of Standard maximum dry density and Optimum moisture content, then soaked for four days prior to testing

LEVEL OF COMPACTION 100 % Standard

SURCHARGE 4.5 kg

SWELL 3.6 %

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m^3
At Compaction	11.5	1.90
After Soaking	18.0	1.83
After Test Top 30mm	19.1	-
- Remainder	16.9	-
Field Values	11.6	-
Standard Compaction	12.0	1.90

RESULTS		
Type	Penetration	CBR (%)
Top	- 2.5 mm	2.0
	- 5.0 mm	2.0

TEST METHOD AS 1289.F1.1

TESTED DC

CHECKED MMK

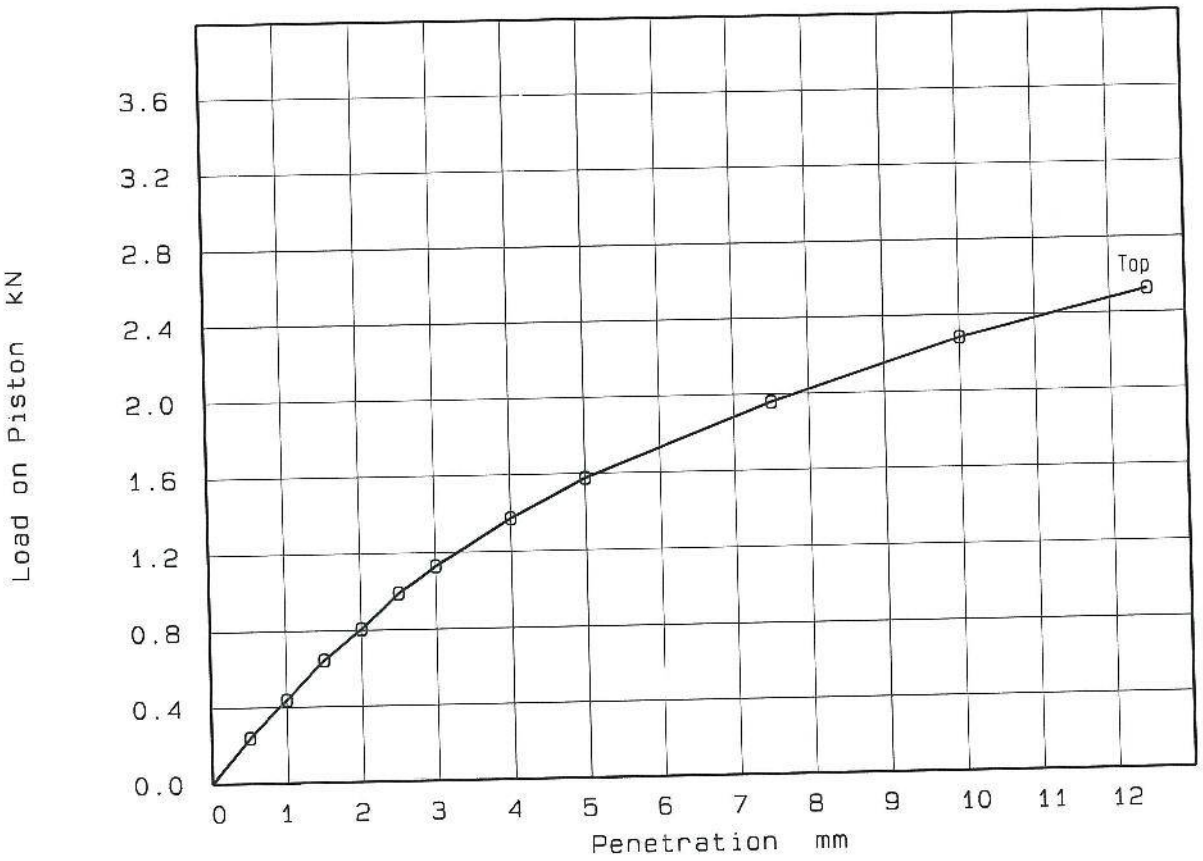
LABORATORY Campbelltown 10715 REPORT No C98062D

SIGNED

M. M. KHAN

RESULTS OF CALIFORNIA BEARING RATIO TEST

CLIENT	SOUTH WESTERN SYDNEY AREA HEALTH SERVICE	DATE	15/09/1998
PROJECT	MACARTHUR STRATEGY PROJECT - CAMPBELLTOWN HOSPITAL	PROJECT No.	22884
LOCATION	THERRY ROAD, CAMPBELLTOWN	TEST LOC. DEPTH	BH 11 0.5 - 1.0



DESCRIPTION SILTY CLAY - brown silty clay

PREPARATION Remoulded to approximatly 100% of Standard maximum dry density and Optimum moisture content, then soaked for four days prior to testing

LEVEL OF COMPACTION 100 % Standard

SURCHARGE 4.5 kg

SWELL 1.6 %

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m^3
At Compaction	22.1	1.67
After Soaking	24.2	1.64
After Test Top 30mm	25.1	-
- Remainder	23.9	-
Field Values	22.3	-
Standard Compaction	21.6	1.67

RESULTS		
Type	Penetration	CBR (%)
Top	- 2.5 mm	8
	- 5.0 mm	8

TEST METHOD AS 1289.F1.1

TESTED DC
CHECKED MMK

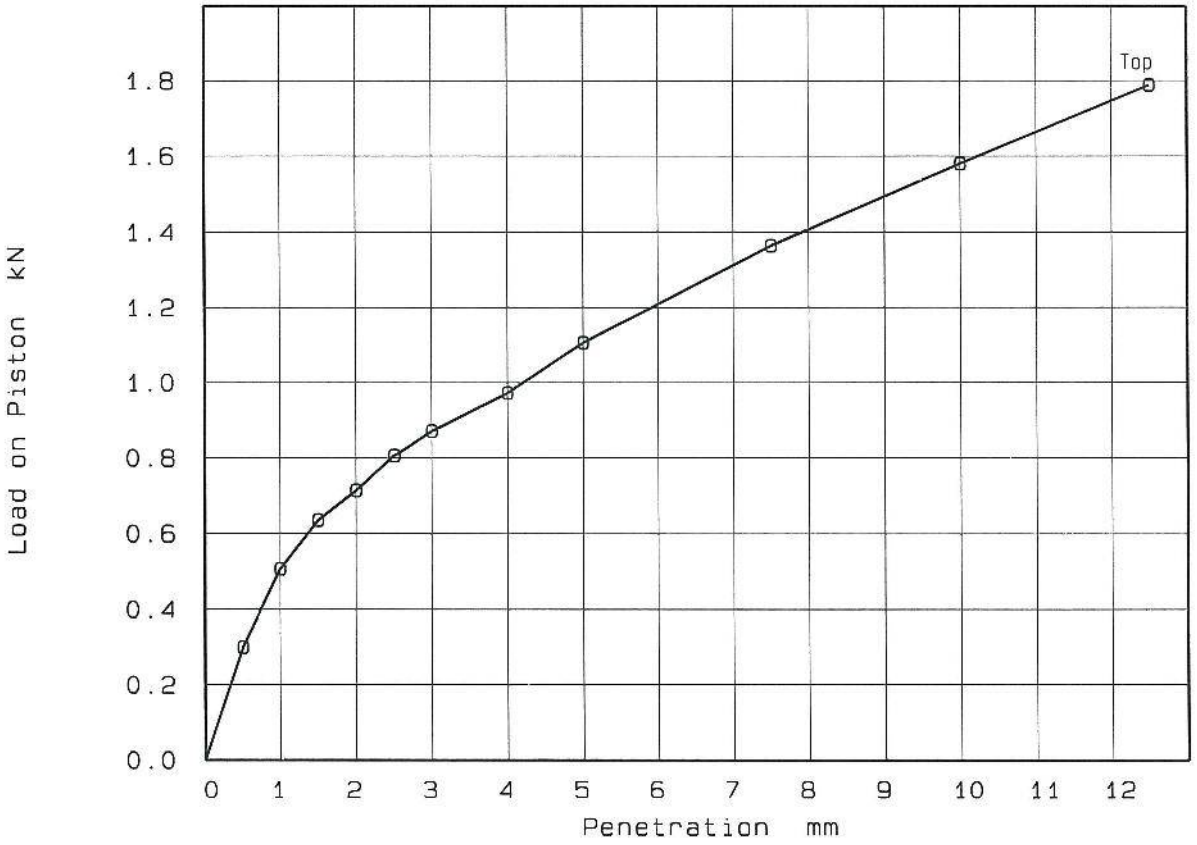
LABORATORY Campbelltown 10715 REPORT No C98062E

SIGNED

M. M. KHAN

RESULTS OF CALIFORNIA BEARING RATIO TEST

CLIENT	SOUTH WESTERN SYDNEY AREA HEALTH SERVICE	DATE	15/09/1998
PROJECT	MACARTHUR STRATEGY PROJECT - CAMPBELLTOWN HOSPITAL	PROJECT No.	22884
LOCATION	THERRY ROAD, CAMPBELLTOWN	TEST LOC. DEPTH	BH 12 0.5 - 1.0



DESCRIPTION FILLING - brown silty clay with some shale and gravel

PREPARATION Remoulded to approximatly 100% of Standard maximum dry density and Optimum moisture content, then soaked for four days prior to testing

LEVEL OF COMPACTION 100 % Standard

SURCHARGE 4.5 kg SWELL 1.2 %

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m^3
At Compaction	13.6	1.92
After Soaking	15.6	1.90
After Test Top 30mm	17.4	-
- Remainder	19.6	-
Field Values	13.0	-
Standard Compaction	13.3	1.92

RESULTS Type	Penetration	CBR (%)
Top	- 2.5 mm	6
	- 5.0 mm	6

TEST METHOD AS 1289.F1.1

TESTED IS
CHECKED MMK

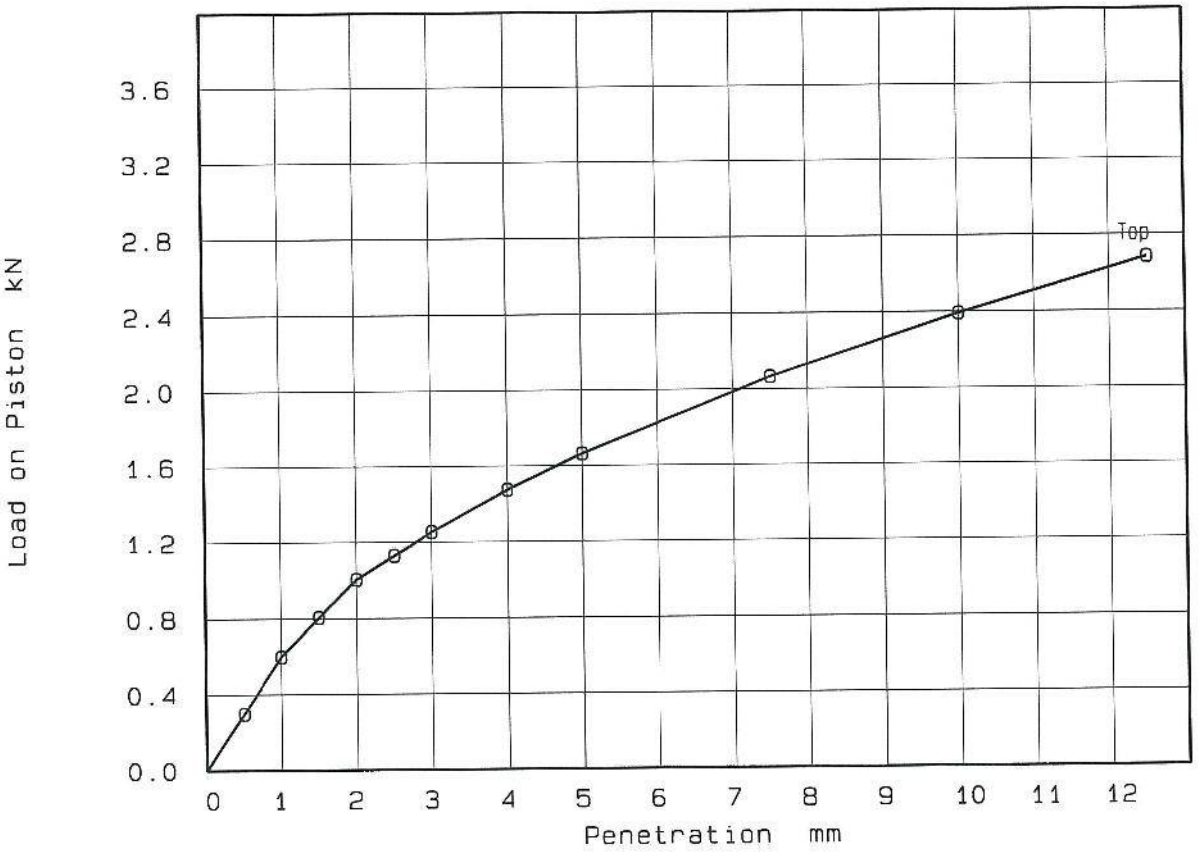
LABORATORY Campbelltown 10715 REPORT No C98062F

SIGNED

M. M. KHAN

RESULTS OF CALIFORNIA BEARING RATIO TEST

CLIENT	SOUTH WESTERN SYDNEY AREA HEALTH SERVICE	DATE	15/09/1998
PROJECT	MACARTHUR STRATEGY PROJECT - CAMPBELLTOWN HOSPITAL	PROJECT No.	22884
LOCATION	THERRY ROAD, CAMPBELLTOWN	TEST LOC.	BH 16
		DEPTH	0.5 - 1.0



DESCRIPTION SILTY CLAY - brown silty clay

PREPARATION Remoulded to approximatly 100% of Standard maximum dry density and Optimum moisture content, then soaked for four days prior to testing

LEVEL OF COMPACTION 102 % Standard

SURCHARGE 4.5 kg

SWELL 1.2 %

CONDITION	MOISTURE CONTENT %	DRY DENSITY t/m^3
At Compaction	15.9	1.83
After Soaking	18.3	1.80
After Test Top 30mm	20.6	-
- Remainder	17.0	-
Field Values	15.8	-
Standard Compaction	15.8	1.79

RESULTS		
Type	Penetration	CBR (%)
Top	- 2.5 mm	9
	- 5.0 mm	8

TEST METHOD AS 1289.F1.1

TESTED IS
CHECKED MMK

LABORATORY Campbelltown 10715 REPORT No C98062J

SIGNED

M. M. KHAN

RESULTS OF INSTABILITY INDEX DETERMINATION

CLIENT:	SOUTH WESTERN SYDNEY HEALTH SERVICE	DATE:	08/09/1998
PROJECT:	MACARTHUR STRATEGY PR.-CAMP. HOSP.	PROJECT No:	22884
LOCATION:	THERRY ROAD, CAMPBELLTOWN	LOC No:	BH 16
		DEPTH:	0.6-0.9m

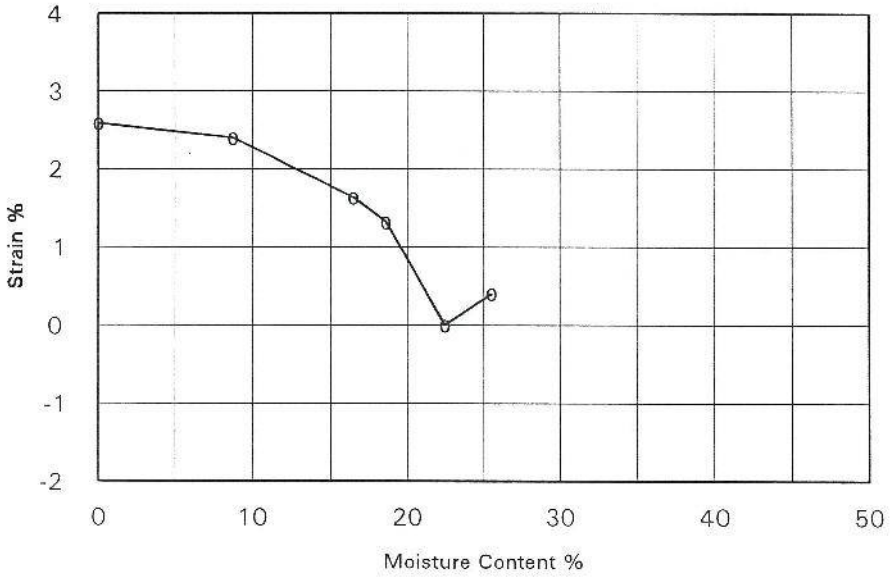
Description: SILTY CLAY - Brown, red brown silty clay

CORE SHRINKAGE TEST

Shrinkage - air dried	2.4 %
Shrinkage - oven dried	2.6 %
Significant inert inclusions	- %
Extent of cracking	- %
Extent of soil crumbling	- %
Moisture content of core	22.4 %

SWELL TEST

Pocket penetrometer reading at initial moisture content	>400 kPa
Pocket penetrometer reading at final moisture content	>400 kPa
Initial Moisture Content	23.8 %
Final moisture content	25.5 %
Swell under 25kPa	-0.4 %



SHRINK-SWELL INDEX I_{SS} 1.4 % per△ pF

Remarks: The swell specimen consolidated

Test Method: AS1289 7.1.1-1998

TESTED BY: KG DATE: 04/09/1998
CHECKED BY: NW DATE: 08/09/1998

LABORATORY: SYDNEY-828 REPORT NO: S98-245b

N.WEIMANN

Australian
Environmental
Laboratories

Quality System
Quality
Endorsed
Company
ISO 9002 Lic 7007
Standards Australia

24 September 1998

Douglas Minto
6/9 Swaffham Rd
Minto
NSW 2566

Your Reference: 22884 Campbelltown
Report Number: 9378

Attention: Daniel Bliss

Dear Daniel
The following samples were received from you on the date indicated.

Samples: Qty.	2 Soils
Date of Registration	18/09/98
Date of Receipt of Samples:	18/9/98
Date of Receipt of Instructions :	18/9/98

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report.
Unless otherwise stated, solid samples are expressed on a dry weight basis and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

Yours faithfully
AUSTRALIAN ENVIRONMENTAL LABORATORIES

Anthony Connaughton
Manager Sydney

David Springer
Manager Operations

National Association of Testing Authorities, Australia
NATA Endorsed Test Report
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Blank procedure Our Reference: Your Reference	UNITS ---------- ----------	9378-1 B1/3.0	9378-2 B3/1.0
pH 1:5 soil:water	pH Units	7.1	5.3
Sulphate, SO4 1:5 soil:water	mg/kg	28	61

QUALITY CONTROL Blank procedure	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base Sample:Duplicate	Spike Sm#	Matrix Spike Duplicate + RPD
pH 1:5 soil:water	pH Units	1	SEI-001	[NT]	9378-1	Nil Replicate	Water	Nil Spike
Sulphate, SO4 1:5 soil:water	mg/kg	2	SEI-038	<2.0	9378-1	28 || 25	Water	90

Result Codes

[INS] : Insufficient Sample for this test
[NR] : Not Requested
[NT] : Not tested
[NA] : Sample Not Assigned test
[HBG] : Results not Reported due to High Background Interference
* : Not part of NATA Registration

Results Comments

Table C1: Summary Table - Laboratory Tests and Assessments

Bore No.	Sample Depth	pH	Chloride Concentration	Sulphate Concentration	Resistivity	Soil Condition	Sample Aggressivity Class					$EC_{1:5}$
					By inversion of EC1:5		Aggr. to Concrete - from sample pH	Aggr. to Concrete - from Sulphate conc.	Aggr. to Steel - from sample pH	Aggr. to Steel - from Chloride conc.	Aggr. to Steel - from sample Resistivity	[Lab.]
	(m bgl)	(pH units)	(mg/kg)	(mg/kg)	Ω.cm	[AS2159-2009]	[AS2159-2009]					(microS/cm)
BH101	3.5	7.3	56	20	11364	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	88
BH101	8.5	7.7			11364	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	88
BH101	16.5	9.4			9091	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	110
BH101	20.5	9.5	10	10	7692	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	130
BH103	5.0	9.5			7143	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	140
BH103	10.0	9.7			5000	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	200
BH103	15.0	9.3			10204	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	98
BH103	18.5	9.3			13514	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	74
BH105	3.5	9.4			7143	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	140
BH105	5.5	9.4			8333	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	120
BH105	10.0	9.2			11494	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	87
BH110	3.5	7.5			10204	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	98
BH110	5.5	8.3			5882	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	170
BH110	10.0	8.0			12048	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	83
BH113	3.5	9.5	10	10	9091	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	110
BH113	5.5	9.5			8333	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	120
BH113	9.0	6.2	420	34	2703	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	370
BH114	3.5	6.0	230	22	5882	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	170
BH114	6.0	7.2			6667	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	150
BH114	10.0	9.0	29	10	9091	B	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	Non-Aggressive	110
BH116	3.5	8.3			8333	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	120
BH116	8.5	9.4			8333	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	120
BH116	16.5	9.3			10870	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	92
BH116	20.5	9.3			11765	B	Non-Aggressive		Non-Aggressive		Non-Aggressive	85
1*	3.0	7.1		28		B	Non-Aggressive	Non-Aggressive	Non-Aggressive			
3*	1.0	5.3		61		B	Mild	Non-Aggressive	Non-Aggressive			
38^	0.5	5.1	94	22		B	Mild	Non-Aggressive	Non-Aggressive	Non-Aggressive		

Note: * Project 22884-1
^ Project 34275.00

Appendix D

Ground Vibrations

APPENDIX D - GROUND VIBRATIONS

Ground vibrations can be described by measurement of the acceleration, velocity or displacement of the ground particles at one or more locations. Triaxial geophone sensors for example can measure the peak velocities of radial, transverse or vertical particle motion (designated PPVr, PPVt and PPVz respectively and PPVi for any directional component) within selected sample periods and peak velocities can also be determined in the resultant direction of particle motion, from calculations of instantaneous vector sums throughout the sample period. Vector sum velocities are designated VSPPV, or in many cases simply PPV.

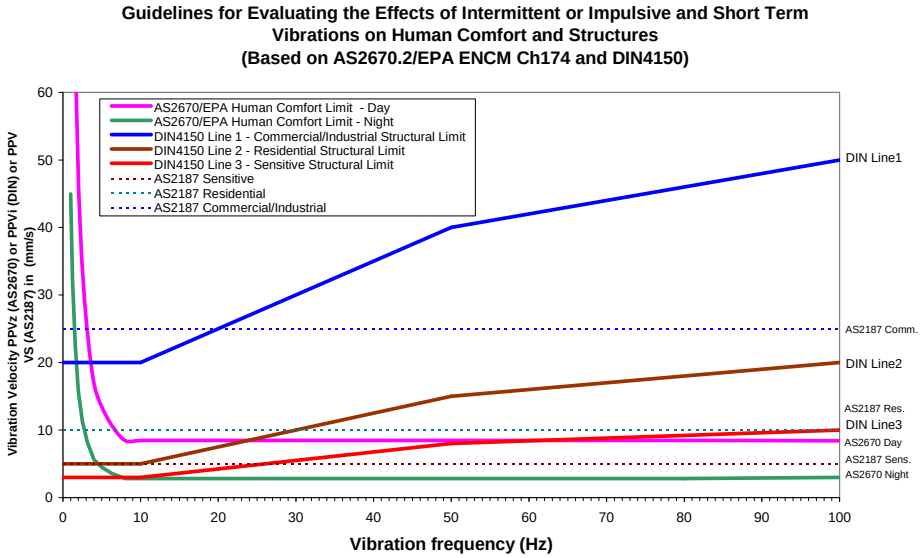
There are three aspects of vibrations which need to be assessed:

1. Effects on structures
2. Effects on architectural finishes
3. Effects on humans

Numerous standards and guidelines exist worldwide which provide a basis for these assessments. Their focus varies from structural damage to human comfort and from transient to intermittent to continuous vibrations. Most provide guideline vibration limits for protection against damage or human discomfort, however these limits are not always consistent and application of a particular standard or guideline should be based on the expected types of vibrations, the types and conditions of the potentially affected buildings and the potential for discomfort of their occupants.

Both the guideline and the vibration limits should be determined on a case by case basis and the adopted limits (damage and human comfort or the lower of the two) may vary from guideline values, according to the experience of the vibration consultant, due to the sensitivity of the building or the activities of its occupants. Some applicable guidelines are summarised in the graph below.

Depending on site conditions, proposed works, results of building condition surveys and on-site vibration trials (indicating vibration attenuation rates and dominant vibration frequencies of excavation plant), the standards, guidelines and limits discussed below are considered appropriate for management of ground vibrations generated during rock excavation.



Effects on Structures

The German Standard DIN 4150-3 (1999) "Structural vibration – effects of vibrations on structures", recommends that ground vibrations at foundation level of residential buildings, in good condition bearing on sound rock foundations, be limited to 5 – 15 – 20 mm/s PPVi (at vibration frequencies of 10 – 50 - 100 Hz typical of excavation plant), in order to reduce the potential for structural damage. Higher limits (20 - 40 – 50 mm/s PPVi) and lower limits (3 – 8 – 10 mm/s PPVi) are recommended for commercial/industrial and sensitive buildings respectively. From DP experience where buildings are bearing on loose sand, maximum vibration levels should be significantly reduced to the order of 5 mm/s to 7 mm/s VSPPV to reduce the risk of vibration-induced sand densification and settlement.

Effects on Architectural Finishes

It has been found from experience that even with buildings bearing on rock, vibration levels as low as 10 mm/s VSPPV may cause minor defects such as cracks through rendering, cornices and skirtings. Management of vibrations may require a lowering of structural damage criteria to this architectural damage criterion, or negotiations with owners of affected buildings.

Effects on Humans

Ground vibration can be strongly perceptible to humans at levels above 2.5 mm/s VSPPV and can be disturbing at levels above 5 mm/s VSPPV. Complaints from residents and building occupants are

sometimes received when levels are as low as 1 mm/s VSPPV. Australian Standard AS 2670.2-1990 "Evaluation of human exposure to whole-body vibrations – continuous and shock induced vibrations in buildings (1-80 Hz)" indicates an acceptable day time limit of 8 mm/s PPVz for human comfort. Management of vibrations may require a lowering of damage criteria to this human comfort criterion, or negotiations with occupants of affected buildings.

Vibration Dosage

A vibration limit based on a particle velocity allows real time control of excavation using warning systems (e.g. flashing lights) attached to vibration monitors. Occasional exceedances (vibration levels exceeding the allowed limit) are not damaging or disturbing and can be allowed but frequent exceedances should be avoided by changes in excavation methods. The difference between occasional and frequent is difficult to gauge on site but can be assessed using recorded vibration data, on the basis of experience or by application of a vibration dosage criterion.

A vibration dosage value (VDV) can be used to assess the effect of intermittent vibrations (e.g. from bursts of rock hammering) on humans over a defined period. Acceptable dosages (generally VDVz for vertical vibrations found most disturbing by humans) have been defined for occupants of residential, commercial and industrial buildings ("Assessing Vibration: a technical guideline", Department of Environment and Conservation, 2006). Estimates of VDV (eVDV) can be calculated from recorded vibration data and can be compared with recommended maxima of 0.4, 0.8 and 1.6 m/s for residential, commercial and industrial locations respectively, to assess the need to change excavation methods to restore human comfort.

The vibration dosage guideline does not relate VDV to structural damage however it is considered that if the VDV is acceptable from a human comfort viewpoint, vibrations leading to that VDV would be unlikely to cause damage to the corresponding residential, commercial or industrial structure. Management of vibrations may require addition of these vibration dosage criteria to other human comfort or damage criteria, if the frequency of vibration exceedances becomes difficult to assess on site or by experienced-based data review.

Appendix E

Design of Braced Excavations

DATA SHEET 11-25

Design of braced excavations

Bracing generally consists of vertical sheet piling supported by a series of struts and waylings. The construction sequence is usually

(a) steel sheet piles are driven into the ground
(b) ground is excavated from inside the area enclosed by the piles
(c) walings and struts are installed and tightened as excavation proceeds.

Because of the method of construction and the rigid support given by the struts, pressures on the sheet piling cannot be predicted by traditional earth pressure theories. The usual design procedure follows the method proposed by Terzaghi, using rules similar to those given below:

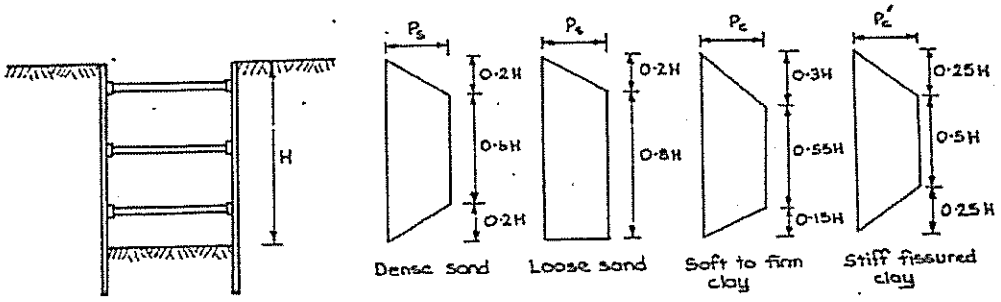


FIGURE 11-25-1 Terzaghi's rules for pressure distributions on braced excavations.

In sand, pressure $p_s = 0.8K_a\gamma.H\cos\delta$

where K_a is the active pressure determined from Data Sheet 11-2
γ is the average soil density
H is the depth of excavation
δ is the angle of wall friction, from Data Sheet 6-5.

In clay, pressure $p_c = \gamma H - 4c_u$

where c_u is the undrained shear strength.

In stiff fissured clays $p_c' = 0.4\gamma H$.

If movement can be reduced to a minimum and construction time is short, this can be reduced to

$p_c' = 0.2\gamma H$

The submerged density is used below the water table and pore water pressures are added to the calculated earth pressures.

In clays, creep effects cause a redistribution of stresses with time. From model tests carried out by Kirkdam, it was concluded that, for long-term design in clays, classical earth pressure theories should be used, based on effective stress parameters.

Reference:
Carter, M (1983) Geotechnical Engineering Handbook