REPORT TO

HEALTH INFRASTRUCTURE

ON

ADDITIONAL GEOTECHNICAL INVESTIGATION

FOR

PROPOSED HOSPITAL REDEVELOPMENT

AT

GRIFFITH BASE HOSPITAL, NOOREBAR AVENUE, GRIFFITH, NSW

Date: 15 November 2019
Ref: 30991L2rpt

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APPENDIX B
GHD Geotechnical Investigation Report (Reference: 2127721) dated December 2018

1 INTRODUCTION

This report presents the results of an additional geotechnical investigation for the proposed hospital redevelopment at Griffith Base Hospital, Noorebar Avenue, Griffith, NSW. The site location is shown on the attached Figure 1. The investigation was commissioned by Health Infrastructure by signed consultancy agreement (Contract No. HI17463), dated 4 October 2019. The investigation was carried out in accordance with our fee submission Reference P49846Lrev1, dated 17 September 2019.

The purpose of the investigation was to provide additional coverage of the site for the proposed redevelopment. The proposed multi-stage redevelopment will involve the progressive demolition of existing structures followed by construction of a new main hospital building and several ancillary services buildings. A large carparking area will be constructed at the southern end of the hospital site. At this stage we have not been provided with specific details of the proposed new buildings, such as structural loads, floor levels etc. Therefore the recommendations provided in Section 4 below are generalised in nature and should be confirmed and amplified once specific building details are provided.

Previous investigations have been undertaken by JK Geotechnics in 2017 and by GHD in 2018. The results of those previous investigations have also been utilised within this report. The previous JK Geotechnics borehole logs and laboratory test results are attached as Appendix A. The previous GHD report is attached as Appendix B.

The subsurface conditions encountered as part of these additional investigations and from those previous investigations have been used to form the basis for comments and recommendations on site classification, earthworks and footings.

This report provides geotechnical advice only. A contamination assessment was carried out concurrently by our environmental division, JK Environments (JKE), the results of which are presented in their report dated November 2019, Ref: E30991BTrpt2.

2 INVESTIGATION PROCEDURE

2.1 Previous Investigations

Previous investigations have been carried out on this site as outlined below. The results of these previous investigations have been incorporated into this report. Borehole logs and laboratory test results from our previous investigation along with the GHD report are attached as appendices.

JK Geotechnics – November 2017

JK Geotechnics completed a site investigation for the Stage 1 redevelopment, particularly the Ambulatory Care Hub, in November 2017 which comprised the drilling of four cored boreholes and ten augered boreholes (BH1 to BH14) within the development area.

GHD – November 2018

GHD were engaged to complete a supplementary investigation in November 2018 for the Stage 1 redevelopment. The GHD investigation included geotechnical and environmental investigations, and comprised;

- Eleven large diameter augered boreholes and five cored boreholes (BH100 to BH115),
- Fourteen large diameter pavement boreholes (IP130 to 1P143),
- Excavation of two test pits (TP120 and TP125) and,
- An additional borehole (BH1116) to permit installation of a groundwater well.

2.2 Current Investigation

Prior to the commencement of the current fieldwork, the investigation locations were electromagnetically scanned by a specialist sub-contractor so that all borehole locations could be located clear of buried services. Reference to 'Dial Before You Dig' plans was also carried out.

The fieldwork for the current investigation was carried out between 15 and 17 October 2019 and comprised the following scope of work:

- Seven cored boreholes (BH201-BH203, BH205, BH207, BH209 and BH217) drilled to termination depths ranging from 4.8m to 6.8m. The purpose of these boreholes was to obtain cored samples of the bedrock to permit more detailed design and geotechnical recommendations.
- Ten augered boreholes (BH204, BH206, BH208 and BH210-BH216) drilled to depths ranging from 0.6m to 1.5m to obtain environmental samples to provide sufficient coverage for the contamination assessment.

The augered boreholes and the augered portion of the cored boreholes were drilled using spiral augers fitted with a tungsten carbide (TC) bit. The cored boreholes were then extended using diamond coring techniques with an NMLC triple tube core barrel and water flush.

The borehole locations and surface reduced levels were obtained from a Sokkia mobile differential GPS unit. The borehole locations are shown on the attached Figure 2 and the surface reduced levels are shown on the borehole logs. The height datum is Australian Height datum (AHD).

The strength of the natural soils was assessed from Standard Penetration Test (SPT) 'N' values, augmented with hand penetrometer readings on cohesive samples recovered from the SPT split tube sampler. The strength of the underlying bedrock was assessed by observation of the drilling resistance of the TC bit attached to the augers, together with examination of the recovered rock chips.

Where the rock was core drilled, the recovered rock core was returned to our NATA registered laboratory where it was photographed and Point Load Strength Index (Is_{50}) testing was carried out. Using established correlations, the unconfined compressive strength (UCS) of the bedrock was estimated from the Is_{50} results. The Point Load Strength test results are summarised in the attached Soil Test Services (STS) Table A1.

Groundwater observations were made both during drilling and after completion of the boreholes.

The fieldwork was completed in the full-time presence of our geotechnical engineer, Mr. Kartik Singh, who set out the boreholes, nominated sampling and testing locations and prepared logs of the strata encountered. The borehole logs, which include field test results and groundwater observations, are attached to the report together with our Report Explanation Notes, which describe the investigation techniques, and their limitations, and define the logging terms and symbols used.

3 RESULTS OF INVESTIGATION

3.1 Site Description

The site is located within undulating to hilly local topography associated with the Griffith Syncline and McPhersons Range Anticline. The site is situated mid-slope on a hill which slopes down at approximately 3° to the south. The site is surrounded by local roads on all sides namely, Warrambool Street, Noorebar Avenue and Animoo Avenue.

Griffith Base Hospital is located on a generally arch-shaped block with an area of approximately 6.4ha. There is an adjoining private hospital beyond the northern corner and two smaller lots beyond the south-west boundary. The hospital site typically comprises one and two-storey brick buildings which generally appeared to be in good condition from our cursory external observation. For more descriptive purposes, the site has been split into 3 separate zones which cover the two main development areas; being the proposed Main Hospital Building, Back of House/Temporary Paediatrics Buildings and the remainder of the site.

Proposed Main Hospital Building Area

The proposed Main Hospital area is located in the north-west of the hospital grounds and typically has one-storey brick buildings (including the existing Paediatrics Building and Back of House buildings) intersected by asphaltic or gravel paved internal roads. A gravel carpark is situated to the north-east of the existing Paediatrics Building. South-west of these buildings is a large grassed areas with some small accommodation buildings along the frontage with Animoo Street. Within this grassed area are a number of large trees. This area generally sloped gently to the south west with the exception of a relatively level building platform adjacent to the Private Hospital.

Proposed Back of House/Temporary Paediatrics Buildings

This area comprises the corridor bound by the main hospital building area to the west, St Vincent's Private Hospital to the north-west and Warrambool Street to the north-east. This area contains a few one storey brick buildings (including the existing Maternity Unit and RMO Accommodation) which are generally surrounded by lawns with some asphalt paved driveways and parking areas off Warrambool Street. At the northern end of the area the site is bound by the two-storey brick St Vincent's Hospital building. A 0.5m-0.8m high brick retaining wall stepped down into the adjoining St Vincent's asphalt car park. Surface levels across the area are relatively level in the north, with a slope of about 2° to the south. Small to medium sized trees are scattered across this area.

Rest of Site

The rest of the site is largely occupied by vacant grassed slopes with the existing main hospital building situated in the centre of the site. A construction site for the new Ambulatory Care Hub was positioned in the south-western corner of the site (in the area of our previous boreholes 1-8). The former Nurses' Quarters buildings in the south-eastern corner of the site have been demolished since our previous site investigation. Medium to large trees are interspersed across the southern half of the site.

3.2 Subsurface Conditions

The Narrandera 1:250,000 Geological Series Sheet SI 55-10 indicates that the site is underlain by rocks of the Cocoparra Group which comprise "undifferentiated quartz sandstone and pebbly sandstone". Contact with the Jimberoo Formation is indicated on the northern boundary of the site. The Jimberoo Formation comprises, according to the Australian Stratigraphic Units Database, "thin- to medium-bedded, coarse to medium grained red and white sandstone, minor red siltstone and grit beds". This profile does not take into account any earthworks i.e. filling that may have occurred on site.

The boreholes generally comprised a shallow profile of cohesive soils overlying weathered sandstone. A summary of the subsurface conditions is provided below, however for a detailed description of the subsurface conditions encountered at each borehole, reference should be made to the attached borehole logs and the previous reports in Appendix A and B.

Topsoil

A shallow topsoil layer was encountered at surface in most boreholes drilled by GHD, BH9 and BH14 in the north-eastern half of the site, and within the grassed areas around the north-western car park. The topsoil typically comprised silty clay, sandy clay or sandy silt and extended to depths ranging from 0.1m to 0.45m with an average depth of about 0.2m.

Fill

Fill was encountered from the surface in most boreholes completed as part of these current investigations. The fill extended to depths ranging from 0.1m to greater than 1.1m. Figure 3 graphically depicts the depth of fill where it was encountered in individual boreholes. The fill within the car park and driveway areas (below existing pavements) typically comprised silty gravel while in grassed areas the fill was generally assessed as silty clay of low plasticity. Within TP121, fill extended to a depth of at least 1.1m against the wall of the General and Medical Ward Building and comprised clayey gravelly sand.

Natural Soils

The natural soils have been classified as residual and erosional (slope wash) in origin. The natural soils generally comprised silty clays of low or medium plasticity with some upper layers of sandy silt of low plasticity also encountered. We note that the natural soils within the GHD report has typically described the soils as sandy clays. These natural soils extended to bedrock and were typically of very stiff or hard strength.

Weathered Sandstone

Sandstone bedrock was encountered at depths ranging from 0.2m to 2.6m below existing surface levels. The attached Figures 4 and 5 graphically depict the approximate top of bedrock (in mAHD) and depth to bedrock (in m) respectively. The sandstone bedrock appears to dip down to the south-west at approximately 2° across the site. The sandstone was typically of medium to high strength either from or near to initial contact with the rock surface. Bands of extremely low to very low strength rock were encountered in the upper 1m at some locations. The bedrock, where cored, contained core loss or extremely weathered seams in the initial 1m with minimal defects below. Defects were typically steeply-inclined joints or thin (less than 5mm thick) extremely weathered/clay seams. Siltstone was encountered in BH13 and BH14 in the north-western portion of the Hospital.

Point Load Strength Index testing of the bedrock returned Unconfined Compressive Strength (UCS) values of between 2MPa and 140MPa with values typically between 24MPa and 60MPa.

Groundwater

Generally, groundwater was not encountered during or on completion of auger drilling in any of the boreholes or test pits during the course of the investigations. As part of the JK Geotechnics investigation in November 2017, standpipe piezometers were installed in three boreholes (BH7, BH9 and BH13) to allow for longer-term monitoring. A standpipe piezometer was also installed in BH116 as part of the GHD investigation in November 2018.

Groundwater was measured at a depth of 1.85m in BH7, 7.5 hours after completion of the drilling. However we note that water is introduced into the borehole during core drilling, and therefore this water level is likely to be artificially high and not representative of the 'actual' groundwater level.

3.2.1 Summary of Borehole Results

The following table provides a general summary of the borehole results from the previous and current investigations. The table has not included the shallow pavement holes completed as part of the GHD investigation in November 2018.

Summary Table of Borehole Results

Borehole	Depth Range of Materials					
	Topsoil/Fill	Residual/Natural	XW Rock	XW/HW Rock	MW/SW Rock	SW/Fr Rock
1	0.0 to 0.1	0.1 to 0.4	-	-	0.4 to 0.5[2]	-
2	0.0 to 0.45	-	-	0.45 to 1.8	1.8 to 2.4[2]	-
3	-	0.0 to 0.5	-	-	0.5 to 1.9[2]	-
4	-	0.0 to 0.5	0.5 to 1.8[1]	-	-	-
5	0.0 to 0.5	0.5 to 2.0	-	-	2.0 to 2.6	2.6 to 4.66[2]
6	0.0 to 0.2	0.2 to 1.5	-	-	1.5 to 2.6[2]	-
7	-	0.0 to 0.9	-	0.9 to 1.65	-	1.65 to 2.7[2]
8	-	0.0 to 1.7	-	-	1.7 to 2.1[2]	-
9	0.0 to 0.2	0.2 to 2.6	-	-	2.6 to 3.1[2]	-
10	-	0.0 to 0.2	-	-	0.2 to 0.3[2]	-

Borehole	Depth Range of Materials					
	Topsoil/Fill	Residual/Natural	XW Rock	XW/HW Rock	MW/SW Rock	SW/Fr Rock
11	-	0.0 to 1.0	-	-	1.0 to 1.2[2]	-
12	-	0.0 to 1.2	-	-	1.2 to 2.08	2.08 to 3.82[2]
13	-	0.0 to 1.1	-	1.1 to 1.4	1.4 to 3.0	3.0 to 4.64[2]
14	0.0 to 0.25	0.25 to 1.0	-	1.0 to 1.65[1]	-	-
100	0.0 to 0.25	0.25 to 1.0	1.0 to 1.5	1.5 to 1.6[1]	-	-
101	0.0 to 0.15	0.15 to 1.1	1.1 to 1.6[1]	-	-	-
102	0.0 to 0.5	0.5 to 1.2	1.2 to 1.5	1.5 to 2.76	2.76 to 6.0	6.0 to 7.0[2]
103	0.0 to 0.2	0.2 to 1.0	1.0 to 1.3	1.3 to 1.4[1]	-	-
104	0.0 to 0.2	0.2 to 0.7	0.7 to 1.25	1.25 to 1.3[1]	-	-
105	0.0 to 0.2	0.2 to 1.1	1.1 to 1.4	1.4 to 1.55[1]	-	-
106	0.0 to 0.2	0.2 to 1.0	1.0 to 1.5[1]	-	-	-
107	0.0 to 0.2	0.5 to 2.6	-	2.6 to 5.0	5.0 to 8.0	8.0 to 9.0[2]
108	0.0 to 0.2	0.2 to 0.7	0.7 to 1.0[1]	-	-	-
109	0.0 to 0.25	0.25 to 1.4	1.4 to 3.0	3.0 to 7.6	7.7 to 8.5	8.5 to 10.6[2]
110	0.0 to 0.2	0.2 to 0.5	0.5 to 0.7	0.7 to 0.8[1]	-	-
111	0.0 to 0.2	0.2 to 0.6	0.6 to 1.0[1]	-	-	-
112	0.0 to 0.2	0.2 to 0.75	0.75 to 1.5	1.5 to 1.8	1.8 to 4.0	5.0 to 5.5[2]
113	0.0 to 0.2	0.2 to 1.0	1.0 to 1.2[1]	-	-	-
114	0.0 to 0.2	0.2 to 0.75	0.75 to 1.0	1.0 to 1.1[1]	-	-
115	0.0 to 0.2	0.2 to 1.0	1.0 to 2.5	2.5 to 2.8	2.8 to 5.0	5.0 to 6.45[2]
116	0.0 to 0.6	0.6 to 0.8	0.8 to 1.25	1.25 to 2.0	2.0 to 10[2]	-
201	0.0 to 0.4	0.4 to 1.4	1.4 to 2.2	2.2 to 4.6	-	4.6 to 6.48[2]
202	0.0 to 0.7	0.7 to 1.6	1.6 to 2.1	2.1 to 5.72	5.72 to 6.8[2]	-
203	0.0 to 0.2	0.2 to 1.1	1.1 to 1.6	-	1.6 to 4.82	4.82 to 6.70[2,3]
204	0.0 to 0.2	0.2 to 0.5[1]	-	-	-	-
205	0.0 to 0.2	0.2 to 1.0	1.0 to 1.2		1.2 to 5.84[2,3]	-
206	0.0 to 0.9	0.9 to 1.5[1]	-	-	-	-
207	0.0 to 0.1	0.1 to 0.3	-	-	-	0.3 to 4.8[2]
208	0.0 to 0.3	0.3 to 0.7	-	-	0.7[1]	-
209	0.0 to 0.2	-	-	0.2 to 3.25	3.25 to 4.5	4.5 to 6.09[2]
210	-	0.0 to 0.2	-	-	0.2 to 0.6[2]	-
211	-	0.0 to 0.95[1]	-	-	-	-
212	0.0 to 0.2	0.2 to 0.95[1]	-	-	-	-
213	0.0 to 0.2	0.2 to 0.8	0.8 to 0.85[1]	-	-	-
214	0.0 to 0.3	0.3 to 0.95[1]	-	-	-	-
215	0.0 to 0.5	0.5 to 0.6	-	0.6 to 0.7[1]	-	-
216	0.0 to 0.6	0.6 to 0.95[1]	-	-	-	-
217	0.0 to 0.3	0.3 to 1.4	-	-	1.4 to 3.5	3.5 to 5.33[2]

1 – Note that this is the termination depth of the borehole and the ground conditions below this depth are unconfirmed.

2 – Note that this is the termination depth of the borehole and the ground conditions below this depth are unconfirmed. Extremely or highly weathered material can occur within zones of slightly weathered or fresh rock

3 – Contains bands of core loss, extremely and highly weathered bedrock

3.3 Laboratory Test Results

The following tables summarise the laboratory testing completed during the previous and current investigations at Griffith Base Hospital. The Point Load Strength Index Test ($I_{s(50)}$) results from the current investigation are summarised on the relevant borehole logs and in the attached Table A1. The laboratory test reports from our previous investigation are attached in the appendices. We note that GHD undertook

Salinity and Emerson dispersion testing of the soils as part of their investigations. The results of those tests have been summarised below for completeness, however we have not provided any specific recommendations within this report in regards to salinity. Reference should be made to the GHD report in Appendix B for further details and discussion on salinity.

3.3.1 Moisture Content Tests

The results of the moisture content testing on rock chip samples correlate well with our field assessment of rock strength. The moisture content test results on soil samples obtained during the GHD investigation indicate the soils have a low moisture content.

Summary Table of Moisture Content Results

Test Location	Depth (m)	Sample Type	Moisture Content (%)
1	0.4-0.5	Sandstone (H strength)	1.0
2	1.6-1.8	Sandstone (VL strength)	22.5
3	1.3-1.5	Sandstone (M-H strength)	7.3
4	0.0-0.4	Silty clay	16.1
5	2.0-2.2	Sandstone (H strength)	3.4
6	1.5-1.8	Sandstone (M-H strength)	3.8
7	0.0-0.4	Silty clay	4.1
7	0.6-0.69	Sandstone (H strength)	4.6
8	1.7-2.0	Sandstone (H strength)	0.3
9	0.5-0.95	Silty clay	19.4
9	2.6-3.0	Sandstone (M-H strength)	3.3
11	1.0-1.2	Sandstone (H strength)	1.1
12	0.5-0.95	Silty clay	11.8
14	1.5-1.63	Siltstone (VL-L strength)	17.7
102	0.5-1.0	Clay	12.5
103	0.5-0.8	Clay/Sandy clay	12.0
108	0.4-0.6	Clayey sand/Sandy clay	5.7
110	0.4-0.6	Gravelly clayey sand	9.0
114	0.4-0.7	Sandy clay	9.5
141	0.4-0.8	Sandy clay	5.8
143	0.4-0.6	Fill (Sandy clay)	4.4

3.3.2 Atterberg Limits and Linear Shrinkage

The Atterberg limit results indicate the soils are primarily of low and sometimes medium plasticity, and therefore we consider that the soils will have a moderate potential for shrink-swell movements with changes in moisture content. These results are consistent with the predominantly low to medium plasticity logged during the fieldwork. The test on BH4 however indicate the silty clay at this location to be medium to high plasticity.

Summary Table of Atterberg Limits and Linear Shrinkage Test Results

Test Location	Depth (m)	Soil Type	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
4	0.0-0.4	Silty clay	20	49	29	14
7	0.0-0.4	Silty clay	14	22	8	4
9	0.5-0.95	Silty clay	15	30	15	7
12	0.5-0.95	Silty clay	18	35	17	8
102	0.5-1.0	Clay	15	23	8	Not tested
103	0.5-0.8	Clay/Sandy clay	12	21	9	Not tested
109	0.5-1.0	Sandy clay	15	24	9	Not tested
112	0.5-1.0	Sandy clay/Clayey sand	11	22	11	Not tested
114	0.4-0.7	Sandy clay/Clayey sand	12	24	12	Not tested
137	0.7-1.0	Sandy clay	13	30	17	Not tested
141	0.4-0.8	Sandy clay	12	21	9	Not tested

3.3.3 Shrink-Swell Index

Shrink-Swell tests were carried out during the previous JK Geotechnics November 2017 investigation. The shrink-swell tests were consistent with the results of the Atterberg Limit tests showing the samples to be of medium to high plasticity for the sample of silty clay in BH4 and low plasticity for the sample of silty clay in BH7.

Summary table of Shrink-Swell Test Results

Test Location	Depth (m)	Soil Type	Shrink Swell Index (%/pF)
4	0.0-0.4	Silty clay	3.07
7	0.0-0.4	Silty clay	0.51

3.3.4 Emerson Class Number

The Emerson Class Numbers reported by GHD in their November 2018 Report indicate that the samples have a high to extreme sediment export risk after Marsh (2002) which indicates high potential for soil erodibility.

Summary Table of Emerson Class Number Test Results

Test Location	Depth (m)	Sample Type	Emerson Class Number
102	0.5-1.0	Clay	2
103	0.5-0.8	Clay/Sandy clay	3
108	0.4-0.6	Clayey sand/Sandy clay	3
110	0.4-0.6	Gravelly clayey sand	2
112	0.5-1.0	Silty clay/Sandy clay	2
114	0.4-0.7	Sandy clay	3
137	0.7-1.0	Sandy clay	3
141	0.4-0.8	Sandy clay	3
143	0.4-0.6	Fill (Sandy clay)	3

3.3.5 Soil Aggression

The soil aggression testing results are summarised below and indicate that in accordance with AS2159-2009 Tables 6.4.2(C) and 6.5.2(C) that the site soils have a 'non-aggressive' exposure classification for both concrete and steel structural elements.

Summary Table of Soil Aggression Test Results

Test Location	Depth (m)	Sample Type	Chloride (mg/kg)	Sulphate (mg/kg)	pH	Resistivity (ohm.cm)
2	0.3-0.45	Sandstone	<10	<10	7.1	55000
3	0.0-0.45	Sandy silty clay	21	<10	6.8	12000
5	1.5-1.93	Silty clay	20	40	8.5	6900
9	1.5-1.95	Gravelly clay	<10	20	9.4	8200
11	0.5-0.95	Sandy silt	10	<10	6.8	36000
13	0.5-0.95	Silty clay	<10	<10	8.5	6900
102	0.5-1.0	Clay	<10	12	8.3	110000
106	0.4-0.7	Clay/Sandy clay	30	<10	7.7	130000
110	0.4-0.6	Gravelly sandy clay	15	<10	7.2	78000
112	1.0-1.1	Sandy clay/Clayey sand	30	150	7.6	20000
114	0.8-1.0	Sandy clay/Clayey sand	24	13	7.8	70000
120	0.3-0.4	Sandy clay	<10	43	8.5	33000
137	0.7-1.0	Sandy clay	12	<10	7.5	110000

3.3.6 Soil Salinity

The soil salinity classes from Taylor (1996) *Dryland Salinity* have been used to assess salinity within the GHD report. The results of the testing indicate that all but one sample is classified as 'Non-saline'. Generally, therefore, the site soils are considered 'non-saline'.

Summary Table of Soil Salinity Test Results

Test Location	Depth (m)	Sample Type	pH	Equivalent Conductivity (dS/m)	Textural Factor	Salinity Class
102	0.5-1.0	Clay	8.3	0.40	8.5	Non-saline
106	0.4-0.7	Clay/Sandy clay	7.7	0.32	9	Non-saline
110	0.4-0.6	Gravelly sandy clay	7.2	0.64	10	Non-saline
112	1.0-1.1	Sandy clay/Clayey sand	7.6	2.34	9	Slightly saline
114	0.8-1.0	Sandy clay/Clayey sand	7.8	0.65	9	Non-saline
120	0.3-0.4	Sandy clay	8.5	1.00	7	Non-saline
137	0.7-1.0	Sandy clay	7.5	0.37	8	Non-saline

3.3.7 CBR

Four-day soaked CBR tests were completed on a variety of subgrade materials. The CBR values ranged from 3% to 12%. The in-situ moisture contents were generally slightly (0.3-0.7%) wet of optimum moisture content.

Test Location	Depth (m)	Subgrade Material	Standard Maximum Dry Density (t/m^3)	Optimum Moisture Content (%)	CBR (%) at 2.5mm
103	0.5-0.8	Clay/Sandy clay	1.94	12.5	8
108	0.4-0.6	Clayey sand	1.95	10.2	12
109	0.5-1.0	Sandy clay	1.86	13.9	5
110	0.4-0.6	Gravelly sandy clay	1.94	10.8	8
114	0.4-0.7	Clay	1.90	12.9	6
132	0.3-0.6	Sandy clay	1.97	10.4	4.5
136	0.4-0.7	Sandy clay	1.74	17.5	3
138	0.3-0.6	Sandy clay	2.02	9.8	11
141	0.4-0.8	Sandy clay	1.99	10.6	4

3.3.8 Point Load Strength Index Test

Axial point load strength index tests (Is_{50}) were completed on rock core for all investigations and returned estimated Unconfined Compressive Strength (UCS) values ranging from 2MPa to 140MPa. Diametric tests were also carried out by GHD as part of their testing.

It should be noted that the point load strength index test does not provide a direct measure of rock strength and correlations between the point load results and UCS are derived statistically for a particular rock type using a range of test results. In estimating the UCS value we have assumed a multiplier of 20 applies to the sandstone bedrock while GHD adopted a multiplier in the range of 10 to 15 for Is_{50} greater than 1.0MPa and 4 to 8 for Is_{50} less than 1.0MPa. Therefore care should be made when comparing rock strength from the UCS values reported by JK Geotechnics and GHD. For a true comparison, the rock strength should be referenced back to the actual Point Load strength Index value Is_{50}.

4 COMMENTS AND RECOMMENDATIONS

4.1 Site Classification

The following comments and recommendations relate to the requirements of AS2870-2011, 'Residential Slabs and Footings'. This standard is designed to be used with residential (or similar type structures) of one to two stories. Therefore this standard may not be applicable to the type of structures proposed as part of the hospital redevelopment. Nevertheless the results of the soil testing can be used to provide an indicative assessment of potential shrink-swell movements with changes in moisture content, which can then be used (using engineering principles) to supplement the design of structure which are outside the scope of AS2870.

The boreholes have generally shown shallow fill across most of the development area for the Main Hospital Building and Back of House building. The exception was BH5, BH202, BH206, BH216 and TP121, where fill to

a depth of 0.5m or greater was encountered. The fill was variable and is unlikely to have been placed as a controlled fill. In accordance with AS2870-2011, 'Residential Slabs and Footings' the presence of uncontrolled fill greater than 0.4m would require the site classification to be Class 'P'. Footings for Class 'P' conditions need to be designed on the basis of engineering principles.

Based on laboratory testing, the cohesive soils encountered beneath the topsoil/fill are predominantly of low to medium plasticity. The reactivity of the overlying soils varies across the site, as does the depth to the underlying bedrock, however the depth to rock is typically less than 1.5m across the site. Therefore provided the depth to rock is less than 1.5m, we consider that characteristic ground surface movements would not exceed about 40mm, and as such footing systems designed for a site classification of 'M' in accordance with AS2870-2011 would be applicable for relevant structures. Where rock depths are greater, or engineered fill platforms comprising the site won residual clay soils are used, a more severe classification may apply and advice should be obtained from the geotechnical engineers during the design stages.

Consideration also needs to be given to the effect of trees on reactive soil movements. This will require a specific calculation when the location of any new buildings in relation to existing or proposed trees is determined. The presence of trees close to a new building can have an adverse effect on structures. We would be pleased to assist with such an assessment.

Reference should be made to Appendix B of AS2870-2011 for foundation performance and maintenance recommendations.

4.2 Dilapidation Reports

Prior to any site works adjacent to existing hospital buildings or adjoining structures, we recommend that a detailed internal and external dilapidation report be carried out on these structures. This will be particularly important where excavation into the underlying rock using hydraulic impact hammers is required. The dilapidation report should include a detailed inspection of the properties, with all defects rigorously described, mapped and photographed. The respective owners of the properties should be provided with a copy of the dilapidation report and should be asked to confirm (by signing a copy of the report) that the report presents a fair assessment of existing conditions. Such reports can be used as a baseline against which to assess possible future claims for damage arising from the works.

4.3 Excavations

The following recommendations should be read in conjunction with the 'Excavation Work – Code of Practise' by Safe Work Australia (July 2015).

We do not expect significant excavations to be carried out on the site, and the following recommendations will be suitable for all minor excavations and excavation depths down to about 3m (i.e. excavation for a single level of basement).

Excavation of the fill and natural soils will be readily achievable using the buckets of conventional hydraulic excavators.

Once sandstone bedrock is encountered, it is typically of medium to high strength on first contact, although occasionally there is some surficial extremely weathered to very low strength rock. Excavation of any very low strength rock will require either large excavators with ripping tynes or the use of rock excavation equipment, such as dozers with ripping tynes, hydraulic impact hammers, rock saws, or rock grinders. Once medium strength rock is encountered, rock excavation techniques will be required. The boreholes indicated that some high or very high strength rock may be encountered, and such material will be effectively 'unrippable' and will require the use of large hydraulic excavators with rock saws and hydraulic impact hammers.

During the use of hydraulic impact hammers, precautions must be made to reduce the risk of vibrational damage to adjoining structures. At the commencement of the use of hydraulic impact hammers some quantitative vibration monitoring should be carried out on adjoining structures by an experienced vibration consultant or geotechnical engineer to check that vibrations are within acceptable limits. Where hard rock excavation is required close to movement sensitive buildings (e.g. radiography units) or services, then continuous vibration monitoring may be required to ensure vibration limits are not exceeded. The attached vibration emission guidelines provide some advice on acceptable vibrations in this regard.

Due to the potential to encounter high or very high strength rock during excavation works, we recommend that wherever possible excavation depths be limited to reduce the potential for excavation cost overruns in relation to slow excavation productivity. Excavation contractors should be provided with a copy of this report and should be asked to confirm that they have adequate equipment to extend excavations through the rock material encountered, and that they have allowed for the presence of such 'hard' rock conditions in their tenders.

Based on the borehole logs, we do not expect any significant groundwater seepage into excavations, however some seepage may occur across the top of the bedrock or through joints and defects within the rock, during or immediately following periods of rainfall. Any such seepage should be controllable by conventional sump and pump techniques.

4.4 Earthworks

Some earthworks may be required to increase site levels to accommodate proposed building platforms where buildings are not designed as suspended slabs or for new pavement areas.

All earthworks recommendations provided below should be complemented by reference to AS3798-2007 'Guidelines for Commercial and Residential Developments'.

4.4.1 Site Drainage

The predominantly clay subgrade is expected to undergo some loss in strength when wet. Therefore during all earthworks activities and for long term site maintenance, it will be important to maintain good and effective site and surface drainage to reduce ponding and promote controlled runoff particularly due to the high erosion potential of the natural cohesive soils. The earthworks should be carefully planned and scheduled to maintain good cross-falls during construction. Effective sediment controls will also need to be adopted to reduce the risk of 'muddy' water discharging from the site. We note that a poorly drained clay subgrade may become untrafficable when wet.

4.4.2 Subgrade Preparation

Subgrade preparation will include removal of existing trees and plants (including their root balls) and stripping of grass, topsoil, existing pavements, root affected soils and any deleterious or contaminated fill. Stripped topsoil/root affected soils should be stockpiled separately as they are considered unsuitable for reuse as engineered fill, however may be re-used within landscaping areas.

Following stripping to design subgrade levels, we expect that the majority of the exposed subgrade will comprise either the natural clayey soils or sandstone bedrock. Where soils are exposed, the following subgrade preparation is recommended;

- Initially the subgrade should be proof rolled with at least six passes of a static (non-vibratory) smooth drum roller of at least 8 tonnes deadweight. The final pass of proof rolling should be carried out under the direction of an experienced geotechnical engineer for the detection of unstable or soft areas.
- Heaving areas should be locally removed to a stable base and replaced with compacted engineered fill. Based on the subsurface conditions at the time of our investigations, we do not expect significant heaving of the subgrade during proof rolling.

Where weathered bedrock is exposed at subgrade level, proof rolling is unlikely to be required, however the subgrade should still be inspected by a geotechnical engineer to confirm whether any subgrade works are required.

4.4.3 Engineered Fill

General

Fill suitable to raise site levels must be 'engineered fill' and may comprise the existing site won silty clays or excavated sandstone bedrock or alternatively approved imported materials. All engineered fill must be free of organic material, deleterious substances and particles greater than a nominal 70mm size. We do not recommend the use of the silty soils, which were primarily encountered around the south-eastern corner of the site, as engineered fill, since they can be sensitive to moisture variations and therefore difficult to compact. Our preference for imported fill would be to use a good quality granular material, such as crushed sandstone.

Where existing site won silty clays are used as engineered fill, it should be placed in layers of approximately 300mm loose thickness (or as appropriate to the size of the equipment being used), compacted to between 98% and 102% of Standard Maximum Dry Density (SMDD) and to within 2% of Standard Optimum Moisture Content (SOMC). Where imported granular material or existing site won sandstone material is to be used as engineered fill it should also be placed in layers not greater than 300mm loose thickness and should be compacted to not less than 98% SMDD.

The importation of clayey materials may be considered, however prior to committing to a source of clayey material, it should be thoroughly sampled and tested to confirm its properties are suitable for re-use as an engineered fill. Clayey soils require a more stringent compaction specification in regards to SMDD and moisture content to ensure suitable performance. Where clays are overly wet they may require drying out prior to their use as engineered fill. Clays when placed and compacted as engineered fill will also undergo greater shrink-swell movements with changes in moisture content than the in situ reactive silty clays. Therefore consideration needs to be given to the affect that greater shrink-swell movements will have on the performance of structures founded above. Further specific advice should be obtained from the geotechnical engineers if reactive clays are to be considered for engineered fill

All engineered fill should be either retained or, alternatively, battered to a permanent slope no steeper than 1 Vertical (V) in 2 Horizontal (H). We note that a flatter batter of 1V in 3H or even 4H, may be preferable from a long-term maintenance perspective. All permanent fill batter slopes must be protected from erosion by quickly establishing a vegetative cover, or other approved proprietary erosion control system. Dish drains should be provided along the crest of all permanent batter slopes to intercept surface water runoff. Discharge should be piped to the stormwater system.

The soils at the site were determined, from testing by GHD, to be non-saline but susceptible to erosion. Further advice is provided within the attached GHD report. We consider that any exposed soil slopes and embankments should be appropriately protected from erosion by approved erosion protection measures.

Edge Compaction

In order to achieve adequate edge compaction for fill embankments, we recommend that the outer edge of each layer extend a horizontal distance of at least 1.5m beyond the design geometry. The roller must extend over the edge of each placed layer in order to seal the batter surface. On completion of filling, the excess under compacted edge fill should be trimmed back to the design geometry. A minimum width of 1.5m should be adopted between the crest of the embankment and the outer edge of any new pavements.

Service Trenching

Backfilling of service trenches must also be carried out using engineered fill in order to reduce post-construction settlements. Due to the reduced energy output of the rollers that can be placed in trenches, backfilling should be carried out in 100mm thick loose layers and compacted using a trench roller or a roller attachment fitted to an excavator. Due to the reduced loose layer thickness, the maximum particle size of the backfill material should also reduce to 40mm. The compaction specifications provided above are applicable, unless there is a stricter contract specification.

Consideration should also be given to the potential erodibility of the clayey soils and appropriate precautions made with all soil materials in and around service trenches.

Earthworks Inspection and Testing

Density testing should be carried out on all engineered fill used to support ground floor slabs and pavements as part of site earthworks to confirm that the above earthworks specifications are achieved. The frequency of density testing for engineered fill should be as per the requirements outlined in Table 8.1 of AS3798-2007. We recommend Level 1 control of fill type, placement and compaction be adhered to on this site. Due to a potential conflict of interest, the Geotechnical Testing and Inspection Authority (GITA) should be directly engaged by the client (or their representative) and not by the earthworks contractor or sub-contractors.

4.5 Batter Slopes and Retaining Walls

4.5.1 Batters

Where space permits, soil batter slopes may be excavated as per the recommendations below and are contingent on the batter slopes being not greater than 3m high and the batter slopes being inspected by a geotechnical engineer at not greater than 1.5m depth intervals.

- Temporary batters through any fill, residual soils and weathered bedrock up to and including very low strength should be battered at not steeper than 1 Vertical (V) in 1 Horizontal (H).
- Temporary batters through bedrock of at least low strength may be excavated vertically however this would be subject to inspection by a geotechnical engineer at 1.5m lifts to ensure no adverse defects are present. Where adverse defects are encountered the geotechnical engineer would provide advice on remediation measures such as rock bolts, shotcreting etc.
- Permanent batter slopes through any fill, residual soils and weathered bedrock up to and including very low strength should be battered at not steeper than 1V in 2H although flatter batters may be preferable to assist with maintenance of the batter slopes. Permanent batters must be protected from erosion, such as by the use of vegetation or other approved erosion protection measures.
- Surcharge loads, including adjoining buildings, construction loads etc. must be kept well clear of the crest of all batters (at least 2H from the crest of temporary batters and H from the crest of permanent batters, where H is the vertical height of the batter slope in metres).
- Surface drainage should not be allowed to flow over the crest of batters, and should be directed and discharged in a manner which avoids concentrated flows and erosion.

There are cost implications with excavating and disposing of additional soil to form temporary batters and importing large quantities of durable gravel backfill. The space required to form temporary batters may also be problematic where there is limited storage and construction space. Therefore it may be preferable to install shoring systems rather than form temporary batters.

4.5.2 Retaining Walls

The following recommendations are on the assumption that retaining walls do not exceed 3m in height. Retaining walls may need to be provided in some areas of the site where;

- Temporary excavation batters cannot be accommodated within the site geometry, or
- Fill is to be placed to increase site levels, or localised excavation is required, and small height retaining walls are preferred to permanent batter slopes.

Where temporary batter slopes cannot be accommodated within the site geometry a properly design insitu retention system will need to be designed and installed prior to excavation commencing. The shoring system may be incorporated into the final structure if required. Given the subsurface conditions encountered, we consider that suitable shoring systems will include soldier piles with shotcrete infill panels or contiguous piled walls. Contiguous piled walls should be adopted where movement sensitive structures or services are in close proximity to the shoring wall (say within about 2m), or where more rigid shoring systems are required to reduce wall movements. Bored piles will be suitable for soldier piles and contiguous piles, however we note that the underlying bedrock can be up to high or even very high strength and therefore long sockets within the bedrock may be very difficult to achieve. As such temporary lateral support of the shoring system is likely to more cost effective using anchors or internal propping rather than deep rock sockets. We assume that any permanent lateral support of shoring systems will be provided by the structure.

For soldier pile walls, reinforced shotcrete panels should be sprayed progressively with the excavation to support the material between the piles, such that there is no more than 1.5m of vertical face material exposed at any one time. It will be necessary to install strip drains with a non woven geotextile filter fabric behind each panel of shotcrete to dissipate any pore pressures behind the shotcrete. We recommend that strip drains be spaced at not greater than 1.5m centres. Where contiguous piled walls are adopted, drainage should be provided by the use of 40mm diameter PVC weep holes drilled through the pile gaps and spaced at not more than 1.5m centres vertically and horizontally. The PVC weep holes should be covered at the end with a non-woven geotextile to reduce subsoil erosion.

The spacing of soldier piles will depend on the location of any adjoining structures, the depth of excavation and the risk of any localised slumps of soils between soldier piles. The geotechnical engineers can provide more specific advice in that regard when such conditions are known. However as a guide we suspect that a soldier pile spacing of not greater than about 1.5m would typically be appropriate.

The following parameters may be used for design of new retaining walls. These parameters are provided on the basis of the retaining walls being properly designed insitu walls (such as soldier pile walls or contiguous piled walls as discussed above) or being backfilled with a properly placed and compacted engineered backfill. Particular care will be required during backfilling against retaining walls that compaction stresses do not cause either damage to the wall or excessive wall deformation.

- For cantilever walls where some movement can be tolerated we recommend a triangular lateral earth pressure distribution using an 'active' earth pressure coefficient (K_a) of 0.35 be applied to the full height of the retaining wall

- For cantilever walls which will be propped by floor slabs or where movements are to be reduced, we recommend a triangular lateral earth pressure distribution using an 'at rest' earth pressure coefficient (K_0) of 0.55 be applied to the full height of the retaining wall.
- Passive resistance through the residual soils of at least stiff strength may be designed using a triangular distribution and a passive earth pressure co-efficient (K_p) of 2.6. A factor of safety of at least 2 should be applied to the passive earth pressure for design purposes.
- A bulk unit weight of 20kN/m^3 may be used for the properly placed and compacted backfill and for residual soils.
- All surcharge loads affecting the walls (e.g. nearby footings, construction loads and traffic etc) are additional to the earth pressure recommendations above and should be included in the design.
- Measures must be taken to provide permanent and effective drainage of the ground immediately behind the free standing cantilever walls (i.e. retaining walls constructed after excavation of a temporary batter slope). We recommend the use of a free draining durable aggregate (such as 20mm size blue metal) with 'agg' pipe surrounded by a geotextile at the base and connected to the stormwater drainage system.

We note that it is possible that some retaining walls may be retaining bedrock. As such the design parameters noted above to be applied to the full height of the retaining wall may be somewhat conservative. Therefore if refinement of the retaining wall deigns is required, we recommend that the geotechnical engineers be requested to inspect any exposed temporary batters and update the above advice if considered appropriate.

Design of shoring walls should include an assessment of wall movements during all stages of the excavation, construction, anchoring etc. The wall designer should review the predicted wall movements and assess whether such movements will adversely affect any nearby adjoining structures or services.

Where retaining walls are to be constructed in front of temporary batters, care will need to be exercised in backfilling between the temporary batter slope and the new retaining wall. Uncontrolled backfilling will lead to large settlements which may adversely affect pavements, structures or landscaping areas. It is often difficult to achieve adequate compaction of backfill due to limited access and the need to use small hand compaction equipment. We therefore recommend the use of a single-sized durable gravel, such as "blue metal" gravel or crushed concrete (free of fines and with less than 10% brick), which do not require significant compactive effort. Such material should be nominally compacted using a hand operated vibrating plate (sled) compactor in 200mm thick loose layers. A non-woven geotextile filter fabric such as Bidim A34 should be placed as a separation layer between the cut batter slope and the gravel backfill to control subsoil erosion. Provided the gravel backfill is placed as recommended above, density testing of the gravel backfill would not be required. The geotextile should then be wrapped over the surface of the gravel backfill and capped with at least a 0.5m thick compacted layer of clayey engineered fill.

4.6 Footings

We consider that suitable footings to provide support to single and two storey structures on this site would include, raft slabs, shallow pad/strip footings or bored piles. The most suitable footing type for the main hospital and back of house buildings would likely comprise pad/strip footings founded on the relatively shallow bedrock.

Our preference is to uniformly support all new footings (including internal and external beams for raft slabs) on the underlying bedrock. Raft slabs can then be designed based on the expected shrink-swell movements of the soils above the rock. All footings founded on the underlying sandstone bedrock of at least very low strength may be designed for a maximum allowable bearing pressure of 1000kPa.

Where rock is deeper, shallow pad/strip footings or internal/external beams for raft slabs may be founded on the underlying silty clays of at least very stiff strength. For such founding conditions we consider that a maximum allowable bearing pressure of 150kPa would be suitable. Shallow pad/strip footings and raft slabs must be designed for the expected shrink-swell movements. We do not recommend founding building footings on a mixture of natural clays and bedrock.

Bored piles may be preferred where rock depths are greater than 1.0m. Bored piles founded on the underlying sandstone bedrock of at least very low strength may also be designed for a maximum allowable end bearing pressure of 1000kPa. We recommend that socket lengths for bored piles be kept to a minimum as the underlying bedrock can be of high and even very high strength which would require large piling rigs to penetrate such material.

Where suspended structures are proposed (such as if the structure is founded on bored piers) then it will be necessary to have void formers between the subgrade and the underside of the slab and beams to reduce the risk of uplift pressures due to swelling clays. We suggest void formers which will allow for at least 75mm of swelling movement be allowed.

Due to the site comprising moderately reactive clays, some movements of the footings and slabs should be expected with time and with changes in weather conditions. While it is not our preference for footings to be founded on different founding materials, if they are, then we strongly recommend that the structure include good articulation to allow for relative movements between portions founded on soil and portions founded on rock.

Footings should be inspected by a geotechnical engineer to confirm that a suitable bearing stratum has been achieved. All footings should be poured as soon as possible after excavation or drilling. Water should be prevented from ponding in the base of footings as this may lead to softening of the base (particularly where the founding stratum is the silty clays). Where there is a delay in pouring footings, than all loose ‘fall in’ or softened material must be removed prior to pouring.

The boreholes have indicated that the underlying bedrock can be of at least medium and often high strength. Therefore we consider it is feasible that higher bearing pressures for footings founded on the underlying

bedrock, than that recommended above, could possibly be adopted. Bearing pressures in the order of 3500kPa may be appropriate and may be beneficial for the larger main hospital building. Where higher bearing pressures are to be adopted, then additional site proving, such as by spoon testing of pad/strip footings, or by additional cored boreholes for piled footings would be required.

4.7 Pavement Design

Four day soaked CBR tests have been carried out on a variety of subgrade samples. The soaked CBR's ranged from 3% to 12%, although the clayey samples typically ranged from 3% to 8%. Therefore, based on the soaked CBR test results, we consider that proposed new pavements with a subgrade of residual silty clay or engineered fills derived from the site won residual silty clays should be designed for a soaked CBR of 3%. This also assumes that the subgrade has been prepared in accordance with the recommendations in Section 4.4 above. If granular materials or a select granular layer are used as an engineered fill to improve subgrade conditions, the pavement designs can be based on the applicable soaked CBR for the granular engineered fill and/or the effective CBR considering the thickness of the select layer. Further laboratory testing would be required to confirm the soaked CBR of any granular engineered fill material to be used as a select subgrade material. Pavement designs should be compliant with the requirements of any council conditions.

Subsoil drains are recommended around the perimeter of any pavements. Subsoil drains should comprise a 100mm diameter slotted 'agg' pipe surrounded by clean 20mm diameter blue metal aggregate, which is wrapped in a geotextile fabric. The subsoil drains should eb constructed with a trench of at least 0.3m wide and taken down to at least 0.2m below the subgrade level.

4.7.1 Concrete Pavements

Concrete pavements should be supported on an unbound granular sub-base of at least 100mm thickness, comprising good quality fine crushed rock such as DGB20 (RMS QA Specification 3051 unbound granular material) and compacted to a minimum density ratio of 100% of SMDD. Adequate moisture conditioning to within 2% of SOMC should be provided during placement. The sub-base material would provide more uniform slab support and would reduce 'pumping' of subgrade 'fines' at joints due to vehicular movements. Slab joints should be designed to resist shear forces but not bending moments by providing dowelled or keyed joints.

4.7.2 Flexible Pavements

We recommend that all base course materials comprise DGB20 (RMS QA Specification 3051). The base course material should be compacted in maximum 200mm thick loose layers using a large static smooth drum roller to at least 100% of SMDD.

We further recommend that all sub-base materials comprise DGS20 or DGS40 (RMS QA Specification 3051). The sub-base material should be compacted in maximum 200mm thick loose layers using a large static

smooth drum roller to at least 98% of SMDD. Again, adequate moisture conditioning to within 2% of SOMC should be provided during placement.

5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. As an example, special treatment of soft spots may be required as a result of their discovery during proof-rolling, etc. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

The long term successful performance of floor slabs and pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage, etc. The satisfactory control and assessment of these items may require judgment from an experienced engineer. Such judgment often cannot be made by a technician who may not have formal engineering qualifications and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

A waste classification is required for any soil and/or bedrock excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM), General Solid, Restricted Solid or Hazardous Waste. Analysis can take up to seven to ten working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) could be expected. We strongly recommend that this requirement is addressed prior to the commencement of excavation on site.

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SOIL TEST SERVICES

TABLE A
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	JK Geotechnics	**Ref No:**	30991L2
Project:	Proposed Hospital Redevelopment	**Report:**	A
Location:	Griffith Regional Health Service - Noorebar Avenue, Griffith, NSW	**Report Date:**	25/10/2019
		Page 1 of 2	

BOREHOLE NUMBER	DEPTH m	$I_{S\,(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)
201	2.62 - 2.65	0.4	8
	3.91 - 3.95	1.1	22
	4.63 - 4.67	2.2	44
	4.91 - 4.96	0.4	8
	5.39 - 5.43	4.4	88
	6.16 - 6.20	3.2	64
202	2.80 - 2.84	3.4	68
	3.00 - 3.04	0.3	6
	3.38 - 3.43	2.9	58
	3.96 - 4.00	0.4	8
	5.08 - 5.12	0.5	10
	5.79 - 5.83	0.3	6
	6.00 - 6.04	0.5	10
	6.56 - 6.60	0.5	10
203	2.80 - 2.84	3.1	62
	3.18 - 3.22	3.2	64
	3.72 - 3.76	4.5	90
	4.58 - 4.62	0.8	16
	4.86 - 4.89	5.3	106
	5.34 - 5.38	3.0	60
	5.65 - 5.68	3.0	60
	6.38 - 6.42	5.0	100
205	2.77 - 2.80	0.9	18
	3.27 - 3.32	2.1	42
	3.82 - 3.86	0.5	10

NOTES: See Page 2 of 2

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Location:	Griffith Regional Health Service - Noorebar Avenue, Griffith, NSW	**Report Date:**	25/10/2019
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BOREHOLE NUMBER	DEPTH m	$I_{S\,(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)
205	4.00 - 4.04	2.4	48
	4.54 - 4.58	0.2	4
	5.42 - 5.45	0.2	4
207	1.22 - 1.25	5.3	106
	1.96 - 1.99	4.3	86
	2.20 - 2.23	7.0	140
	2.77 - 2.80	4.6	92
	3.30 - 3.34	4.5	90
	4.25 - 4.28	4.6	92
209	1.24 - 1.29	1.1	22
	3.33 - 3.38	0.2	4
	3.92 - 3.97	0.3	6
	4.16 - 4.20	0.4	8
	4.71 - 4.76	1.0	20
	5.17 - 5.21	0.6	12
	5.78 - 5.82	2.8	56
217	2.80 - 2.84	2.1	42
	3.42 - 3.46	1.5	30
	3.96 - 4.00	1.9	38
	4.16 - 4.20	2.6	52
	4.62 - 4.65	2.8	56
	5.16 - 5.19	1.8	36

NOTES:

1. In the above table testing was completed in the Axial direction.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RMS T223.
4. For reporting purposes, the $I_{S(50)}$ has been rounded to the nearest 0.1MPa, or to one significant figure if less than 0.1MPa
5. The Estimated Unconfined Compressive Strength was calculated from the Point Load Strength Index by the following approximate relationship and rounded off to the nearest whole number : U.C.S. = 20 IS (50)

JKGeotechnics

BOREHOLE LOG

Borehole No. 201

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 136.8 m

Date: 15/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										FILL: Silty clay, low to medium plasticity, red brown, trace of fine to coarse grained sub-angular igneous gravel and root fibres.	w<PL			GRASS COVER
					N = 20 7,8,12	136	1		CL	Silty CLAY: low plasticity, red brown.	w<PL	Hd	>600 >600 >600	RESIDUAL
					N = 43 21,18,25	135	2		-	Extremely Weathered siltstone: clayey SILT, low plasticity, grey and light red brown.	XW	Hd		TOO FRIABLE FOR HP TESTING
										SILTSTONE: grey.	DW	M		MELBERGEN SANDSTONE HIGH 'TC' BIT RESISTANCE
						134 133 132 131 130	3 4 5 6			REFER TO CORED BOREHOLE LOG				

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CORED BOREHOLE LOG

Borehole No. 201

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Core Size:** NMLC **R.L. Surface:** 136.8 m

Date: 15/10/19 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** K.K.S./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 2.62m						
0% RETURN		134	3		SILTSTONE: grey, bedded sub horizontally.	SW	H - VH	0.40		(2.76m) J, 60°, P, R, Cn	Melbergen Sandstone
					NO CORE 0.34m					(3.46m) J, 65°, Un, R, Cn	
		133			SILTSTONE: grey, bedded sub horizontally.	HW	VL				
					NO CORE 0.36m						
			4		SILTSTONE: grey, with ironstone bands, bedded sub horizontally.	MW	H	1.1		(4.00m) XWS, 0°, 60 mm.t (4.13m) J, 65°, Un, R, Cn (4.26m) J, 65°, Un, R, Cn (4.34m) XWS, 0°, 120 mm.t	
					SANDSTONE: fine grained, red brown, bedded sub horizontally.	SW					
					NO CORE 0.21m						
50% RETURN		132	5		Interbedded SILTSTONE: light grey, & SANDSTONE: fine grained, light red brown.	SW	H	2.2		(4.73m) XWS, 0°, 20 mm.t (4.81m) XWS, 0°, 15 mm.t (4.86m) XWS, 0°, 20 mm.t	Melbergen Sandstone
					SANDSTONE: fine grained, red brown and light red brown, bedded sub horizontally.		H - VH	0.40 4.4 3.2	600 200 60 20	(5.18m) Be, 10°, P, R, Fe Sn (5.63m) Be, 0°, P, R, Fe Sn (5.77m) Be, 0°, P, R, Fe Sn (6.33m) Be, 0°, Un, R, Cn	
		131	6								
		130	7		END OF BOREHOLE AT 6.48 m						
		129	8								
		128									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JK Geotechnics
30991LZ BH201 START CORING AT 2.62m
3m
NO CORE: 0.34m
NO CORE: 0.36m
4m
NO CORE: 0.21m
5m
6m
EOH AT 6.48m

JKGeotechnics

BOREHOLE LOG

Borehole No. 202

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 137.1 m

Date: 15/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						137				FILL: Silty clay, low to medium plasticity, red brown, trace of fine to coarse grained sub-angular igneous gravel, and root fibres.	w<PL			GRASS COVER
					N = 21 9,11,10	136	1		CL	Silty CLAY: low plasticity, red brown.	w<PL	Hd	>600 >600 >600	RESIDUAL
					N = 31 7,12,19	135	2		-	Extremely Weathered siltstone: silty CLAY, low plasticity, grey.	XW	Hd		MELBERGEN SANDSTONE
									-	SANDSTONE: fine to medium grained, light red brown.	DW	H		VERY HIGH 'TC' BIT RESISTANCE
						134	3			REFER TO CORED BOREHOLE LOG				
						133	4							
						132	5							
						131	6							

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 202 **2 / 2**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Core Size:** NMLC **R.L. Surface:** 137.1 m

Date: 15/10/19 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** K.K.S./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
		135			START CORING AT 2.70m						
50% RETURN		134	3		SANDSTONE: fine grained, light red brown, bedded sub horizontally.	SW	H	3.4		(2.96m) Be, 0°, P, R, Cn	Melbergen Sandstone
					Interbedded SILTSTONE and SANDSTONE: grey, bedded sub horizontally.	MW	M	0.30		(3.12m) XWS, 0°, 20 mm.t (3.19m) Be, 0°, Un, R, Cn (3.25m) J, 42°, Un, R, Cn	
					SANDSTONE: fine grained, red brown, bedded sub horizontally.	SW	H	2.9		(3.46m) J, 85°, P, R, Cn (3.58m) J, 55°, St, R, Cn (3.65m) XWS, 0°, 30 mm.t (3.73m) Be, 0°, Un, R, Cn (3.77m) XWS, 0°, 10 mm.t (3.80m) XWS, 0°, 90 mm.t	
		133	4		Interbedded SILTSTONE: grey, & SANDSTONE: fine grained, orange brown and red brown.	HW	L	0.40			
					SILTSTONE: red brown and grey, bedded sub horizontally.	XW	Hd				
					Extremely Weathered siltstone: silty CLAY, low plasticity, grey.						
					NO CORE 0.44m						
0% RETURN		132	5		SILTSTONE: grey.	HW	VL - L	0.50		(4.90m) XWS, 0°, 120 mm.t (5.05m) XWS, 0°, 30 mm.t (5.17m) XWS, 0°, 10 mm.t (5.31m) XWS, 0°, 10 mm.t	Melbergen Sandstone
					Extremely Weathered siltstone: silty CLAY, low plasticity, grey and red brown.	XW	Hd				
		131	6		SANDSTONE: fine grained, red brown and grey, bedded at 0-15°.	MW	L - M	0.30		(5.78m) CS, 0°,5 mm.t (5.83m) Be, 0°, Un, R, Cn, 5 mm.t (5.87m) XWS, 0°, 15 mm.t (5.95m) J, 85°, P, R, Cn	
							M - H	0.50			
								0.50		(6.21m) Be, 0°, P, R, Fe Sn	
		130	7		END OF BOREHOLE AT 6.80 m						
		129	8								

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JK Geotechnics
30991L2 BH202 START AT 2.70m
3m
4m
NO CORE: 0.44m
5m
6m
EOH AT 6.80m

JKGeotechnics

BOREHOLE LOG

Borehole No. 203 1 / 2

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 137.6 m

Date: 15/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										FILL: Silty gravel, fine to coarse grained, grey brown, sub-angular igneous gravel.	D			GRAVEL COVER
									CL	Silty CLAY: low plasticity, red brown.	w<PL	Hd		RESIDUAL
					N = 39 10,19,20	137	1						>600 >600 >600	
									-	Extremely Weathered siltstone: silty CLAY, low plasticity, red brown and grey, with iron indurated bands.	XW	Hd		MELBERGEN SANDSTONE
						136	2			SILTSTONE: grey.	DW	M - H		HIGH 'TC' BIT RESISTSNCE
						135				REFER TO CORED BOREHOLE LOG				
						134	3							
							4							
						133	5							
						132	6							
						131								

JK 9.02.4 LIB:GLB Log JK AUGERHOLE - MASTER 30991L2 GRIFFITH.GPJ <<DrawingFile>> 14/11/2019 16:51 10.01.00.01 Datgel Lab and In Situ Tool - DGD | Lib: JK 9.02.4 2019-05-31 Prj: JK 9.01.0 2018-03-20

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 203 **2 / 2**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Core Size:** NMLC **R.L. Surface:** 137.6 m

Date: 15/10/19 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** K.K.S./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
		135			START CORING AT 2.65m						
100% RETURN		134	3		SANDSTONE: fine grained, red brown and grey, with occasional cross bedding, bedded sub horizontally.	MW	M - H	3.1, 3.2, 4.5		(2.71m) Be, 0°, P, R, SAND INFILL (3.05m) J, 30°, P, R, Cn	Melbergen Sandstone
		133	4		Interbedded SANDSTONE and SILTSTONE: silty CLAY, low plasticity, grey, with bands of slightly weathered medium strength siltstone and sandstone.	HW	M	0.80		(3.81-4.82m) FRACTURED ZONE	
		132	5		SANDSTONE: fine grained, light red brown and orange brown, bedded sub horizontally.	SW	H	5.3, 3.0, 3.0, 5.0		(5.00m) XWS, 0°, 120 mm.t (5.20m) J, 75°, Un, R, Cn (5.82m) J, 5°, P, R, Fe Sn (6.12m) J, 60°, P, R, Fe Sn (6.52m) Be, 0°, P, R, Cn	
		131	6		Extremely weathered siltstone, silty CLAY, low plasticity, red brown and grey.	XW	Hd				
		130	7		END OF BOREHOLE AT 6.70 m						
		129	8								

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JK Geotechnics
309911L2 BH203 START AT 2.65m
3m
4m
5m
6m
EOH AT 6.72m

JKGeotechnics

BOREHOLE LOG

Borehole No. 204

1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 137.9 m

Date: 16/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■									FILL: Silty gravel, fine to coarse grained, brown, sub-angular igneous gravel.	D			
	■								CL	Silty CLAY: low plasticity, red brown.	w<PL	Hd		RESIDUAL
				■	N > 16 8,8,8/ 50mm REFUSAL					as above, but orange brown and red brown.			600 580 60	
						137	1			END OF BOREHOLE AT 0.90 m				
						136	2							
						135	3							
						134	4							
						133	5							
						132	6							
						131								

JKGeotechnics

BOREHOLE LOG

Borehole No. 205

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 138.9 m

Date: 16/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■									FILL: Silty gravel, fine to coarse grained, brown, sub-angular igneous gravel.	M			GRAVEL COVER
									CL	Silty CLAY: low plasticity, red brown.	w<PL	Hd		RESIDUAL
					N = 33 12,20,13									NO SAMPLE RETURN IN SPT
				■		138	1		-	Extremely Weathered siltstone: silty CLAY, low plasticity, grey.	XW	Hd		MELBERGEN SANDSTONE
										SILTSTONE: grey.	DW	H		VERY HIGH 'TC' BIT RESISTANCE
						137	2					L - M		LOW RESISTANCE WITH HIGH TO MODERATE BANDS
														MODERATE RESISTANCE WITH LOW BANDS
										REFER TO CORED BOREHOLE LOG				
						136	3							
						135	4							
						134	5							
						133	6							
						132								

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 205 **2 / 2**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Core Size:** NMLC **R.L. Surface:** 138.9 m

Date: 16/10/19 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** K.K.S./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 2.63m						
75% RETURN		136	3		SILTSTONE: grey brown, bedded sub horizontally.	SW	M - H	0.90		(2.67m) J, 80°, P, R, Cn	Melbergen Sandstone
					as above, but light red brown.					(3.10m) J, 85°, P, R, Cn	
					SANDSTONE: fine grained, light red brown, bedded sub horizontally.			2.1			
		135	4		Interbedded SILTSTONE: grey, & SANDSTONE: fine grained, light red brown, bedded sub horizontally.	MW / SW	M / H	0.50 / 2.4		(3.56m) J, 85°, Un, R, Cn (3.63m) Be, 0°, Un, R, Cn (3.68m) J, 31°, C, R, Cn (3.73m) Be, 0°, Un, R, Cn (3.87m) XWS, 0°, 20 mm.t	
					SANDSTONE: fine grained, light red brown, bedded sub horizontally.					(4.25m) J, 85°, P, R, Cn	
		134	5		SILTSTONE: orange brown and grey, bedded at sub horizontally.	HW	M - H	0.20		(4.56m) Be, 70°, P, R, Fe Sn (4.60m) XWS, 0°, 90 mm.t (4.69m) CS, 0°, 40 mm.t (4.90m) XWS, 0°, 100 mm.t	
					NO CORE 0.27m						Melbergen Sandstone
					SILTSTONE: grey brown, bedded sub horizontally.	MW	L	0.20	60 20	(5.49m) J, 22°, Un, S, Cn (5.55m) J, 22°, Un, S, Cn	
		133	6		END OF BOREHOLE AT 5.63 m						
		132	7								
		131	8								
		130									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JK Geotechnics
309911L2 BH205 START AT 2.63m
3m
4m
5m NO CORE: 0.27m
EOH AT 5.63m

JKGeotechnics

BOREHOLE LOG

Borehole No. 206

1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 139.2 m

Date: 16/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■					139				FILL: Silty clay, medium to high plasticity, brown, trace of fine to medium grained igneous and sandstone gravel.	w<PL			GRASS COVER
				■	N=SPT 11/ 100mm REFUSAL	138	1		CL-Cl	Silty CLAY: low to medium plasticity, orange brown.	w~PL	VSt	270 250 250	RESIDUAL
						137	2			END OF BOREHOLE AT 1.50 m				
						136	3							
						135	4							
						134	5							
						133	6							

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BOREHOLE LOG

Borehole No. 207

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 140.1 m

Date: 16/10/16 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■					140				FILL: Silty gravel, fine to coarse grained, grey brown, with sub-angular igneous gravel.	D			
									CL		w~PL	Hd		RESIDUAL
									-	Silty CLAY: low plasticity, red brown.	SW	H		MELBERGEN SANDSTONE
				■						SILTSTONE: grey, with iron indurated bands.				VERY HIGH 'TC' BIT RESISTANCE WITH LOW BANDS
						139	1			REFER TO CORED BOREHOLE LOG				
						138	2							
						137	3							
						136	4							
						135	5							
						134	6							

JKGeotechnics

CORED BOREHOLE LOG

Borehole No. 207 **2 / 2**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Core Size:** NMLC **R.L. Surface:** 140.1 m

Date: 16/10/16 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** K.K.S./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
		140									
			1		START CORING AT 1.08m						
75% RETURN		139			SANDSTONE: fine grained, light red brown, bedded at 0-10°.	SW	VH	5.3		(1.32m) XWS, 0°, 50 mm.t (1.51m) Be, 0°, Un, R, Cn	Melbergen Sandstone
			2		NO CORE 0.05m SANDSTONE: fine grained, light red brown, bedded at 0-10°.	SW	VH	4.3 7.0		(1.82m) XWS, 0°, 50 mm.t	
10% RETURN		138			as above, but red brown and grey.			4.6			Melbergen Sandstone
		137	3					4.5	600 200 60 20	(3.48m) Be, 2°, P, R, Cn	
		136	4		SANDSTONE: fine to medium grained, grey, with occasional dark grey bands.			4.6		(4.16m) XWS, 0°, 20 mm.t (4.45m) Be, 0°, P, R, Cn (4.52m) J, 58°, C, R, Cn (4.61m) XWS, 0°, St	
					END OF BOREHOLE AT 4.80 m						
		135	5								
		134	6								

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JK Geotechnics
309911L2 BH207 START AT 1.08m
NO CORE: 0.15m
1m
2m
3m
4m
EOH AT 4.8m

JKGeotechnics

BOREHOLE LOG

Borehole No. 208

1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 140.5 m

Date: 16/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■								-	CONCRETE: 30mm.t	M			NO OBSERVED REINFORCEMENT
										FILL: Silty gravel, fine to coarse grained, brown, with sub-angular igneous gravel.				ROADBASE
	■								CL	Silty CLAY: low plasticity, red brown.	w<PL	Hd		RESIDUAL
				■	N > 10 9,10/ 50mm REFUSAL	140							>600 >600	
										END OF BOREHOLE AT 0.70 m			>600	REFUSAL ON SANDSTONE BEDROCK
						139	1							
						138	2							
						137	3							
						136	4							
						135	5							
						134	6							

JKGeotechnics

BOREHOLE LOG

Borehole No.
209
1 / 2

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 140.9 m

Date: 17/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						140	1		-	FILL: Clayey silt, low plasticity, red brown, trace of fine to medium grained sub-angular igneous gravel, and root fibres.	w<PL			GRASS COVER
											DW	H		MELBERGEN SANDSTONE
										SILTSTONE: grey.				HIGH 'TC' BIT RESISTSANCE
										REFER TO CORED BOREHOLE LOG				
						139	2							
						138	3							
						137	4							
						136	5							
						135	6							
						134								

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CORED BOREHOLE LOG

Borehole No. 209 **2 / 2**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Core Size:** NMLC **R.L. Surface:** 140.9 m

Date: 17/10/19 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** K.K.S./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
					START CORING AT 1.15m						
75% RETURN		139	2		SANDSTONE: fine to medium grained, red brown, bedded sub horizontally.	SW	H	1.1			Melbergen Sandstone
					NO CORE 0.49m						
					Extremely Weathered siltstone: clayey sandy SILT, low plasticity, red brown, fine grained sand.	XW	Hd				
					Extremely Weathered siltstone: clayey SILT, low plasticity, grey.						
					NO CORE 0.59m						
50% RETURN		138	3		Extremely Weathered siltstone: clayey SILT, low plasticity, grey.	XW	Hd				Melbergen Sandstone
		137	4		SILTSTONE: grey, bedded sub horizontally, with sandstone, fine grained, red brown.	MW	M	0.20 0.30 0.40	600 200 60 20	(3.28m) XWS, 0°, 50 mm.t (3.38m) XWS, 0°, 10 mm.t (3.48m) XWS, 0°, 20 mm.t (3.58m) J, 80°, P, R, Cn (3.89m) J, 6°, Un, R, Fe Sn (3.94m) XWS, 0°, 10 mm.t (4.24m) XWS, 10°, 150 mm.t	
		136	5		SANDSTONE: fine grained, red brown and grey, bedded sub horizontally.	HW SW	L H	1.0 0.60	600 200 60 20	(4.53m) Be, 0°, Un, R, Cn (4.72m) Be, 0°, Un, R, Cn (4.86m) XWS, 0°, 5 mm.t (4.87m) XWS, 0°, 20 mm.t (4.95m) XWS, 0°, 50 mm.t	
		135	6					2.8		(5.74m) XWS, 0°, 15 mm.t (5.79m) Be, 0°, Un, R, Fe Sn	
					END OF BOREHOLE AT 6.09 m						
		134	7								
		133									

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JK Geotechnics
30991L2 BH209 START AT 1.15m
1m
NO CORE 0.49m
2m
NO CORE 0.59m
3m
4m
5m
6m
END OF BH209 AT 6.09m

JKGeotechnics

BOREHOLE LOG

Borehole No. 210
1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 141.2 m

Date: 17/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION						141			ML	Clayey SILT: low plasticity, red brown, trace of root fibres.	M			GRASS COVER EROSIONAL
									-	as above, but without root fibres.	DW	H		MELBERGEN SANDSTONE
										SILTSTONE: grey.				HIGH 'TC' BIT RESISTANCE
										END OF BOREHOLE AT 0.60 m				
						140	1							
						139	2							
						138	3							
						137	4							
						136	5							
						135	6							

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BOREHOLE LOG

Borehole No. 211
1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 141.3 m

Date: 17/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■					141			ML	Clayey SILT: low plasticity, red brown, trace of root fibres.	w<PL	Hd		GRASS COVER
	■									as above, but without root fibres.				EROSIONAL
				■	N = 21 11,13,8					Clayey SILT: low plasticity, red brown, with iron indurated bands.				
						140	1			END OF BOREHOLE AT 0.95 m				
						139	2							
						138	3							
						137	4							
						136	5							
						135	6							

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BOREHOLE LOG

Borehole No. 212

1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 141.0 m

Date: 17/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■									FILL: Silty clay, low plasticity, red brown, trace of fine to medium grained sub-angular igneous gravel, and root fibres.	w<PL			GRASS COVER
									ML		w<PL	Hd		EROSIONAL
				■	N = 23 6,10,13					Clayey SILT: low plasticity, red brown.				
						140	1			END OF BOREHOLE AT 0.95 m				
						139	2							
						138	3							
						137	4							
						136	5							
						135	6							

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BOREHOLE LOG

Borehole No. 213

1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 140.8 m

Date: 17/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■									FILL: Silty gravel, fine to coarse grained, grey brown, with sub-angular igneous gravel.	M			
									ML		w<PL	(VSt)		EROSIONAL
				■	N > 14 3,6,8/ 50mm REFUSAL					Clayey SILT: low plasticity, red brown.				TOO FRIABLE FOR HP TESTING
						140			-	Extremely Weathered siltstone: silty CLAY, low plasticity, grey.	XW	Hd		MELBERGEN SANDSTONE
							1			END OF BOREHOLE AT 0.85 m				
						139	2							
						138	3							
						137	4							
						136	5							
						135	6							
						134								

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BOREHOLE LOG

Borehole No. 214

1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 140.4 m

Date: 16/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■									FILL: Silty gravel, fine to coarse grained, grey brown, with sub-angular igneous gravel.	M			
	■					140			ML	Clayey SILT: low plasticity, red brown.	w<PL	Hd		EROSIONAL
				■	N = 23 11,11,12									
							1			END OF BOREHOLE AT 0.95 m				
						139								
							2							
						138								
							3							
						137								
							4							
						136								
							5							
						135								
							6							
						134								

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BOREHOLE LOG

Borehole No. 215

1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 139.2 m

Date: 16/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■					139				FILL: Silty clay, medium plasticity, brown, trace of fine to medium grained igneous gravel and root fibres.	w<PL			GRASS COVER 0-0.5m HAND AUGER DOWN TO SERVICES
				■					CL	Silty CLAY: low plasticity, red brown.				RESIDUAL
									-	SILTSTONE: grey. END OF BOREHOLE AT 0.70 m	DW	M		MELBERGEN SANDSTONE MODERATE 'TC' BIT RESISTANCE
						138	1							
						137	2							
						136	3							
						135	4							
						134	5							
						133	6							

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BOREHOLE LOG

Borehole No. 216

1 / 1

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 139 m

Date: 17/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■									FILL: Silty clay, low to medium plasticity, red brown, trace of fine to medium grained sub-angular igneous gravel.	w<PL			
	■				N = 15 5,8,7				ML	Clayey SILT: low plasticity, red brown.	w<PL	Hd		EROSIONAL
				■		138	1			END OF BOREHOLE AT 0.95 m				
						137	2							
						136	3							
						135	4							
						134	5							
						133	6							

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BOREHOLE LOG

Borehole No. 217

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Method:** SPIRAL AUGER **R.L. Surface:** 140.3 m

Date: 17/10/19 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** K.K.S./A.B.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■					140				FILL: Silty clay, fine to medium plasticity, red brown, fine to medium grained sub-angular igneous gravel, and root fibres.	w<PL			GRASS COVER
	■								CL	Silty CLAY: low plasticity, red brown.	w<PL	F		RESIDUAL TOO FRIABLE FOR HP TESTING
				■	N = 3 1,1,2		1							
						139			-	SANDSTONE: light red brown.	DW	H		MELBERGEN SANDSTONE HIGH 'TC' BIT RESISTANCE
				■		138	2					L - M		MODERATE RESISTANCE WITH VERY LOW BANDS
										REFER TO CORED BOREHOLE LOG				
						137	3							
						136	4							
						135	5							
						134	6							

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CORED BOREHOLE LOG

Borehole No. 217 **2 / 2**

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL REDEVELOPMENT

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L2 **Core Size:** NMLC **R.L. Surface:** 140.3 m

Date: 17/10/19 **Inclination:** VERTICAL **Datum:** AHD

Plant Type: JK308 **Bearing:** N/A **Logged/Checked By:** K.K.S./A.B.

Water Loss\Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS SPACING (mm)	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
		138			START CORING AT 2.70m						
75% RETURN ON COMPLETION OF CORING		137	3		SANDSTONE: fine grained, light red brown, bedded sub horizontally.	MW	H	2.1, 1.5		(3.21m) J, 85°, Un, R, Cn (3.30m) XWS, 0°, 70 mm.t	Melbergen Sandstone
		136	4		as above, but with siltstone laminae.	SW	H - VH	1.9, 2.6, 2.8, 1.8		(3.48m) J, 8°, Un, R, Cn (3.75m) J, 80°, Un, R, Cn (4.82m) J, 75 - 85°, Un, R, Cn	
		135	5		END OF BOREHOLE AT 5.33 m						
		134	6								
		133	7								
		132	8								

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JK Geotechnics
30991L2 BH217 START CORING AT 2.70m
3m
4m
5m
EOH AT 5.33m

0 25 50 75 100 125

SCALE 1:2500 @A4 m

This plan should be read in conjunction with the JK Geotechnics report.

Title: **SITE LOCATION PLAN**

Location: GRIFFITH REGIONAL HEALTH SERVICE,NOOREBAR AVE GRIFFITH, NSW

Report No: 30991L2

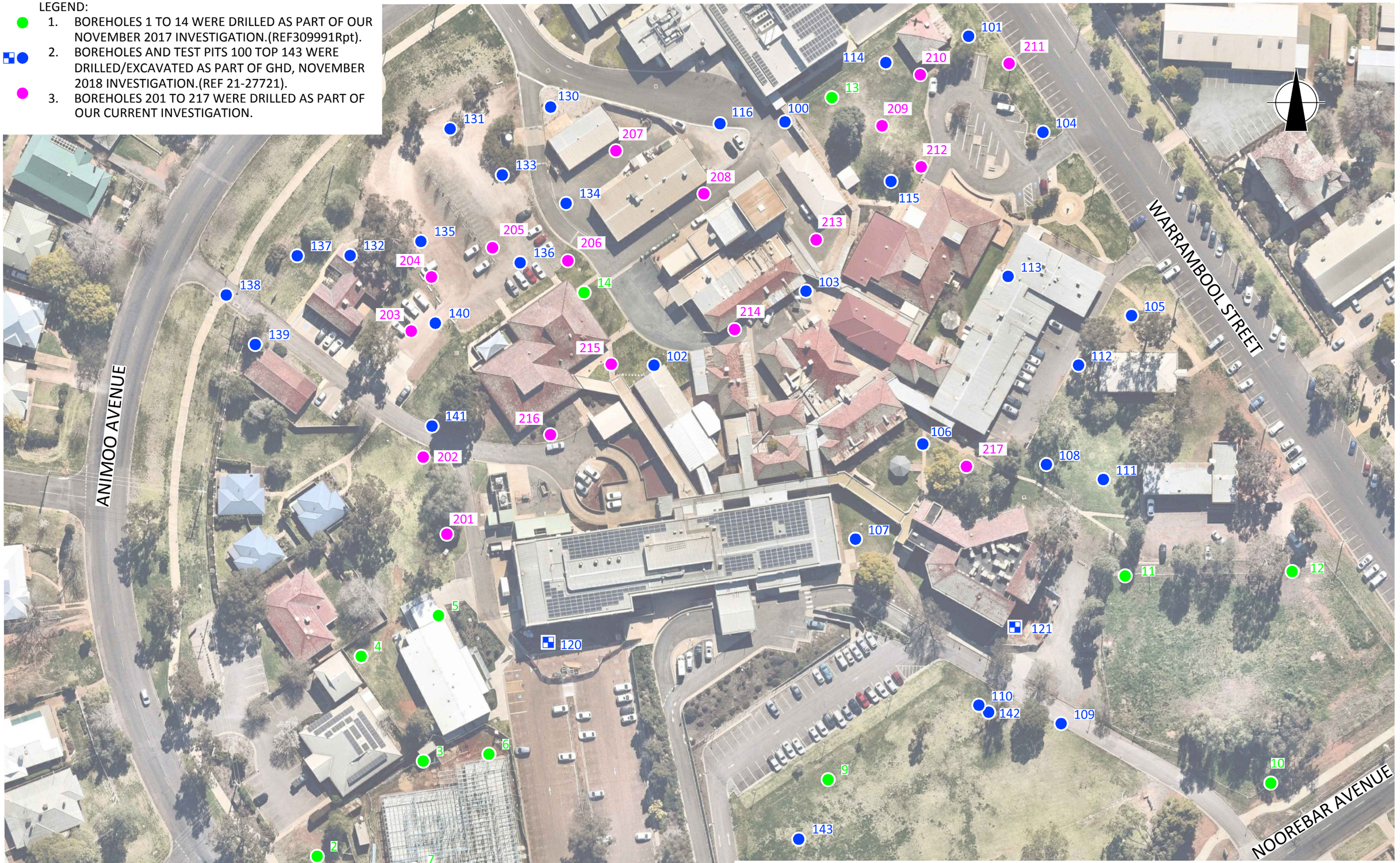
Figure: 1

JKGeotechnics

PLOT DATE: 14/11/2019 2:58:26 PM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\30000'S\30991L GRIFFITH\CAD\CAD30991L2\30991L2.DWG

LEGEND:

1. BOREHOLES 1 TO 14 WERE DRILLED AS PART OF OUR NOVEMBER 2017 INVESTIGATION.(REF309991Rpt).
2. BOREHOLES AND TEST PITS 100 TOP 143 WERE DRILLED/EXCAVATED AS PART OF GHD, NOVEMBER 2018 INVESTIGATION.(REF 21-27721).
3. BOREHOLES 201 TO 217 WERE DRILLED AS PART OF OUR CURRENT INVESTIGATION.



0 10 20 30 40 50

SCALE 1:1000 @A3 m

This plan should be read in conjunction with the JK Geotechnics report.

Title: **BOREHOLE LOCATION PLAN**

Location: GRIFFITH REGIONAL HEALTH SERVICE,NOOREBAR AVE GRIFFITH, NSW

Report No: 30991L2

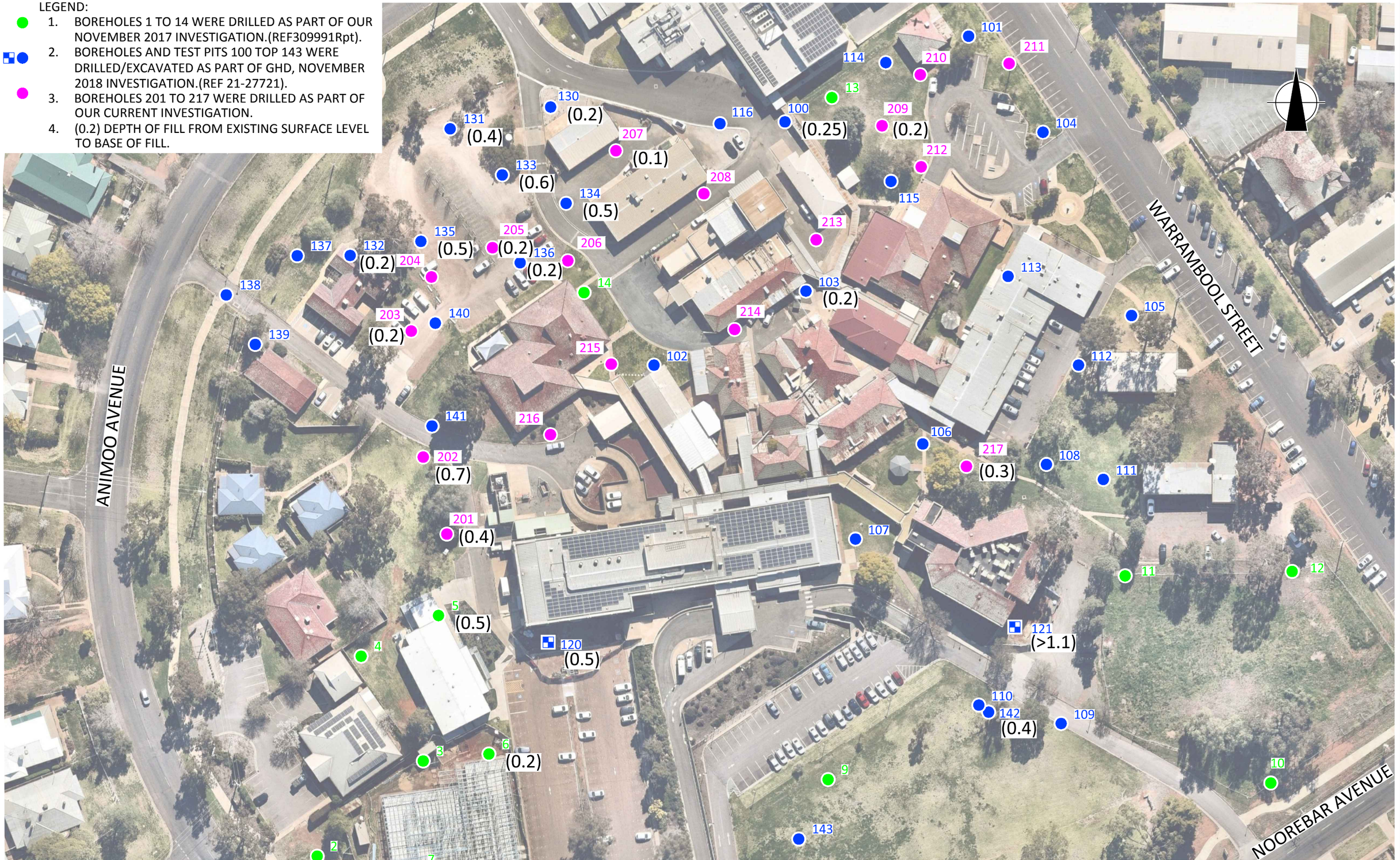
Figure: 2

JKGeotechnics

PLOT DATE: 14/11/2019 2:56:43 PM DWG FILE: S:\G GEOTECHNICAL\GF GEOTECHNICAL JOBS\30000'S\30991L GRIFFITH\CAD\CAD30991L2\30991L2.DWG

LEGEND:

1. BOREHOLES 1 TO 14 WERE DRILLED AS PART OF OUR NOVEMBER 2017 INVESTIGATION.(REF309991Rpt).
2. BOREHOLES AND TEST PITS 100 TOP 143 WERE DRILLED/EXCAVATED AS PART OF GHD, NOVEMBER 2018 INVESTIGATION.(REF 21-27721).
3. BOREHOLES 201 TO 217 WERE DRILLED AS PART OF OUR CURRENT INVESTIGATION.
4. (0.2) DEPTH OF FILL FROM EXISTING SURFACE LEVEL TO BASE OF FILL.



0 10 20 30 40 50

SCALE 1:1000 @A3 m

This plan should be read in conjunction with the JK Geotechnics report.

Title: **DEPTH OF FILL (m) PLAN**

Location: GRIFFITH REGIONAL HEALTH SERVICE,NOOREBAR AVE GRIFFITH, NSW

Report No: 30991L2

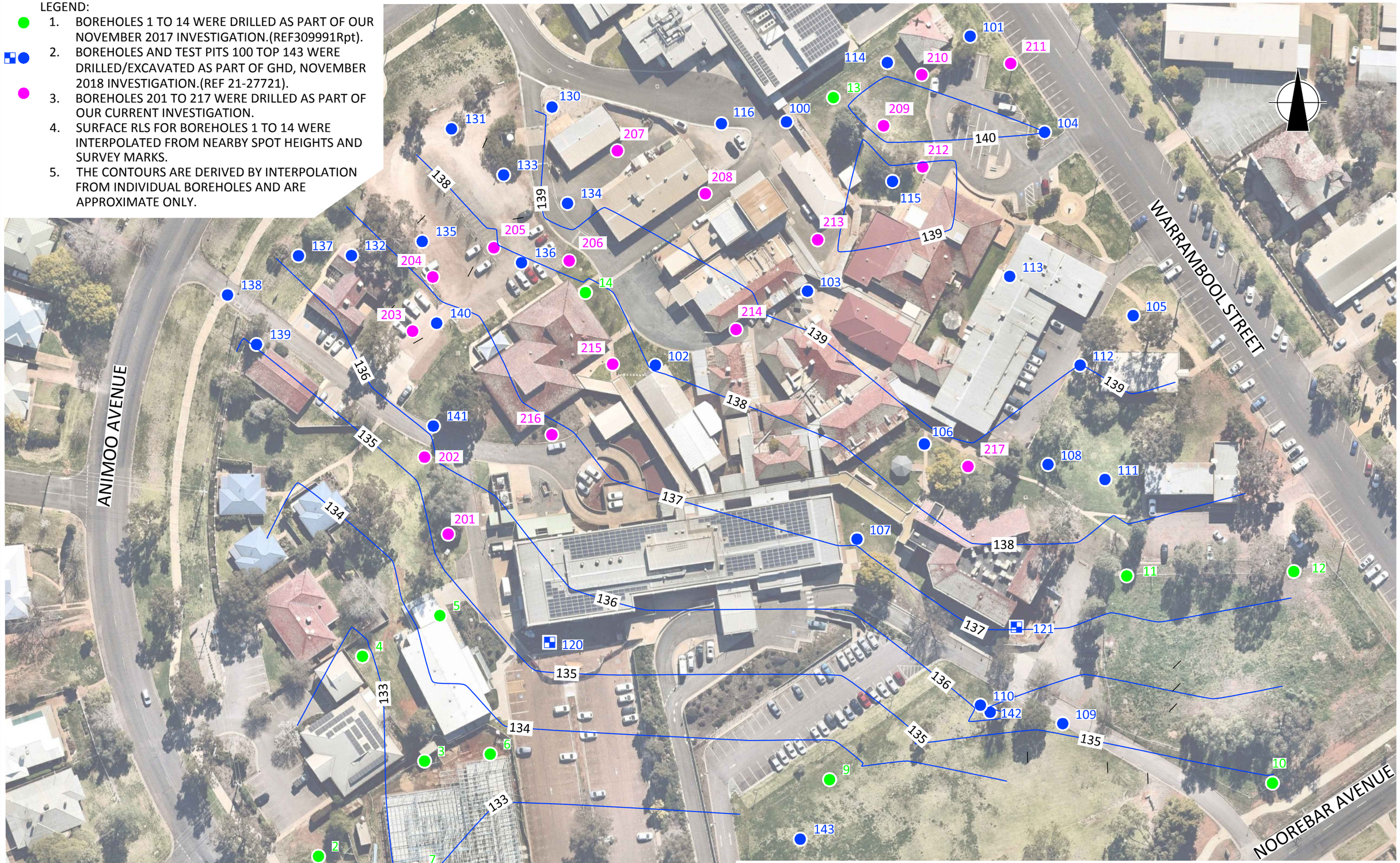
Figure: 3

JKGeotechnics

PLOT DATE: 14/11/2019 2:56:58 PM DWG FILE: S:\G GEOTECHNICAL\GF GEOTECHNICAL JOBS\30000's\30991L GRIFFITH\CAD\CAD\30991L3099112.DWG

LEGEND:

1. BOREHOLES 1 TO 14 WERE DRILLED AS PART OF OUR NOVEMBER 2017 INVESTIGATION.(REF309991Rpt).
2. BOREHOLES AND TEST PITS 100 TOP 143 WERE DRILLED/EXCAVATED AS PART OF GHD, NOVEMBER 2018 INVESTIGATION.(REF 21-27721).
3. BOREHOLES 201 TO 217 WERE DRILLED AS PART OF OUR CURRENT INVESTIGATION.
4. SURFACE RLS FOR BOREHOLES 1 TO 14 WERE INTERPOLATED FROM NEARBY SPOT HEIGHTS AND SURVEY MARKS.
5. THE CONTOURS ARE DERIVED BY INTERPOLATION FROM INDIVIDUAL BOREHOLES AND ARE APPROXIMATE ONLY.



0 10 20 30 40 50
SCALE 1:1000 @A3 m

This plan should be read in conjunction with the JK Geotechnics report.

Title: **TOP OF BEDROCK RL (m AHD)**

Location: GRIFFITH REGIONAL HEALTH SERVICE,NOOREBAR AVE GRIFFITH, NSW

Report No: 30991L2

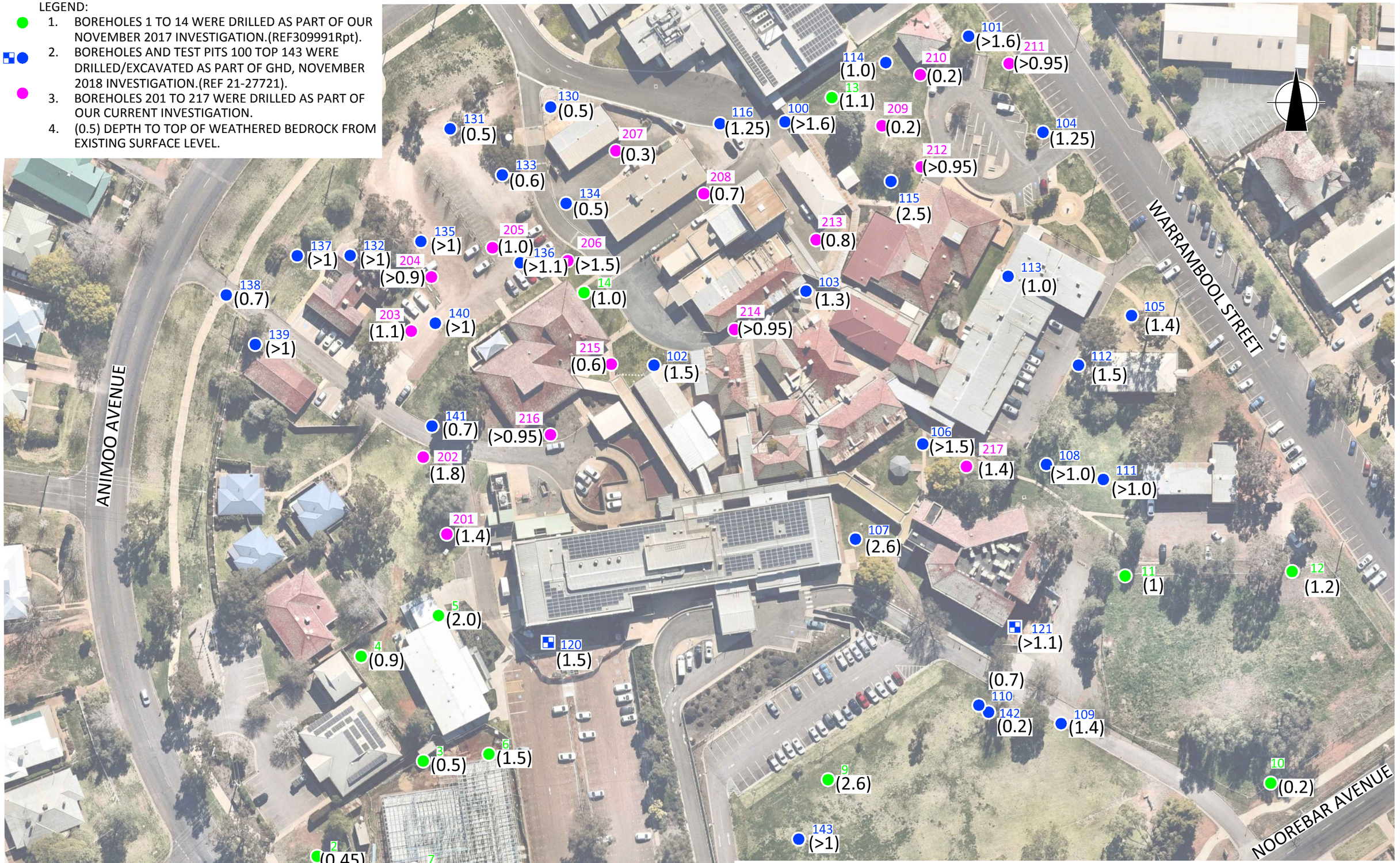
Figure: 4

JKGeotechnics

PLOT DATE: 14/11/2019 3:32:11 PM DWG FILE: S:\G GEOTECHNICAL\GF GEOTECHNICAL JOBS\30000'S\30991L GRIFFITH\CAD\CAD30991L2\30991L2.DWG

LEGEND:

1. BOREHOLES 1 TO 14 WERE DRILLED AS PART OF OUR NOVEMBER 2017 INVESTIGATION.(REF309991Rpt).
2. BOREHOLES AND TEST PITS 100 TOP 143 WERE DRILLED/EXCAVATED AS PART OF GHD, NOVEMBER 2018 INVESTIGATION.(REF 21-27721).
3. BOREHOLES 201 TO 217 WERE DRILLED AS PART OF OUR CURRENT INVESTIGATION.
4. (0.5) DEPTH TO TOP OF WEATHERED BEDROCK FROM EXISTING SURFACE LEVEL.



0 10 20 30 40 50
SCALE 1:1000 @A3 m

This plan should be read in conjunction with the JK Geotechnics report.

Title: **DEPTH TO ROCK (m)**

Location: GRIFFITH REGIONAL HEALTH SERVICE,NOOREBAR AVE GRIFFITH, NSW

Report No: 30991L2

Figure: 5

JKGeotechnics

PLOT DATE: 14/11/2019 2:57:28 PM DWG FILE: S:\G GEOTECHNICAL\GF GEOTECHNICAL JOBS\30000'S\30991L GRIFFITH\CAD\CAD30991L\30991L2.DWG

VIBRATION EMISSION DESIGN GOALS

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 1 below.

It should be noted that peak vibration velocities higher than the minimum figures in Table 1 for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual condition of the structure.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table 1: DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity in mm/s			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (eg. buildings that are under a preservation order).	3	3 to 8	8 to 10	8

Note: For frequencies above 100Hz, the higher values in the 50Hz to 100Hz column should be used.

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) is referred to as 'laminite'.

SAMPLING

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shrink-swell behaviour, strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm 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 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

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

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing (CPT) and Interpretation: The cone penetrometer is sometimes referred to as a Dutch Cone. The test is described in Australian Standard 1289.6.5.1–1999 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Static Cone Penetration Resistance of a Soil – Field Test using a Mechanical and Electrical Cone or Friction-Cone Penetrometer'*.

In the tests, a 35mm or 44mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm or 165mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck. The CPT does not provide soil sample recovery.

As penetration occurs (at a rate of approximately 20mm per second), the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa. There are two scales presented for the cone resistance. The lower scale has a range of 0 to 5MPa and the main scale has a range of 0 to 50MPa. For cone resistance values less than 5MPa, the plot will appear on both scales.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between CPT and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of CPT values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

There are limitations when using the CPT in that it may not penetrate obstructions within any fill, thick layers of hard clay and very dense sand, gravel and weathered bedrock. Normally a 'dummy' cone is pushed through fill to protect the equipment. No information is recorded by the 'dummy' probe.

Flat Dilatometer Test: The flat dilatometer (DMT), also known as the Marchetti Dilometer comprises a stainless steel blade having a flat, circular steel membrane mounted flush on one side.

The blade is connected to a control unit at ground surface by a pneumatic-electrical tube running through the insertion rods. A gas tank, connected to the control unit by a pneumatic cable, supplies the gas pressure required to expand the membrane. The control unit is equipped with a pressure regulator, pressure gauges, an audio-visual signal and vent valves.

The blade is advanced into the ground using our CPT rig or one of our drilling rigs, and can be driven into the ground using an SPT hammer. As soon as the blade is in place, the membrane is inflated, and the pressure required to lift the membrane (approximately 0.1mm) is recorded. The pressure then required to lift the centre of the membrane by an additional 1mm is recorded. The membrane is then deflated before pushing to the next depth increment, usually 200mm down. The pressure readings are corrected for membrane stiffness.

The DMT is used to measure material index (I_D), horizontal stress index (K_D), and dilatometer modulus (E_D). Using established correlations, the DMT results can also be used to assess the 'at rest' earth pressure coefficient (K_o), over-consolidation ratio (OCR), undrained shear strength (C_u), friction angle (ϕ), coefficient of consolidation (C_h), coefficient of permeability (K_h), unit weight (γ), and vertical drained constrained modulus (M).

The seismic dilatometer (SDMT) is the combination of the DMT with an add-on seismic module for the measurement of shear wave velocity (V_s). Using established correlations, the SDMT results can also be used to assess the small strain modulus (G_o).

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod with a 20mm diameter cone end with a 9kg hammer dropping 510mm. The test is described in Australian Standard 1289.6.3.2–1997 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – 9kg Dynamic Cone Penetrometer Test'*.

The results are used to assess the relative compaction of fill, the relative density of granular soils, and the strength of cohesive soils. Using established correlations, the DCP test results can also be used to assess California Bearing Ratio (CBR).

Refusal of the DCP can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Vane Shear Test: The vane shear test is used to measure the undrained shear strength (C_u) of typically very soft to firm fine grained cohesive soils. The vane shear is normally performed in the bottom of a borehole, but can be completed from surface level, the bottom and sides of test pits, and on recovered undisturbed tube samples (when using a hand vane).

The vane comprises four rectangular blades arranged in the form of a cross on the end of a thin rod, which is coupled to the bottom of a drill rod string when used in a borehole. The size of the vane is dependent on the strength of the fine grained cohesive soils; that is, larger vanes are normally used for very low strength soils. For borehole testing, the size of the vane can be limited by the size of the casing that is used.

For testing inside a borehole, a device is used at the top of the casing, which suspends the vane and rods so that they do not sink under self-weight into the 'soft' soils beyond the depth at which the test is to be carried out. A calibrated torque head is used to rotate the rods and vane and to measure the resistance of the vane to rotation.

With the vane in position, torque is applied to cause rotation of the vane at a constant rate. A rate of 6° per minute is the common rotation rate. Rotation is continued until the soil is sheared and the maximum torque has been recorded. This value is then used to calculate the undrained shear strength. The vane is then rotated rapidly a number of times and the operation repeated until a constant torque reading is obtained. This torque value is used to calculate the remoulded shear strength. Where appropriate, friction on the vane rods is measured and taken into account in the shear strength calculation.

LOGS

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

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it 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 and may not be the same at the time of construction.
- 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 be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to 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 perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soils for Engineering Purposes'* or appropriate NSW Government Roads & Maritime Services (RMS) test methods. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.
- Details of the development that the Company could not reasonably be expected to anticipate.

If these occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

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, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Where information obtained from this investigation 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. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. Licence to use the documents may be revoked without notice if the Client is in breach of any obligation to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/constraints are quite complex, it is prudent to have a joint design review which involves an experienced geotechnical engineer/engineering geologist.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types and appropriate footing or pile founding depths, or

iii) full time engineering presence on site.

SYMBOL LEGENDS

SOIL


FILL


TOPSOIL


CLAY (CL, CI, CH)


SILT (ML, MH)


SAND (SP, SW)


GRAVEL (GP, GW)


SANDY CLAY (CL, CI, CH)


SILTY CLAY (CL, CI, CH)


CLAYEY SAND (SC)


SILTY SAND (SM)


GRAVELLY CLAY (CL, CI, CH)


CLAYEY GRAVEL (GC)


SANDY SILT (ML, MH)


PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK


CONGLOMERATE


SANDSTONE


SHALE/MUDSTONE


SILTSTONE


CLAYSTONE


COAL


LAMINITE


LIMESTONE


PHYLLITE, SCHIST


TUFF


GRANITE, GABBRO


DOLERITE, DIORITE


BASALT, ANDESITE


QUARTZITE

OTHER MATERIALS


BRICKS OR PAVERS


CONCRETE


ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
Fine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\, D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

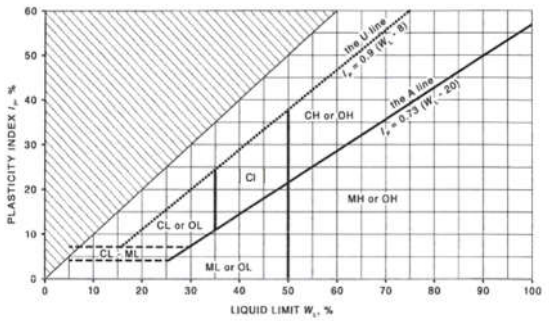
1 For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.

2 Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.

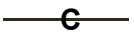
3 Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.

4 The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record		Standing water level. Time delay following completion of drilling/excavation may be shown.
		Extent of borehole/test pit collapse shortly after drilling/excavation.
		Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES	Sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos analysis.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of undrained shear strength.
	PID = 100	Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL	Moisture content estimated to be greater than plastic limit.
	$w \approx$ PL	Moisture content estimated to be approximately equal to plastic limit.
	w < PL	Moisture content estimated to be less than plastic limit.
	$w \approx$ LL	Moisture content estimated to be near liquid limit.
	w > LL	Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D	DRY – runs freely through fingers.
	M	MOIST – does not run freely but no free water visible on soil surface.
	W	WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – unconfined compressive strength ≤ 25kPa.
	S	SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa.
	F	FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa.
	St	STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa.
	VSt	VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa.
	Hd	HARD – unconfined compressive strength > 400kPa.
	Fr	FRIABLE – strength not attainable, soil crumbles.
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	VERY LOOSE – ≤ 15 – 0 – 4
	L	LOOSE – > 15 and ≤ 35 – 4 – 10
	MD	MEDIUM DENSE – > 35 and ≤ 65 – 10 – 30
	D	DENSE – > 65 and ≤ 85 – 30 – 50
	VD	VERY DENSE – > 85 – > 50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other assessment.
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.

Log Column	Symbol	Definition
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as: RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock. EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock. ALLUVIAL – soil deposited by creeks and rivers. ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents. MARINE – soil deposited in a marine environment. AEOLIAN – soil carried and deposited by wind. COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits. LITTORAL – beach deposited soil.

Classification of Material Weathering

Term		Abbreviation		Definition
Residual Soil		RS		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered (Note 1)	HW	DW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered		MW		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh		FR		Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Abbreviations Used in Defect Description

Cored Borehole Log Column		Symbol Abbreviation	Description
Point Load Strength Index		• 0.6	Axial point load strength index test result (MPa)
		x 0.6	Diametral point load strength index test result (MPa)
Defect Details	– Type	Be	Parting – bedding or cleavage
		CS	Clay seam
		Cr	Crushed/sheared seam or zone
		J	Joint
		Jh	Healed joint
		Ji	Incipient joint
		XWS	Extremely weathered seam
	– Orientation	Degrees	Defect orientation is measured relative to normal to the core axis (ie. relative to the horizontal for a vertical borehole)
	– Shape	P	Planar
		C	Curved
		Un	Undulating
		St	Stepped
		Ir	Irregular
	– Roughness	Vr	Very rough
		R	Rough
		S	Smooth
		Po	Polished
		Sl	Slickensided
	– Infill Material	Ca	Calcite
		Cb	Carbonaceous
		Clay	Clay
		Fe	Iron
		Qz	Quartz
		Py	Pyrite
	– Coatings	Cn	Clean
		Sn	Stained – no visible coating, surface is discoloured
		Vn	Veneer – visible, too thin to measure, may be patchy
		Ct	Coating ≤ 1mm thick
		Filled	Coating > 1mm thick
	– Thickness	mm.t	Defect thickness measured in millimetres

APPENDIX A

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, BC 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

TABLE A
MOISTURE CONTENT, ATTERBERG LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client: JK Geotechnics
Project: Proposed Hospital Upgrade
Location: Griffith Regional Health Service, Noorebar Avenue, Griffith, NSW

Ref No: 30991L
Report: A
Report Date: 23/11/2017
Page 1 of 1

AS 1289	TEST METHOD	2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER	DEPTH m	MOISTURE CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTICITY INDEX %	LINEAR SHRINKAGE %
1	0.40-0.50	1.0				
2	1.60-1.80	22.5				
3	1.30-1.50	7.3				
4	0.00-0.40	16.1	49	20	29	14.0
5	2.00-2.20	3.4				
6	1.50-1.80	3.8				
7	0.00-0.40	4.1	22	14	8	4.0
7	0.60-0.69	4.6				
8	1.70-2.00	0.3				
9	0.50-0.95	19.4	30	15	15	7.0
9	2.60-3.00	3.3				
11	1.00-1.20	1.1				
12	0.50-0.95	11.8	35	18	17	8.0
14	1.50-1.63	17.7				

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 10/11/2017

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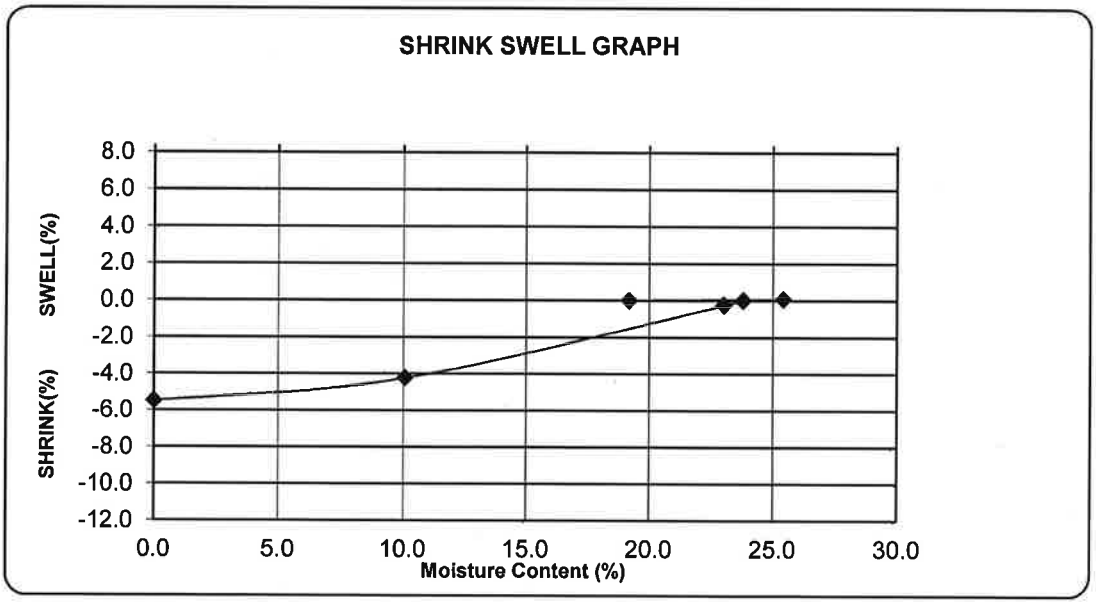
SOIL TEST SERVICES

ABN 43 002 145 173

TABLE B
SHRINK - SWELL TEST REPORT
TEST METHOD: AS1289 7.1.1

Client:	JK Geotechnics	**STS Job No:**	30991L
Project:	Proposed Hospital Upgrade	**Report:**	B
Location:	Griffith Regional Health Service, Noorebar Avenue, Griffith, NSW	**Report Date:**	23/11/2017
		Page	1 of 2

BOREHOLE NO: 4		DEPTH: 0.00-0.40 m	
MOISTURE CONTENT (SWELL)		ESTIMATED UNCONFINED COMPRESSIVE STRENGTH	
BEFORE TEST	AFTER TEST	BEFORE TEST	AFTER TEST
19.2%	25.4%	320, 260 kPa	240, 250 kPa
LOAD	SETTLEMENT UNDER LOAD BEFORE SATURATION	SWELL ON SATURATION	SHRINKAGE
25	0.0%	0.1%	5.5%



SHRINK SWELL INDEX
3.07 %/pF

Notes:

- Suction Value used in calculation = 1.8pF
- Volume Change Coefficient (α) was assumed = 2
- Inert Inclusions by volume = 5-10%
- Shrinkage Cracking = Moderate
- Soil Crumbling = none
- Date of receipt of sample: 10/11/2017

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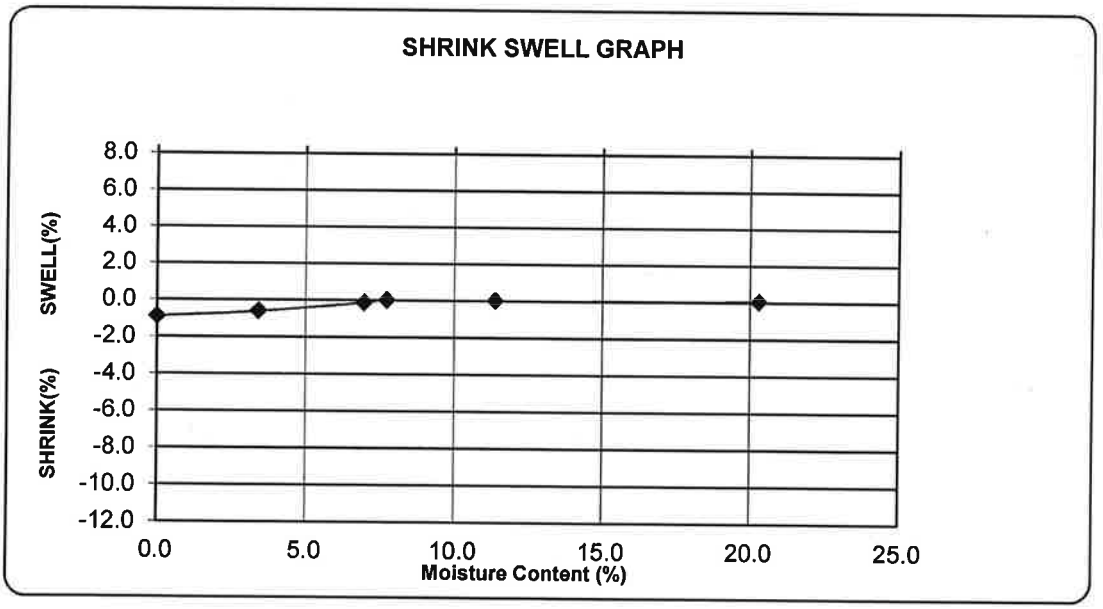
SOIL TEST SERVICES

ABN 43 002 145 173

TABLE B
SHRINK - SWELL TEST REPORT
TEST METHOD: AS1289 7.1.1

Client:	JK Geotechnics	**STS Job No:**	30991L
Project:	Proposed Hospital Upgrade	**Report:**	B
Location:	Griffith Regional Health Service, Noorebar Avenue, Griffith, NSW	**Report Date:**	23/11/2017
		Page	2 of 2

BOREHOLE NO: 7		DEPTH: 0.00-0.40 m	
MOISTURE CONTENT (SWELL)		ESTIMATED UNCONFINED COMPRESSIVE STRENGTH	
BEFORE TEST	AFTER TEST	BEFORE TEST	AFTER TEST
11.4%	20.3%	250-300 kPa	100-150 kPa
LOAD	SETTLEMENT UNDER LOAD BEFORE SATURATION	SWELL ON SATURATION	SHRINKAGE
25	0.0%	0.0%	0.9%



SHRINK SWELL INDEX
0.51 %/pF

Notes:
- Suction Value used in calculation = 1.8pF
- Volume Change Coefficient (α) was assumed = 2
- Inert Inclusions by volume = 20-25%
- Shrinkage Cracking = Moderate
- Soil Crumbling = none
- Date of receipt of sample: 10/11/2017

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SOIL TEST SERVICES
ABN 43 002 145 173

TABLE C
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	JK Geotechnics	**Ref No:**	30991L
Project:	Proposed Hospital Upgrade	**Report:**	C
Location:	Griffith Regional Health Service, Noorebar Avenue, Griffith, NSW	**Report Date:**	13/11/2017
		Page 1 of 1	

BOREHOLE NUMBER	DEPTH m	$I_{S\,(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)
5	2.89-2.92	1.8	36
	3.15-3.19	3.0	60
	3.70-3.74	3.0	60
	4.08-4.15	2.8	56
	4.58-4.61	3.7	74
7	0.93-0.96	>5.5	>110
	1.24-1.29	0.1	2
	1.68-1.72	0.7	14
	2.25-2.28	4.7	94
	2.63-2.67	4.2	84
12	2.16-2.20	3.0	60
	2.71-2.75	3.6	72
	3.17-3.21	2.8	56
	3.53-3.57	3.0	60
13	2.16-2.21	1.1	22
	2.56-2.59	0.7	14
	3.27-3.31	1.1	22
	3.73-3.77	1.2	24
	4.16-4.20	1.5	30
	4.52-4.55	3.6	72

NOTES:

1. In the above table testing was completed in the Axial direction.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RMS T223.
4. For reporting purposes, the $I_{S(50)}$ has been rounded to the nearest 0.1MPa, or to one significant figure if less than 0.1MPa
5. The Estimated Unconfined Compressive Strength was calculated from the point load Strength Index by the following approximate relationship and rounded off to the nearest whole number :
   U.C.S. = 20 $I_{S\,(50)}$

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CERTIFICATE OF ANALYSIS 179650

Client Details

Client	JK Geotechnics
Attention	Arthur Billingham, L Speechley
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**30991L, Griffith**
Number of Samples	6 Soil
Date samples received	10/11/2017
Date completed instructions received	10/11/2017

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	17/11/2017
Date of Issue	16/11/2017

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

David Springer, General Manager

Misc Inorg - Soil						
Our Reference		179650-1	179650-2	179650-3	179650-4	179650-5
Your Reference	UNITS	2	3	5	9	11
Depth		0.3-0.45	0-0.45	1.5-1.93	1.5-1.95	0.5-0.95
Date Sampled		07/11/2017	07/11/2017	07/11/2017	07/11/2017	07/11/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	14/11/2017	14/11/2017	14/11/2017	14/11/2017	14/11/2017
Date analysed	-	14/11/2017	14/11/2017	14/11/2017	14/11/2017	14/11/2017
pH 1:5 soil:water	pH Units	7.1	6.8	8.5	9.4	6.8
Chloride, Cl 1:5 soil:water	mg/kg	<10	21	20	<10	10
Sulphate, SO4 1:5 soil:water	mg/kg	<10	<10	40	20	<10
Resistivity in soil*	ohm m	550	120	69	82	360

Misc Inorg - Soil		
Our Reference		179650-6
Your Reference	UNITS	13
Depth		0.5-0.95
Date Sampled		08/11/2017
Type of sample		Soil
Date prepared	-	14/11/2017
Date analysed	-	14/11/2017
pH 1:5 soil:water	pH Units	8.5
Chloride, Cl 1:5 soil:water	mg/kg	<10
Sulphate, SO4 1:5 soil:water	mg/kg	<10
Resistivity in soil*	ohm m	69

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 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
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	179650-2
Date prepared	-			14/11/2017	1	14/11/2017	14/11/2017		14/11/2017	14/11/2017
Date analysed	-			14/11/2017	1	14/11/2017	14/11/2017		14/11/2017	14/11/2017
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	7.1	7.0	1	101	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	<10	0	86	109
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	<10	<10	0	99	119
Resistivity in soil*	ohm m	1	Inorg-002	<1	1	550	520	6	[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.

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 1
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 6/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■							CH	TOPSOIL: Silty clay, medium plasticity, brown.	MC~PL			GRASS COVER
									SILTY CLAY: high plasticity, red brown.	MC~PL			
				■				-	SANDSTONE: fine grained, light red brown.	SW	H		
									END OF BOREHOLE AT 0.50 m				'TC' BIT REFUSAL
						1							
						2							
						3							
						4							
						5							
						6							

JK_LIB_CURRENT - V8.00.GLB Log J & K AUGERHOLE - MASTER 30991L GRIFFITH.GPJ <<DrawingFile>> 05/12/2017 16:52 Produced by gINT Professional. Developed by Datgel

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 2
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED HOSPITAL UPGRADE
Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 7/11/17 **Datum:**
Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■			■	N = 14 3,3,11				TOPSOIL: Silty clay, low plasticity.	MC<PL			GRASS COVER
								-	SANDSTONE: fine grained, light red brown and red brown.	DW	VL		VERY LOW 'TC' BIT RESISTANCE WITH SOME HIGH STRENGTH BANDS
						1					H		HIGH RESISTANCE
				■							VL		VERY LOW RESISTANCE
				■		2					H		HIGH RESISTANCE
									END OF BOREHOLE AT 2.40 m				'TC' BIT REFUSAL
						3							
						4							
						5							
						6							

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JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
3
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 7/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■			■	N = 22 4,6,16			CL	SANDY SILTY CLAY: low plasticity, red brown, trace of root fibres, and fine to medium grained sub rounded ironstone gravel.	MC<PL	H	>600 >600 >600	GRASS COVER
								-	SANDSTONE: fine grained, yellow brown.	DW	L - M		LOW TO MODERATE 'TC' BIT RESISTANCE
				■		1					M - H		MODERATE RESISTANCE
											VL		VERY LOW RESISTANCE
											H		HIGH RESISTANCE
						2			END OF BOREHOLE AT 1.90 m				'TC' BIT REFUSAL
						3							
						4							
						5							
						6							

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JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 4
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED HOSPITAL UPGRADE
Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 7/11/17 **Datum:**
Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■							CL-CH	SILTY CLAY: medium to high plasticity, brown and red.	MC>PL	(VSt)		GRASS COVER
								-	SANDSTONE: fine grained, red brown.	DW	H		HIGH 'TC' BIT RESISTANCE
		■				1		CL-CH / -	INTERBEDDED SILTY CLAY: medium to high plasticity, red brown, and SILTSTONE: light grey, with fine to medium grained ironstone gravel.	MC~PL XW	(VSt) / EL		
				■	N > 18 8,14,4/ 20mm REFUSAL								
						2			END OF BOREHOLE AT 1.80 m				'TC' BIT REFUSAL
						3							
						4							
						5							
						6							

JK_LIB_CURRENT - V8.00.GLB Log J & K AUGERHOLE - MASTER 30991L GRIFFITH.GPJ <<DrawingFile>> 05/12/2017 16:52 Produced by gINT Professional. Developed by Datgel

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 5
1 / 2

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED HOSPITAL UPGRADE
Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 7/11/17 **Datum:**
Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■								FILL: Clayey gravel, fine to medium grained, red brown, sandstone gravel, fine to medium grained, silty clay, low plasticity.	M			GRASS COVER
		■		■	N = 6 7,4,2			CL-CH	SILTY CLAY: medium to high plasticity, red brown, trace of medium to coarse grained quartz gravel.	MC~PL	(VSt)		
	■					1		CL	as above, but medium plasticity, trace of ash.	MC<PL	VSt - H		
				■	N > 33 9,13,20/ 130mm REFUSAL							390 430 440	
				■		2		-	SANDSTONE: fine grained, light brown and light red brown.	DW	H		HIGH 'TC' BIT RESISTANCE
									REFER TO CORED BOREHOLE LOG				'TC' BIT REFUSAL
						3							
						4							
						5							
						6							

JK_LIB_CURRENT - V8.00.GLB Log J & K AUGERHOLE - MASTER 30991L GRIFFITH.GPJ <<DrawingFile>> 05/12/2017 16:53 Produced by gINT Professional. Developed by Datgel

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
5
2 / 2

CORED BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED HOSPITAL UPGRADE
Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L | **Core Size:** NMLC | **R.L. Surface:** N/A
Date: 7/11/17 | **Inclination:** VERTICAL | **Datum:**
Plant Type: JK205 | **Bearing:** N/A | **Logged/Checked By:** A.B./L.S.

Water Loss\Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (EL .03, VL .1, L .3, M 1, H 3, VH 10, EH)	DEFECT SPACING (mm) (500, 300, 100, 50, 30, 10)	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
				START CORING AT 2.26m					
				CORE LOSS 0.32m					
100% RETURN		3		SANDSTONE: fine grained, light brown and light red brown, with light grey laminae, bedded at 30°.	SW	H			(2.70m) J, 90°, P, R (3.27m) J, 90°, P, R
		4		SANDSTONE: fine grained, red brown.	FR	H - VH			(3.50m) J, 80°, P, R
				as above, but grey and red brown.					
				END OF BOREHOLE AT 4.66 m					
		5							
		6							
		7							
		8							

JK_LIB_CURRENT - V8.00.GLB Log J & K CORED BOREHOLE - MASTER 30991L GRIFFITH.GPJ <<DrawingFile>> 05/12/2017 16:53 Produced by gINT Professional. Developed by Datgel


JK Geotechnics
JOB No. 30991L BH5 START CORING AT 2.26m
2
CORE LOSS 0.32m
3
4
EOBH AT 4.66m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
6
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 8/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■								FILL: Gravelly clay, low plasticity, brown, medium to coarse grained, sandstone and quartz gravel.	MC<PL			GRASS COVER
								CL-CH	SILTY CLAY: medium to high plasticity, red brown, trace of fine grained ironstone gravel, fine grained sand bands, and ash.	MC~PL	H		
	■			■	N = 15 6,8,7							540 >600 >600	
						1							
				■				-	SANDSTONE: fine grained, light red brown.	DW	M - H		HIGH 'TC' BIT RESISTANCE
				■		2							
									END OF BOREHOLE AT 2.70 m				
						3							
						4							
						5							
						6							

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JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 7
1 / 2

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 8/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING								CL	SILTY CLAY: low plasticity, brown, trace of ash, root fibres.	MC<PL	H		GRASS COVER
									SILTY CLAY: low plasticity, red brown, trace of ash.				
					N > 6 9,6/ 40mm REFUSAL				as above, but with bands of sandstone, fine grained, yellow brown.			>600	
								-	SANDSTONE: fine grained, light brown and light red brown.	DW	H		HIGH 'TC' BIT RESISTANCE
						1			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 2.70m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 0.1m TO 2.70m. 2mm SAND FILTER PACK 1.0m TO 2.70m. BENTONITE SEAL 0.1m TO 1.0m. COMPLETED WITH A CONCRETED GATIC COVER.
						2							
						3							
						4							
						5							
						6							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 7
2 / 2

CORED BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED HOSPITAL UPGRADE
Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L | **Core Size:** NMLC | **R.L. Surface:** N/A
Date: 8/11/17 | **Inclination:** VERTICAL | **Datum:**
Plant Type: JK205 | **Bearing:** N/A | **Logged/Checked By:** A.B./L.S.

Water Loss\Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL .03 / VL .1 / L .3 / M 1 / H 3 / VH 10 / EH	DEFECT DETAILS DEFECT SPACING (mm) 500 300 100 50 30 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
				START CORING AT 0.84m					
AFTER 7.5 HRS		1		SANDSTONE: fine grained, light brown and light red brown.	SW	VH			(0.93m) Be, 0°, P, S
					XW - DW	EL - VL			
		2		SANDSTONE: fine grained, red brown.	SW	M VH			(1.68m) J, 90°, P, S (1.76m) J, 20°, P, S (2.47m) Be, 0°, P, R (2.51m) J, 80°, P, R (2.57m) XWS, 0°, 5 mm.t (2.64m) XWS, 0°, 5 mm.t
				END OF BOREHOLE AT 2.70 m					
		3							
		4							
		5							
		6							


JK Geotechnics
JOB No. 30991L BH7 START CORING AT 0.84
0
1
2
EOBH AT 2.73m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 8
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 7/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■			■	N = 33 10,13,20			CL	SILTY CLAY: low plasticity, red brown, trace of fine grained sand, fine grained sandstone gravel, and ash.	MC<PL	H		GRASS COVER
									as above, but no sandstone gravel.				TOO FRIABLE FOR HP TESTING
				■	N = 30 12,14,16	1						>600 >600 >600	
					N > 5 13,5/ 50mm REFUSAL								
				■		2			SANDSTONE: fine grained, light brown, light red brown.	DW	H		HIGH 'TC' BIT RESISTANCE
									END OF BOREHOLE AT 2.10 m				'TC' BIT REFUSAL
						3							
						4							
						5							
						6							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
9
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 7/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■								TOPSOIL: Silty clay, low plasticity, dark brown, trace of roots.	MC~PL			GRASS COVER
								CL	SILTY CLAY: low plasticity, orange brown, trace of ash.	MC~PL	VSt		
				■	N = 9 4,3,6							250 220 230	
						1							
				■	N = 23 13,11,12				GRAVELLY CLAY: medium plasticity, red brown and light grey, fine to coarse grained, quartz gravel.	MC~PL	VSt - H		
						2							
				■				-	SANDSTONE: fine grained, grey and light brown.	DW	M - H		MODERATE TO HIGH 'TC' BIT RESISTANCE
						3							
									END OF BOREHOLE AT 3.10 m				GROUNDWATER MONITORING WELL INSTALLED TO 3.10m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 0.05m TO 3.10m. 2mm SAND FILTER PACK 1.0m TO 3.10m. BENTONITE SEAL 0.1m TO 1.0m. COMPLETED WITH A CONCRETED GATIC COVER.
						4							
						5							
						6							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
10
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 7/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION								ML	SANDY SILT: low plasticity, orange brown, with clay.	MC<PL			GRASS COVER
								-	SANDSTONE: fine grained, light red brown.	DW	H		HIGH 'TC' BIT RESISTANCE
									END OF BOREHOLE AT 0.30 m				'TC' BIT REFUSAL
DUP1						1							
						2							
						3							
						4							
						5							
						6							

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JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
11
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 7/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION	■							ML	SANDY SILT: low plasticity, red brown, fine grained sand.	MC<PL	VSt		
				■	N = 21 4,7,14								
				■		1			SANDSTONE: fine grained, light red brown.	DW	H		HIGH 'TC' BIT RESISTANCE
									END OF BOREHOLE AT 1.20 m				'TC' BIT REFUSAL
						2							
						3							
						4							
						5							
						6							

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JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 12
1 / 2

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 8/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■							ML	SANDY SILT: low plasticity, orange brown.	MC<PL			
								CL	SILTY CLAY: low to medium plasticity, orange brown, trace of fine grained sand.	MC<PL	H		
				■	N = 37 6,17,20							>600 >600 >600	
						1		-	SANDSTONE: fine grained, light grey and light red brown.	DW	H		HIGH 'TC' BIT RESISTANCE
									REFER TO CORED BOREHOLE LOG				
						2							
						3							
						4							
						5							
						6							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
12
2 / 2

CORED BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L | **Core Size:** NMLC | **R.L. Surface:** N/A

Date: 8/11/17 | **Inclination:** VERTICAL | **Datum:**

Plant Type: JK205 | **Bearing:** N/A | **Logged/Checked By:** A.B./L.S.

Water Loss\Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH	DEFECT DETAILS DEFECT SPACING (mm) 500, 300, 100, 50, 30, 10 DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
				START CORING AT 1.52m				
		2		CORE LOSS 0.55m				
				SANDSTONE: fine grained, light grey and light red brown.	SW	H		(2.14m) J, 90°, P, S (2.29m) J, 90°, P, S
		3		as above, but red brown and light grey bands.				(2.57m) J, 90°, P, S (2.95m) J, 70°, P, S, IS (3.67m) J, 90°, P, S
				END OF BOREHOLE AT 3.82 m				
		4						
		5						
		6						
		7						


JK Geotechnics
JOB No. 30991L BH12 START CORING AT 1.52m
CORE LOSS 0.56
2
3
4
EOBH 3.82m

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 13
1 / 2

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE
Project: PROPOSED HOSPITAL UPGRADE
Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A
Date: 8/11/17 **Datum:**
Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING	■							CL	SANDY CLAYEY SILT: low plasticity, red brown.	MC<PL			GRASS COVER
									SILTY CLAY: medium plasticity, red brown, trace of fine grained sandstone gravel, and ash.	MC<PL	H		
				■	N = 24 6,12,12							>600 >600 >600	
						1		-	SILTSTONE: light grey and orange brown, with sandstone bands, fine grained, orange brown.	DW	VL		LOW 'TC' BIT RESISTANCE
											H		MODERATE RESISTANCE
									REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 4.55m. CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 1.55m TO 4.55m. CASING 0.11m TO 1.5m. 2mm SAND FILTER PACK 1.5m TO 4.55m. BENTONITE SEAL 0.15m TO 1.5m. COMPLETED WITH A CONCRETED GATIC COVER.
						2							
						3							
						4							
						5							
						6							

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 13
2 / 2

CORED BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L | **Core Size:** NMLC | **R.L. Surface:** N/A

Date: 8/11/17 | **Inclination:** VERTICAL | **Datum:**

Plant Type: JK205 | **Bearing:** N/A | **Logged/Checked By:** A.B./L.S.

Water Loss\Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH	DEFECT DETAILS DEFECT SPACING (mm) 500, 300, 100, 50, 30, 10	DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / General
				START CORING AT 1.64m					
				CORE LOSS 0.29m					
		2		SILTSTONE: light grey, with sandstone, fine grained, light grey and orange brown.	DW	M - H			(1.98m) FRAGMENTED ZONE, 0°, 110 mm.t (2.17m) Be, 0°, P, S (2.27m) J, 60°, P, S, IS
				SILTSTONE: light grey.	SW				(2.46m) J, 90°, P, R (2.54m) FRAGMENTED ZONE, 0°, 10 mm.t (2.68m) J, 70 - 90°, Un, R
				CORE LOSS 0.20m					
		3		SILTSTONE: light grey.	SW	H			(2.98m) J, 90°, P, S
				SANDSTONE: fine grained, light grey and light red brown.	FR				(3.34m) J, 20°, P, S
		4							(4.18m) CS, 0°, 1 mm.t (4.20m) CS, 0°, 1 mm.t
				END OF BOREHOLE AT 4.64 m					
		5							
		6							
		7							

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JK Geotechnics
JOB No 30991L BH13 START CORING AT 1.64
1
CORE LOSS: 0.29m
2
CORE LOSS: 0.2
3
4

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No.
14
1 / 1

BOREHOLE LOG

Client: HEALTH INFRASTRUCTURE

Project: PROPOSED HOSPITAL UPGRADE

Location: GRIFFITH REGIONAL HEALTH SERVICE - NOOREBAR AVENUE, GRIFFITH, NSW

Job No.: 30991L **Method:** SPIRAL AUGER **R.L. Surface:** N/A

Date: 7/11/17 **Datum:**

Plant Type: JK205 **Logged/Checked By:** A.B./L.S.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION									TOPSOIL: Silty clay, medium plasticity, dark brown.	MC~PL			GRASS COVER
								-	SANDSTONE: fine grained, light red brown.	DW	M - H		
					N = 10 3,3,7			CL	SILTY CLAY: medium plasticity, orange brown.	MC~PL	VSt		
						1		-	SILTSTONE: light grey, with sandstone, fine to coarse grained yellow brown bands.	DW	VL - L		LOW 'TC' BIT RESISTANCE
					N=SPT 5/ 130mm REFUSAL				END OF BOREHOLE AT 1.65 m				'TC' BIT REFUSAL
						2							
						3							
						4							
						5							
						6							

APPENDIX B

Health Infrastructure

Griffith Base Hospital Redevelopment

Geotechnical Investigation Report

December 2018

Table of contents

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Figure index

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Appendices

1. Introduction

1.1 Engagement

GHD have been engaged by Health Infrastructure (HI) NSW to provide consultancy services for the proposed upgrade to Griffith Base Hospital as part of the proposed Stage 1 re-development. The consultancy services covered by this engagement include a hazardous materials assessment, contamination and geotechnical investigations within the Stage 1 works area and the proposed masterplan area as shown in Figure 1.

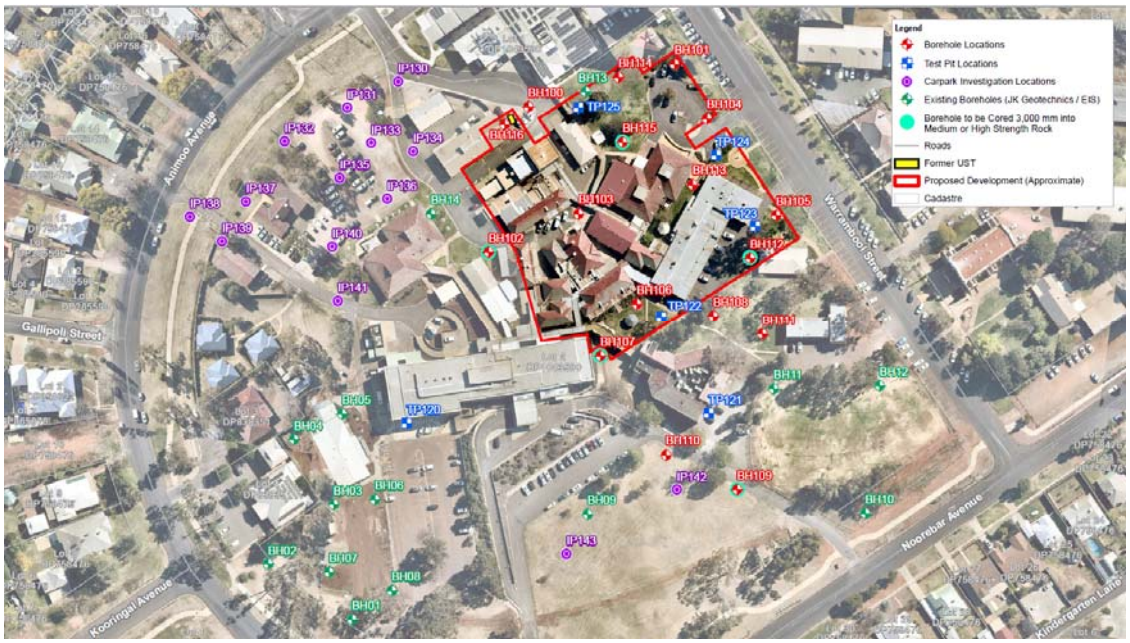

Figure 1 – Development Area (source: JK Geotechnics Figure No. 2 – Borehole Location Plan)

This report contains the findings of the geotechnical investigation carried out at the Griffith Base Hospital and provides geotechnical interpretation of the subsurface ground conditions encountered.

Contamination assessment and HAZMAT survey were also carried out by GHD concurrently with the geotechnical investigations. The results of those works are presented in separate reports.

1.2 Purpose of this report

The purpose of this Geotechnical Investigation is to provide further information to inform design and construction of the proposed development, proposed road and carpark for the site and advice in relation to the proposed redevelopment.

geotechnical investigations was carried out to supplement the available geotechnical findings from JK Geotechnics (2017).

This report should be read in conjunction with the limitations outlined in Section 4 and the general notes presented in Appendix B.

1.3 Available information

A number of document were provided by HI as part of the tender brief including:

- RFQ (Request for Quotation) relating to the provision of Contamination, Geotechnical and Hazardous Materials Consulting Services, Contract No: HI 18435 – Service Investigation, Geotech & HazMat Consultants, dated 28 August 2018;
- Annexure A - Stage 1 Endorsed Scope;
- Annexure B - Intensive Care Unit Extension and IPU Refurbishment Plans;
- Annexure C - Design Guidance Note 015 (Revision C, August 2016) Asbestos Management;
- Updated borehole location plan (Ref: Bonacci, SK180815-01 Rev A, dated 13/9/2018)
- Annexure E - HazMat Survey prepared by Environmental and Safety Professionals (ESP, Ref:J30414, dated July 2015)
- Annexure F - Geotechnical investigation report prepared by Jeffery and Katauskas Pty Ltd (JK Geotechnics, Ref: 30991Lrpt, dated 5 December 2017).
- Annexure G - Preliminary environmental site assessment report prepared by Environmental Investigation Services (EIS) (Ref: E30991KHrpt, dated 8/12/2017);
- Lower ground floor plan and details (Ref:130565-BON-ST-DWG-B1_0100 01, dated 28/9/2018)
- Detail survey plan (Ref: 17362.01_DT_001_RevE.dwg, dated 20/9/2018)

2. Objectives

The brief sets out the objectives of the Geotechnical Investigation, which were to provide information to inform the design and construction of the proposed redevelopment, road and carparks for the site, and provide advice in relation to the proposed redevelopment.

GHD understand the following objectives for the proposed Stage 1 redevelopment scope:

- Review the existing Hazardous Materials Survey prepared by ESP, July 2015 as it relates to the endorsed scope for Stage 1 of the Griffith Base Hospital Redevelopment, and undertake an investigation of the hazardous materials within the extension areas of the Medical Services Building and Main Ward Block (i.e. removal of walls to accommodate the endorsed design) and the masterplan area (buildings to be demolished).
- Carry out a Phase 2 contamination assessment to evaluate the contamination status of the site in relation to the proposed redevelopment, notably relating to the former fuel underground storage tanks, and for the proposed building envelop and car park extensions.
- Assess whether concentrations of contaminants at the site present a potential risk to human health and/or the environment
- Carry out geotechnical investigations (at locations as shown in Bonacci Drawing SK180815-01 Rev A, dated 13/09/2018) to supplement the available geotechnical findings from the JK Geotechnics investigation from 2017.

This report relates to geotechnical aspects of the site only. Contamination assessment of the soil and groundwater conditions, and HAZMAT survey fndings will be reported under separate cover.

3. Scope of work

The scope of work completed by GHD as part of this engagement, was carried out in general accordance with GHD's proposal (Ref: Griffith Base Hospital Proposal_Updated, dated 2 October 2018). Only aspects relevant to the Geotechnical Investigation have been outlined below:

3.1 Desktop study

A desktop study was carried out in preparation of this report and included a review of the following:

- The geotechnical report prepared by JK Geotechnics (2017), and the Preliminary Environmental Site Assessment completed by Environmental Investigation Services (EIS) December 2017;
- Review of available published mapped information;
- Preparation of sampling and staging plans for fieldwork.

3.2 Preliminary tasks

The following sections provide details of the planning and safety aspects of the fieldwork program that was developed to address the objectives and scope of works for the project.

3.2.1 Workplace health and safety

GHD developed a site specific health safety and environment (HSE) Plan for the site investigation works as part of the overall commitment to provide a healthy and safe working environment for staff and contractors. All work employed appropriate personal protection equipment (PPE).

The HSE plan included a job safety and environment analysis detailing the step by step procedures of all aspects of the works and associated hazards and control measures to be implemented. The HSE plan was read by all GHD personnel and subcontractors and feedback and discussion provided prior to the works commencing. A site specific pre-start safety assessment was conducted each morning before commencing works.

Prior to commencement of fieldwork, several discussion were carried out by a GHD representative, HI representative and hospital management to assess test locations for accessibility and any traffic control requirements. Services clearance was undertaken by a professional underground services locator to further reduce the risk of intersecting subsurface services during the intrusive works, and dial before you dig were also referenced.

3.2.2 Project safety and environmental management plan

A Project Safety and Environmental Management Plan (PS & EMP) was implemented during the undertaking of the geotechnical investigation works. The PS & EMP provided guidance to site personnel and subcontractors during the undertaking of the site works, ensuring that appropriate environmental mitigation measures and controls were being implemented and checked as required. The PS & EMP provided NSW Health Infrastructure with assurance that the works were being undertaken in a manner considerate of environmental risk and potential impacts, with appropriate controls in place. The PS & EMP also included a strategy on how GHD achieved the project outcomes, including obtaining geotechnical and site contamination information.

The PS & EMP was also included an assessment of the potential safety risks associated with carrying out the fieldwork. The plan was included (but is not limited to) an emergency contact list, an assessment of the risks associated with the fieldwork prior to going to site, reassessment at the site, personal protective equipment requirements, emergency response, Job Safety and Environment Analysis (JSEA). Subcontractors were selected from GHD's approved suppliers list.

3.3 Geotechnical site investigations

Geotechnical site investigation fieldwork was carried out between 29th October to 3 November 2018, and comprised the following:

- Underground services clearance by a qualified services locator
- Drilling of sixteen (16) combined geotechnical and contamination investigation boreholes (BH100 to BH115) at locations as shown in the Bonacci Geotechnical Investigation Mark Up Plan (SK180815-01 Rev A, 13/9/2018);
- Drilling of fourteen (14) large diameter boreholes (IP130 to IP143) to enable an assessment of the subgrade conditions to inform pavement design for the proposed car park footprint extensions;
- Excavation of two test pits (TP120 and TP121) that were intended to investigate the existing building footing configurations and founding conditions at those locations;
- Drilling of one borehole (BH116) in proximity to the former fuel underground storage tanks, as a combined groundwater/gas monitoring well.

4. Limitations

This report has been prepared by GHD for NSW Health Infrastructure and may only be used and relied on by NSW Health Infrastructure for the purpose agreed between GHD and the NSW Health Infrastructure as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than NSW Health Infrastructure arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by NSW Government Health Infrastructure and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, roadways, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

General notes relating to limitations of this report are included in Appendix B and should be read in conjunction with this report.

5. Fieldwork investigation

Subsurface investigation comprised of the following:

- Drilling of sixteen (16) combined geotechnical and contamination investigation boreholes (BH100 to BH115) at locations as shown in the Bonacci Geotechnical Investigation Mark Up Plan (SK180815-01 Rev A, 13/9/2018) across the Stage 1 Scope locations of the Hotel Services Zone, IPU Refurbishment extension, ICU and Recovery Refurbishment extension, and cover the masterplan area, complementing the existing information (JK Geotechnics, 2017). These boreholes were constitute the following:
    - Nine (9) boreholes (BH100, BH101, BH103 to BH106, BH108, BH110 and BH111) drilled by augering technique, terminating 300 mm into weathered rock;
    - Five (5) boreholes (BH102, BH107, BH109, BH112 and BH115) drilled by augering technique in the overburden soils, and progressed into the underlying bedrock a further 3m by NMLC diamond rock coring technique to enable rock core recovery.
- Drilling of fourteen (14) large diameter boreholes (IP130 to IP143) to enable an assessment of the subgrade conditions to inform pavement design for the proposed car park footprint extensions
- Excavation of two test pits (TP120 and TP121) that were intended to investigate the existing building footing configurations and founding conditions at those locations;
- Drilling of one borehole (BH116) in proximity to the former fuel underground storage tanks, as a combined groundwater/gas monitoring well. Details of well installation are presented in the engineering borehole log.

The fieldwork was completed in the full-time presence of two geotechnical engineers, who set out the borehole and test pit locations, conducted in-situ testing and sampling and prepared the engineering logs.

Select samples recovered from the geotechnical investigation fieldwork was subjected to laboratory testing, which included the following:

- Nine (9) soil samples were assessed for California Bearing Ratio (CBR) testing within the anticipated pavement subgrade;
- Seven (7) soil samples were assessed for Atterberg Limits to assess soil index properties;
- Nine (9) soil samples assessed for Emerson Class Number.

6. Project details

6.1 General details

The Griffith Base Hospital Redevelopment Project is envisaged to be a major site redevelopment of the existing Griffith Base Hospital, delivered in stages.

The NSW Government has committed $35M for 'Stage 1' of the redevelopment of Griffith Base Hospital. This will need to include both short term enabling and enhancement works and longer term main works in line with an agreed masterplan for the site. As part of the master planning for the site and following identification of the clinical services priorities, further enabling works and new works will be identified as part of Stage 1 ($35m) of the redevelopment. These works will be undertaken from late 2018 onwards.

With the Delivery of the Renal building already underway, the remaining proposed Stage 1 works can be defined as:

- A new-build, Ambulatory Care Hub that combines Medical Oncology, Rehabilitation, Day Medical (HITH) and an Outpatient Clinics. The Ambulatory Care Hub will be located to the south of the temporary Renal Unit. Relocating these clinical services also enables demolition of existing buildings currently located within the future masterplan zone. Whilst a traditional build option is proposed, the building is still considered to be temporary and the construction will reflect this;
- Pending the outcome of any Ministerial Direction, it is proposed that non-clinical support services would be relocated to the where the former Nurses Accommodation is located (South East of the site) or alternate nearby location. Relocated services would include the morgue, workshop, kitchen, linen handling and bulk storage. This also enable demolition of existing buildings within the masterplan zone. A number of these support services (such as the kitchen) are currently located in sub-optimal facilities. Provisional feedback from HealthShare has indicated that this approach could improve service delivery;
- An expanded building footprint to incorporate additional support areas and storage in CCU and Perioperative areas. This would address a number of current non-compliances (such as the current scope clean area) and provides an expanded patient bay in CCU. The additional storage will allow the current recovery bays that are being used for storage to be converted back to clinical use;
- An expansion to the IPU unit to the south of the existing building to provide additional bathrooms, office accommodation, storage and an IPU gym. The clinical areas that are currently used for these functions, can be returned to clinical use and also facilitate a new model of care (co-located IPU gym);
- The provision of site wide infrastructure including new car parking. With services relocating and/or expanding to the south of the campus, there will be a need for additional car parking to support these services;
- The proposed works above will leave a number of buildings vacant (within the future masterplan area). The proposed scope includes demolishing the vacated buildings.

6.2 Key geotechnical elements

From a geotechnical perspective, the key design elements of the project include:

- Foundations for new buildings;
- Site classification and assessment of soil reactivity to inform design of ground bearing slabs;
- Earthworks, materials assessment and re-use potential;
- Subgrade assessment to inform design and construction of new car parks.
- Exposure classification of soils and groundwater to buried concrete structures.

7. Results of field investigations

7.1 Previous investigation by Jeffery and Katauskas (2017)

A geotechnical report was prepared by Jeffery and Katauskas Pty Ltd (JK Geotechnics) for Health Infrastructure NSW (Ref: 30991Lrpt, dated 5 December 2017), to provide geotechnical information about the immediate subsurface, as well as recommendations regarding future earthworks and footings.

A total of fourteen (14) boreholes were auger drilled to refusal in the underlying siltstone / sandstone bedrock using a TC bit. Four (4) of those boreholes (BH5, BH7, BH12 and BH13) were progressed further with rock coring. Standpipes were installed in three (3) of the boreholes (BH7, BH9 and BH13) to enable future groundwater monitoring.

The report provided by JK Geotechnics recommended that excavation depths be limited to reduce cost due to the observed and tested high to very high strength sandstone. The JK Geotechnics test locations are included for completeness in the Investigation Location Plan (Figure 1 – Appendix A).

7.2 Regional geology

The 1:250,000 scale Geological Series Sheet SI 55-10 for 'Narrandera' indicates that the site is expected to be underlain by the Cocoparra Group geological unit which comprise "undifferentiated quartz sandstone and pebbly sandstone. Based on the geological map, the site is located on the boundary of Jimberoo Formation on the east and south side of the site. This is described as "red and white sandstone, minor red siltstone and grit beds"

The mapped information is consistent with the material encountered during GHD's field investigation which encountered medium grained sandstone.

7.3 Site observations and topography

The existing Griffith Base Hospital is located on a roughly arch shaped block approximately 6.4 ha. in size with St Vincent's Private Community Hospital located directly to the north and two smaller lots to the south west. The site is situated mid slope on a hill having a gentle slope to the south. The hospital lot is surrounded by local roads Noorebar Avenue, Animoo Avenue and Warrambool Street.

Buildings across the site are typically one and two storey brick buildings that appeared to be in good condition based on cursory observations at the time of site works. As part of the hospital redevelopment works, investigations have been completed in two stages. Stage 1 investigations cover all works within the red boundary as shown in Figure 1, and stage 2 covers works outside of this red boundary.

There are several paved areas over the site around the existing buildings and over access roads, generally comprising a thin bituminous wearing course overlying roadbase. Some local deformation and damage to the asphalt pavement was noted.

There are also local areas with unsealed gravel pavements and concrete paving along the site. There is also an unsealed gravel parking area located on the western side of the hospital. The remainder of the ground surface over the site is mostly covered in vegetation comprising a thin to medium grass cover, garden areas with low bushes and areas with scattered tree growth.

Vegetation over the site comprised of a mown grass cover and a number of small to medium size trees that appeared to be at least 30 years old with a few larger trees over the site.

The ground surface over the site was generally firm under foot and with no deformation under the drilling rig. No obvious wet boggy areas or seepages were observed on the surface. Also, no rock outcrops were visible over the investigation area. There was no evidence of any significant erosion or landslide activity over the proposed development area.

Based on Dial-Before-You-Dig (DBYD) plans and existing underground services plans provided by the Hospital maintenance department, there are several buried services within or adjacent to the site, including several electrical cables, sewer pipe and water pipeline, high voltage power and high pressure gas mains.

The general topography of the site is gently sloping towards the south-southwest.

7.4 Borehole investigation

The general subsurface conditions encountered in boreholes BH100 to BH116 are summarised in Table 1 and Table 2. Engineering logs of the boreholes are presented in Appendix C. The following general observations were made:

Table 1. Summary of subsurface conditions encountered in boreholes BH100 to BH116

Unit	Unit General Description	Depth range to top of unit (m)
Topsoil/Fill	Silty Sandy Clay, brown, low plasticity, fine to coarse grained sand, with rootlets, fine to coarse angular to sub-angular gravel	Ground surface to 0.5
	Asphalt/Gravelly Sand (Roadbase), grey, fine to coarse grained sand, fine to coarse grained angular to sub-angular gravel	Ground surface to 0.6
Residual	Sandy Clay, brown, medium plasticity, fine to coarse grained sand, trace of fine to medium, sub-angular gravel	0.15 to 2.6
Extremely weathered Rock	Sandy Clay/Clayey Sand, red, brown, medium plasticity, fine to coarse grained sand, trace of fine to coarse angular to sub-angular gravel	0.5 to 3.0
Extremely to Highly weathered Rock	Sand/sandy Clay, brown, pale brown, medium plasticity, fine to coarse grained sand, trace of fine to coarse angular to sub-angular gravel	0.7 to 7.6
Moderately to Slightly weathered Rock	SANDSTONE, brown, grey, fine to medium grained, high strength. Core loss recorded in borehole BH107 (at about 5.75 to 6.0m and 7 to 7.21m depth). The core loss is likely to be associated with an extremely weathered or clay seam.	1.8 to 10.0
Slightly weathered to Fresh Rock	SANDSTONE, grey, fine to medium grained, high becoming very high strength	4 to 10.6*

*Note that this is the termination depth of the borehole and the ground conditions below this depth are unconfirmed. Extremely or highly weathered material can occur within zones of slightly weathered or fresh rock.

Table 2. Summary of depth range for material encountered in Boreholes

Borehole	Depth range of material (m)					
	Topsoil/Fill	Residual	EW Rock	EW/HW Rock	MW/SW Rock	SW/Fr Rock
BH100	0.0 to 0.25 (Only Roadbase)	0.25 to 1.0	1.0 to 1.5	1.5 to 1.6 note 1	–	–
BH101	0.0 to 0.15	0.15 to 1.1	1.1 to 1.6 note 1	–	–	–
BH102	0.0 to 0.5	0.5 to 1.2	1.2 to 1.5	1.5 to 2.76	2.76 to 6.0	6.0 to 7.0 note 2
BH103	0.0 to 0.2 (0.05m asphalt and 0.15m Roadbase)	0.2 to 1.0	1.0 to 1.3	1.3 to 1.4 note 1	–	–
BH104	0.0 to 0.2	0.2 to 0.7	0.7 to 1.25	1.25 to 1.3 note 1	–	–
BH105	0.0 to 0.2	0.2 to 1.1	1.1 to 1.4	1.4 to 1.55 note 1	–	–
BH106	0.0 to 0.2	0.2 to 1.0	1.0 to 1.5 note 1	–	–	–
BH107	0.0 to 0.5	0.5 to 2.6	–	2.6 to 5.0	5.0 to 8.0	8.0 to 9.0 note 2
BH108	0.0 to 0.2	0.2 to 0.7	0.7 to 1.0 note 1	–	–	–
BH109	0.0 to 0.25	0.25 to 1.4	1.4 to 3.0	3.0 to 7.6	–	7.6 to 10.6 note 2
BH110	0.0 to 0.2	0.2 to 0.5	0.5 to 0.7	0.7 to 0.8 note 1	–	–
BH111	0.0 to 0.2	0.2 to 0.6	0.6 to 1.0 note 1	–	–	–
BH112	0.0 to 0.2	0.2 to 0.75	0.75 to 1.5	1.5 to 1.8	1.8 to 4.0	4.0 to 5.5 note 2
BH113	0.0 to 0.2	0.2 to 1.0	1.0 to 1.2 note 1	–	–	–
BH114	0.0 to 0.2	0.2 to 0.75	0.75 to 1.0	1.0 to 1.1 note 1	–	–
BH115	0.0 to 0.2	0.2 to 1.0	1.0 to 2.5	2.5 to 2.8	2.8 to 5.0	5.0 to 6.45 note 2
BH116	0.0 to 0.6	0.6 to 0.8	0.8 to 1.25	1.25 to 2.0	2.0 to 10 note 2	–

Notes:

1- Note that this is the termination depth of the borehole and the ground conditions below this depth are unconfirmed

2- Note that this is the termination depth of the borehole and the ground conditions below this depth are unconfirmed. Extremely or highly weathered material can occur within zones of slightly weathered or fresh rock.

Selected general site photographs showing general view and site conditions are provided below in Photos 1 to 9.

Photo 1. Drilling of BH107 in vicinity of Emergency Building

Photo 2. Drilling of BH109 in front of emergency Carpark area

Photo 3. Drilling of BH112 in front of Dental Clinic

Photo 4. Drilling of BH112 in front of Assessment, Rehabilitation and Physio Building

Photo 5. Soil and weathered rock profile encountered in BH100 in vicinity of Bulk Workshop

Photo 6. Soil and weathered rock profile encountered in BH103 in vicinity of Staff Dining Room and Kitchen

Photo 7. Soil and weathered rock profile encountered in BH111 in vicinity of Nurses Training School

Photo 8. Soil and weathered rock profile encountered in BH113 in vicinity of Oncology and Specialist Clinic 1

Photo 9. Soil and weathered rock profile encountered in BH114 in vicinity of RMO Accommodation

7.5 Pavement profile and subgrade investigations

The general subsurface conditions in carpark area encountered in boreholes IP130 to IP143 are summarised in Table 3 and Table 4. Generally, a thin layer of roadbase was encountered in majority of boreholes overlying residual soil. Engineering logs of the boreholes are presented in Appendix C. The following general observations were made:

Table 3. Summary of subsurface conditions encountered in boreholes IP130 to IP143

Unit	Unit General Description	Depth range to top of unit (m)
Topsoil	Sandy Clay, red, brown, medium plasticity, fine to coarse grained sand, with rootlets, with fine to coarse sub-angular to sub-rounded gravel	Ground surface to 0.2
Roadbase	Gravelly Sand, grey, medium dense, fine to coarse angular to sub-angular gravel	Ground surface to 0.4
Fill	Sandy Clay, brown, red, low to medium plasticity, fine to coarse sand, with fine to coarse sub-angular to sub-rounded gravel	0.1 to 0.6
Residual	Sandy Clay/Clayey Sand, red, brown, medium plasticity, fine to coarse grained sand, with fine to coarse sub-angular to sub-rounded gravel	0.2 to 1.0
Extremely Weathered Rock	Sandy Clay/Clayey Sand, brown, pale brown, medium plasticity, fine to coarse grained sand, with fine to coarse sub-angular to sub-rounded gravel	0.2 to 1.5

Table 4. Summary of depth range for material encountered in boreholes

Borehole	Depth range of material (m)				
	Topsoil	Roadbase	Fill	Residual	EW Rock
IP130	–	0.0 to 0.1	0.1 to 0.2	0.2 to 0.5	0.5 to 1.5 note 2
IP131	–	0.0 to 0.1	0.1 to 0.4	0.4 to 0.5 note 2	–
IP132	0.0 to 0.2	–	–	0.2 to 1.0 note 1	–
IP133	–	0.0 to 0.1	0.1 to 0.6 note 2	–	–
IP134	–	0.0 to 0.25	0.25 to 0.5 note 2	–	–
IP135	–	0.0 to 0.1	0.1 to 0.5	0.5 to 1.0 note 1	–
IP136	–	0.0 to 0.1	0.1 to 0.2	0.2 to 0.7	0.7 to 1.1 note 1
IP137	0.0 to 0.2	–	–	0.2 to 1.0 note 1	–
IP138	0.0 to 0.2	–	–	0.2 to 0.7	0.7 to 0.8 note 2
IP139	0.0 to 0.2	–	–	0.2 to 1.0 note 1	–
IP140	0.0 to 0.2	–	–	0.2 to 1.0 note 1	–
IP141	–	0.0 to 0.4 (including 50mm asphalt wearing course at surface)	–	0.4 to 0.6	0.6 to 0.8 note 2
IP142	0.0 to 0.2	–	–	–	0.2 to 0.3 note 2
IP143	0.0 to 0.2	–	0.2 to 0.6	0.6 to 1.0 note 1	–

Notes:

1- Note that this is the termination depth of the borehole and the ground conditions below this depth are unconfirmed

2- Borehole was terminated due to refusal on HW/MW bedrock.

Selected general site photographs showing site conditions are provided below in Photos 10 and 11.

Photo 10. Soil and weathered rock profile encountered in IP136 in vicinity of Children's Ward

Photo 11. Soil and weathered rock profile encountered in IP141 in vicinity of Children's Ward

7.6 Groundwater

No groundwater was encountered in the boreholes during or on completion of auger drilling. However, water was introduced into borehole to enable NMLC diamond rock core drilling, precluding measurement of any groundwater. No groundwater or seepage was encountered during test pitting or in the short time that the test pits remains open.

We note that relatively dry weather had occurred for some months prior to the investigation. It should be noted that groundwater conditions may vary depending on other factors.

7.7 Existing building footing configurations

In order to investigate the width and thickness of existing building shallow footings, two test pits were excavated, one outside of the Main Service building (TP120) and the other located at the General and Medical Ward Building (TP121). Engineering logs of the test pits are presented in Appendix C. The locations of these test pits have been specifically nominated by Bonacci as per the their Drawing SK180815-01 Rev A, dated 13/09/2018.

7.7.1 Main Services Building

Two concrete cores of 300mm diamater each were cored in the existing concrete ground slab to enable penetration of the subsoils to investigate the thickness of existing footings at locations of TP120. Due to existing underground services at the test location, test pitting had proceeded with only hand tool equipment. Two DCP tests were carried after removing oncrete cored to assess stiffness of soil adjacent to and below founding levels of the exisitng footing. Approximate DCP test locations are shown in Photo 12.

DCP01 was terminated at 1.6m (from current concrete lab level), due to refusal on very stiff/hard/EW material. Due to existing underground service PVC pipe, test pit was not proceeded and it was terminated at 0.3m depth.

However, DCP02 was terminated at 0.6m depth from existing concrelt slab. Accordingly test pit was terminated due to difficulty of excavation. Approximate footing dimensions are presented in Figure 2. Test pits were restored after completion of work.

Photo 12. View of concrete core and edge of existing footing encountered in TP120 in vicinity of Main Service Building

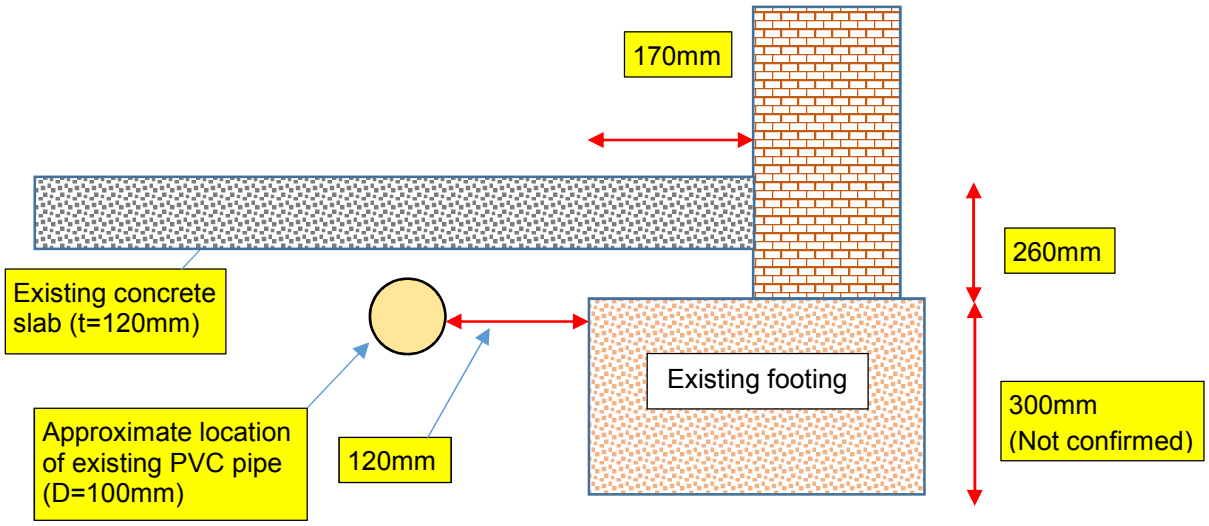

Figure 2. Schematic diagram of existing footing and adjacent to the Main Service Building

7.7.2 General and Medical Ward Building

In order to assess existing building shallow footings of the General and Medical Ward Building, test pit TP121 was excavated. The approximate depths of the test pit was about 1.1m relative to ground surface levels. Due to continual collapse of materials (clayey gravels) into the open test pit, the test pit could not be further deepened and was therefore terminated at 1.1m depth. This clayey gravel was backfill material against the building wall.

During our test pitting, it was found that the building contained a subfloor/basement at this location and the building wall continued to depths below the limit of investigation reach. Accordingly, the building footings at this location was not identified.

Based on discussion with the hospital maintenance department, GHD found out about the presence of a subfloor/basement in that building as shown in Photo 14. Accordingly, further assessment of the existing footing was carried out from inside the building basement level.

Based on our observations, there are either unexcavated materials or backfilled materials in the basement against the subject building wall where the location of TP121 was nominated against. This precluded GHD's field crew from determining the footing configurations along that section of wall even from inside the basement of that building.

However, approximate footing dimension was assess based on exposed footing as shown in Photo 17. However, further investigation is recommended to determine founding depth of footings.

Photo 13. View of General and Medical Ward Building

Photo 14. View of test pit (TP121) excavated adjacent to General and Medical Ward Building

Photo 15. View of entrance to subfloor/basement of General and Medical Ward Building

Photo 16. View of subfloor/basement of General and Medical Ward Building

Photo 17. View of existing footing of General and Medical Ward Building

Photo 18. View of unexcavated materials or backfilled materials in the basement against the subject building wall

8. Laboratory test results

8.1 Rock

Laboratory tests included Point Load Strength Index tests on suitable rock core samples from boreholes BH102, BH107, BH109, BH112 and BH115. Axial and diametral point load strength index test results are shown on the engineering logs in Appendix C.

The point load strength index test results for the weathered rock core samples tested ranged from 0.3 to 6.7 MPa in the highly weathered to Slightly/fresh rock. The point load test results indicated that point load strength index increased significantly with increasing depth.

The point load strength index test provides an index of strength and not a direct strength value. Correlations between Point Load Strength Index and Unconfined Compressive Strength (UCS) are derived statistically for a particular rock type using a number of test results.

For the sandstone tested a UCS to point load strength ratio in the range of 10 to 15 would be typical for rock with point load strength index greater than 1.0 MPa. A UCS to point load strength index ratio in the range of 4 to 8 would be typical for rock with point load strength index less than 1.0 MPa.

8.2 Soils

Seven samples of the natural clay/sandy clay material were collected from different test locations across the site and tested for moisture content and Atterberg Limits. California Bearing Ratio and standard compaction tests were undertaken on nine samples of the residual clay collected from different test locations. Also nine soil sample was collected and tested for Emerson Class Number. Testing was carried out at our GHD NATA accredited laboratory. The laboratory test reports are presented in Appendix D. A summary of the laboratory test results is presented in Table 5 and Table 6.

Table 5. Summary of CBR test results

Borehole location	Sample Depth (m)	Subgrade material	Standard Maximum dry density (t/m^3)	Optimum Moisture Content OMC (%)	CBR (%) at 2.5mm
BH103	0.5 to 0.8	Clay/sandy Clay	1.94	12.5	8
BH108	0.4 to 0.6	Clayey Sand	1.95	10.2	12
BH109	0.5 to 1.0	Sandy Clay	1.86	13.9	5
BH110	0.4 to 0.6	Gravelly sandy Clay	1.94	10.8	8
BH114	0.4 to 0.7	Clay	1.9	12.9	6
IP132	0.3 to 0.6	Sandy Clay	1.97	10.4	4.5
IP136	0.4 to 0.7	Sandy Clay	1.74	17.5	3
IP138	0.3 to 0.6	Sandy Clay	2.02	9.8	11
IP141	0.4 to 0.8	Sandy Clay	1.99	10.6	4

Table 6 Summary of Atterberg Limits test results

Test location	Depth (m)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)
BH102	0.5 to 1.0	15	23	8
BH103	0.5 to 0.8	12	21	9
BH109	0.5 to 1.0	15	24	9
BH112	0.5 to 1.0	11	22	11
BH114	0.4 to 0.7	12	24	12
IP137	0.7 to 1.0	13	30	17
IP141	0.4 to 0.8	12	21	9

The Atterberg limits test results indicate a low plasticity clay, verging on low to medium plasticity, with a moderate potential for volume change with variations in moisture content. These results are generally consistent with the observations during the site investigation which recorded clayey soils of medium plasticity at these locations and depths.

Table 7 Summary of Emerson Class Number

Test location	Depth (m)	Moisture content (%)	Emerson Class Number
BH102	0.5 to 1.0	12.5	2
BH103	0.5 to 0.8	12.0	3
BH108	0.4 to 0.6	5.7	3
BH110	0.4 to 0.6	9.0	2
BH112	0.5 to 1.0	Not tested	2
BH114	0.4 to 0.7	9.5	3
IP137	0.7 to 1.0	Note tested	3
IP141	0.4 to 0.8	5.8	3
IP143	0.4 to 0.6	4.4	3

9. Geotechnical discussions

9.1 Soil aggressivity

Soil samples were collected during the investigation for purposes of assessing aggressiveness to concrete structures. Testing for aggressivity included pH, chloride, and sulfates. The laboratory test report is enclosed in Appendix E.

The assessment has been carried out in accordance with Australian Standards AS3600-2009 and AS2159-2009, and is applicable to the following design elements:

- AS2159-2009 – piled retaining walls and piled foundations;
- AS3600-2009 – general concrete structures with a design life of 40 to 60 years.

Chemical testing to assess soil aggressivity was carried out on soil samples collected from boreholes BH102, BH106, BH110, BH112, BH114, IP137 and TP120.

The laboratory test results indicate that the soil samples tested are 'non-aggressive' to concrete in accordance with Table 6.4.2(c) AS2159-2009. However, based on the resistivity laboratory results, the soils exhibit a 'moderate to mild' exposure classification to steel in accordance with Table 6.5.2(c) AS2159-2009.

In accordance with Table 4.3 of AS3600-2009, an exposure classification of 'A2' apply for concrete members that are in contact with the ground.

A summary of the aggressivity test results on soil samples is presented in Table 8.

Table 8 Summary of aggressivity test results on soil samples

Borehole location	Sample depth (m)	Chloride (mg/kg)	Conductivity (uS/cm)	pH	Resistivity (ohm.cm)	Sulphate (as SO_4) (mg/kg)
BH102	0.5 to 1.0	<10	47	8.3	1100	12
BH106	0.4 to 0.7	30	40	7.7	1300	<10
BH110	0.4 to 0.6	15	64	7.2	780	<10
BH112	1.0 to 1.1	30	260	7.6	200	150
BH114	0.8 to 1.0	24	72	7.8	700	13
IP137	0.7 to 1.0	12	46	7.5	1100	<10
TP120	0.3 to 0.4	<10	150	8.5	330	43

9.2 Salinity and dispersion

The salinity classes for soil (Taylor, Dryland Salinity, DLWC 1996) for purposes of assessing soil salinity are as shown in Table 9 below.

Table 9 Soil Salinity Classes

Class	ECe (dS/cm)
Non-saline	<2
Slightly Saline	2-4
Moderately Saline	4-8
Very Saline	8-16
Highly Saline	>16

The results of the laboratory testing on the soil samples are presented against salinity classification in Table 10 below.

Table 10 Summary of soil salinity and pH test results on soil samples

Borehole location	Sample depth (m)	Soil Description	pH	Conductivity (dS/m)	Textural Factor F	Equivalent Conductivity ECe (dS/m)	Salinity Class
BH102	0.5 - 1.0	(CL) Clay	8.3	0.047	8.5	0.40	Non-saline
BH106	0.4 - 0.7	(CL) Clay / Sandy Clay	7.7	0.04	9	0.32	Non-saline
BH110	0.4 - 0.6	(SP) Gravelly Clayey Sand	7.2	0.064	10	0.64	Non-saline
BH112	1.0 - 1.1	(CL-CI) Sandy Clay / Clayey Sand	7.6	0.260	9	2.34	Slightly Saline
BH114	0.8 - 1.0	(CL-CI) Sandy Clay / Clayey Sand (Possibly extremely weathered sandstone)	7.8	0.072	9	0.65	Non-saline
IP137	0.7 - 1.0	(CL-CI) Sandy Clay	7.5	0.046	8	0.37	Non-saline
TP120	0.3 - 0.4	(CI) Sandy Clay	8.5	0.150	7	1.05	Non-saline

Notes: (CL) = Low Plasticity Sandy Clay
(CI) = Medium Plasticity Clay with Silt

The results indicate that all but one soil sample is classed as 'Non-saline'. Therefore, generally, the site soils are considered 'non-saline'.

Emerson Crumb dispersion testing returned Emerson Class Numbers (ECN) of between 2 and 3 (summarised in Table 7 above). ECN of 2 and 3 indicates dispersive soils. To minimise the risk of piping erosion of such materials, pavement subgrades and areas around drainage should be stabilised to minimise the soils potential for dispersion erosion. The most commonly used chemical treatment for dispersive soils is the exchange of sodium ions by calcium ions through the addition of calcium sulphate (gypsum) to stabilise the clay structure. The use of gypsum may also entail the need for a sulphate resistant cement for buried concrete and masonry, due to increased sulphate concentrations.

9.3 Site classification

We understand that new buildings will be constructed as part of the hospital upgrade development. The exact location of new building and their configuration is not known at the time of preparing this report. Future earthworks that will result in site regrading, placement of fill, and cuts may affect the site classification in accordance with Australian Standards AS2870-2011 *Residential Slabs and Footings*. Boreholes IP130, IP131, IP133 to IP136, IP141 to IP143, BH100, BH102, BH103, BH116 encountered fill to depths of 0.2m to 0.6m relative to the ground surface, overlying stiff to very stiff clay. The fill was noted to be variable in consistency and composition and is unlikely to have been placed and compacted under engineering control at least in some locations, therefore it would be considered as 'uncontrolled fill'. In accordance with AS2870-2011, a site classification of P will apply where 'uncontrolled' fill or other unsuitable materials are deeper than 400mm.

Based on laboratory testing results, the clay soils encountered beneath the topsoil/fill are of mainly low or low to medium plasticity (based on visual tactile assessment during the fieldwork investigation and confirmed by laboratory index testing). Such materials are expected to exhibit a low degree of shrink-swell movements. In addition, considering the shallow depth to bedrock, we expect that characteristic ground surface movements over the majority of the site would not exceed 40mm. Accordingly, a site classification of 'M' in accordance with AS2870-2011 'Residential Slabs and Footings' would apply for buildings founded in the natural undisturbed stiff clay soils. Site classification is generally only applicable to residential and commercial buildings up to two levels, therefore for this site, the classifications should only be used to indicate potential for soil reactivity for ground bearing slabs and shallow footings.

The site classification is based on the soil reactivity and depth of the underlying soils encountered. Some variations in bearing capacity and soil reactivity may occur on this site. Engineering assessment of footing excavations should be undertaken by the design engineer or geotechnical engineer at the time of construction to confirm that the ground conditions encountered are consistent with those encountered in the boreholes and test pits in this report.

Where natural clay soils occur, the site classification is based on soil reactivity and potential characteristic surface movement (Ys), as defined in Table 11.

Table 11 Classification by characteristic surface movement (Ys) as per AS2870-2011

Class	Foundation Material	Characteristic Surface Movement, Ys (mm)
A	Most sand and rock sites with little or no ground movement from moisture changes	–
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes	0 < Ys ≤ 20
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes	20 < Ys ≤ 40
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes	40 < Ys ≤ 60
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes	60 < Ys ≤ 75
E	Extremely reactive clay sites, which may experience extreme ground movement from moisture changes	Ys > 75

9.4 General site preparation and trafficability

No structural design drawings were available at the time of this report to inform earthworks design. Due to the presence of clay soils and clays with some of the fill materials in the upper 1 to 2 metres, and relatively gentle grades, surface water drainage over the site in its current condition will be relatively poor, therefore trafficability during construction is likely to be poor with potential for significant disturbance to the surface materials particularly if clays are exposed to moisture.

Allowance should be made for the placement of a working platform in construction vehicle access areas comprising a minimum of 300mm of crushed rock or approved recycled low plasticity or non-plastic material such as crushed concrete or quarry product for general site traffic. For heavy equipment such mobile cranes, it will be necessary to assess platform requirements once details of the particular plant are known.

Removal of the existing pavements and old building footings will be required during site preparation works. A number of trees occur across the site. Removal of trees including root affected soils during site preparation works will likely be required, and this may result in disturbance to the soils and changes to in situ moisture regimes particularly if exposed to rain or surface runoff. This will need to be considered in the preparation of the building platform and design of high level footings and also subgrades for carparks and accessways.

Roadbase materials should be separated during construction for possible reuse as a structural fill material.

Underground service trenches are likely to be encountered in a number of areas over the site within the proposed development footprint. Where disused sewer or drainage pipes are intersected during site excavations, they should be removed and the trenches backfilled in a 'controlled' manner.

Earthworks should be carried out in accordance with specific project specifications, or as a minimum in accordance with AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*.

9.5 Design Subgrade

Results of the geotechnical investigation identified that the near surface materials encountered in the boreholes comprised mainly low or low to medium plasticity clay. California Bearing Ratio (CBR) testing was carried out on nine samples of the residual clay. CBR values of between 3% to 12% was obtained. On that basis, for purposes of preliminary advice, a median design subgrade value of 6% may be considered, subject to further testing at a later stage to inform design once design subgrade levels (hence materials) are known. It is assumed that the upper 300 mm of the subgrade will be compacted to at least 100% of Standard Maximum Dry Density.

Should the final pavement surface levels be lower than the existing surface levels at the sampling locations then boxing of the pavement to the required depths below may intersect weathered rock materials in some areas. In this case, the pavement thickness may be reduced subject to assessment of the exposed subgrade and approval of the geotechnical engineer. Where intact rock is encountered at design subgrade levels, such rock may need to be over-excavated and re-compacted to eliminate any natural drainage features inherent in such materials.

9.6 Material reuse potential

It is anticipated that earthworks required for the site will typically be associated with site levelling, preparation of building platforms, foundation excavations, pavements, service installation and landscaping. There is a potential that site won materials may be re-used from cut to fill areas to minimise the costs associated with off-site disposal of materials and cost of sourcing imported materials. Topsoil should be stockpiled separately and may be reused for landscaping purposes subject to contamination status of such materials.

The soils at the site was determined to be non-saline, but exhibits dispersive characteristics. Therefore, gypsum stabilisation of site won soils in exposed areas and along drainage lines and in pavement subgrade adjacent to drainage lines, as discussed in Section 9.2, is recommended to minimise the soils potential for dispersion erosion.

Excavated materials from the site that may be suitable for re-use as structural fill will include the stiff residual clay soils, extremely to high weathered rock and less weathered rock, provided the maximum particle size is limited to 100 mm and rocky materials contain sufficient fines to allow compaction requirements to be readily achieved. Where coarser rock materials are excavated they may be re-used as structural fill provided the rock is processed by crushing to achieve a graded material with a maximum particle size of 100 mm. Structural fill should be placed and compacted in accordance with AS3798 to at least 98% of Standard Maximum Dry Density (SMDD) at a moisture content within +/- 2% of Standard Optimum Moisture Content in 200 mm compacted thickness layers. For the upper 300 mm of fill placed within accessways, carparks and under building floor slabs, structural fill should be compacted to 100% of SMDD. If fill is to be placed close to existing structures or sensitive services, then it should be placed without vibration unless otherwise advised by the geotechnical engineer.

9.7 Excavation conditions and earthworks

No structural plans for the proposed development have been provided at this stage. We anticipate that excavation depths will be in the order of 1.5m to maximum 2.0 m below existing surface levels. We assume that bulk excavations for the foundation excavation and deeper service trenches will be in clay soils. However, in view of the shallow depth to weathered rock over most of this site, particularly at current carpark area, rock excavation is expected.

The ease with which materials can be excavated on site has been assessed in accordance with Kirsten's "Classification for the excavation of natural materials" (1992), as shown in Table 12. It is understood that the proposed new hospital building will have some deeper excavations of up to 2.5 m to 3 m below existing surface level for basement construction.

The topsoil, fill, residual soil and extremely weathered materials are expected to be Class 2 or 3 materials and should be readily excavated by backhoe or small excavator (>5 t), while the highly weathered rock is expected to be Class 4 to 5. Our experience indicates that Class 5 materials can be excavated with a 25 to 30 tonne excavator with a rock hammer or ripped with a D7 to D8 dozer.

In view of the relatively shallow depth to weathered rock over most of this site, rock excavation may be a significant constraint within the proposed building footprint on this site. Rock excavations within trenching for drainage lines services will also be difficult where high or very high strength rock is encountered. Accordingly, we recommend that wherever possible, excavation depths be limited to reduce the potential for excavation cost.

High to very high strength rock will generally require extremely hard ripping or blasting. However we note that blasting will not be permitted at this site. Accordingly, methods of excavation for the high to very high strength rock (if encountered) will typically include use of rock saws and large excavators (30 t to 50 t) with hydraulic rock hammers.

Table 12 Kirsten's eight point excavation classification system

Class	Material type	Description of excavatability
1	Soil	Hand spade (Dozer D3)
2		Hand pick and spade
3		Power tools
4	Rock	Easy ripping (Dozer D7)
5		Hard ripping (Dozer D8)
6		Very hard ripping (Dozer D9)
7		Extremely hard ripping / blasting (Dozer D10)
8		Blasting

9.7.1 Excavation support requirements

No design drawings for the building or civil works were available at the time of this report. Based on the available information for proposed building footprint, it is estimated that the lower floor level of the excavation for the building will be less than 1.5m to 2m below current ground level. Sandy clay residual soil in proposed building area and roadbase in proposed carpark area are likely to be encountered. Sandstone of varying degrees of weathering and strength will be encountered beneath the residual soils. Where local battering of excavation cuts for the building is considered feasible, preliminary batter slopes for unsupported temporary and permanent cuts are provided in the sections below to facilitate estimation of construction costs.

9.7.2 Unsupported cuts

Unsupported temporary cuts in very stiff soils and extremely to highly weathered sandstone within building areas that are less than 1.5m deep should be battered to slopes no steeper than 1.5H: 1V. Permanent cut batters in extremely to highly weathered sandstone that are less than 1.5m deep should not be steeper than 2.5H: 1V or should be structurally retained. Excavations deeper than 1.5m should be structurally retained. The above batter or retaining wall recommendations assume:

- The ground surface is horizontal beyond the crest of the excavation;
- The slopes are well drained with no runoff concentrated behind the crest or behind the retaining walls;
- No surcharge loads (such as low rise buildings with shallow footings) are located within a horizontal distance of the cut crest equal to the vertical height of the cut.

Unsupported temporary cuts in the highly to moderately weathered rock should be battered to a slope not steeper than 1H: 1V. Permanent unsupported cut batters in highly to moderately weathered sandstone should not be steeper than 1.5H:1V.

Excavations for the new building may be close to existing buildings, roadways and infrastructure such as buried services or pipes. In such instances, a retention system will be required to support exposed soils and the very low to low strength rock in the upper part of the excavation. Depending on excavation depth and extent of materials requiring support, the retention system would likely include gravity walls, or cantilevered type retaining structures.

9.7.3 Retaining structures

Where there is insufficient space to batter excavation cuts as discussed above, permanent structural support will be required.

Bored soldier piles with mesh and shotcrete infill panels or contiguous bored piles may be considered for support of the basement excavation if excavations are too close to other structures. The clear spacing between soldier piles with mesh and shotcrete infill panels should not exceed 1 m at this site.

Structural design of retaining structures must be sufficient to limit lateral ground movement in the soil and rock at this site. A triangular pressure distribution could be adopted for the design of shoring and permanent retaining walls, which cantilever or where pile head movement is limited in the lateral direction by a single point restraint.

Earth pressures on the active side of the wall may be calculated using the following equation:

$p_a = K (p_s + \gamma_b.z)$

where:

p_a = Lateral earth pressure on the active side of the wall (kPa)

K = Earth pressure coefficient which depends upon material type; whether movement needs to be limited; whether temporary or permanent.

p_s = Design surcharge pressure (kPa)

z = depth below top of excavation (m)

γ_b =Bulk unit weight (kN/m^3)

The following table provides design values for the following cases:

- Case 1 = temporary retention; no adjacent footings
- Case 2 = permanent retention; no adjacent footings
- Case 3 = adjacent footings and hence need to limit movement.

Design parameters for the structurally retained cuts are provided in Table 13.

Table 13. Geotechnical design parameters for structurally retained cuts

Material	Lateral Earth Pressure Coefficient, K			Passive Pressure Coefficient, Kp	Bulk Unit Weight, γ_b (kN/m^3)
	Case 1	Case 2	Case 3	All cases	All cases
Stiff to very stiff clay and extremely weathered material	0.2	0.35	0.5	2.5	20

The assumed lateral pressure distributions may need to be modified to account for material layering, surcharge loads due to the ground level not being horizontal, any concentrated pad or strip footing loadings, or hydrostatic pressure due to build-up of water behind the wall.

9.8 Potential ground settlements

In general, the site is underlain by fill of variable depths, overlying stiff to very stiff Residual soil. As the existing fill materials include zones of firm to stiff materials that may consolidate with time, settlement of the fill, if left in place, may be expected. For the current ground conditions, settlements in the order of 20mm to 40mm in the deeper fill areas could occur under self-weight. If additional fill is added we would settlement to increase. Due to the unknown history of fill placement and compaction, shallow footings founded within the fill are not recommended.

Services within the fill or any soft or loose soils and pavements around the building may be affected by long term settlement and this should be considered in the design. Service conduits or pipes that are sensitive to differential movement should be designed to allow for some differential settlement where entering buildings using suitable flexible joints or other measures advised by the building services designers.

9.9 Building foundations

The type of footings adopted for the building will be dependent on the depth of the basement excavation and design loads. Based on the anticipated excavation depths, an appropriate footing system for the building may comprise pad and strip footings terminated uniformly in the

moderately to slightly weathered sandstone (ranging from Class II to Class IV sandstone, Pells et al, 1998). A raft foundation system with beam and pad thickenings would also be suitable, founded in the extremely weathered sandstone of uniform bearing capacity. As the base of excavation floor will occur at various depths of penetration into the weathered rock, the bearing capacity will vary depending on the class of rock exposed. For high level shallow footings founded in extremely weathered sandstone (those that can exhibit residual clay properties), a conservative serviceability end bearing pressure of 500kPa is recommended given that clay zones and bands are expected to be present. Where low strength sandstone bedrock is encountered at founding levels of footings, a serviceability end bearing pressure of 1000Kpa may be adopted.

Should higher bearing capacities are required, deep foundations may be considered. Preliminary design parameters for pile design are presented in Table 14.

Table 14. Geotechnical foundation design parameters for pile design

Unit	γ_b (kN/m^3)	f_b (MPa)	f_s (MPa)	E_{sv} (MPa)	E_{sh} (MPa)	p_y (MPa)
Residual soil	19	1.5 to 2.0	–	30 to 50	22.5 to 37.5	–
Class V	20	1 to 3	1	40 to 80	30 to 60	–
Class IV	21	3 to 12	3	100 to 400	75 to 300	1.5
Class III	22	20 to 40	5	280 to 800	210 to 600	3
Class II	22	40 to 80	10	800 to 1600	600 to 1200	10

Where:

γb – Bulk unit weight

fb - Ultimate end bearing capacity for the layer at the tip of the pile

fs - Ultimate skin friction

Esh - Young's modulus for lateral response

Esv - Young's modulus for axial response

Py - Ultimate lateral yield pressure

The parameters provided in Table 14 are the indicative ultimate limit state geotechnical design parameters that can be adopted for a non-displacement pile foundation design. For the design of piles, a limit state method must be adopted to comply with the piling code AS2159-2009.

All footing excavations should be assessed by an experienced geotechnical engineer prior to placement of reinforcement or concrete.

9.10 Dilapidation surveys and vibration monitoring

Generally, the excavation of proposed development will be in close proximity to existing roads, buried services and existing buildings. Therefore, we recommend that a dilapidation survey be carried out on each of the adjacent structures to assess the condition of the structures prior to and after excavation and building works.

Service providers for any sensitive buried services should also be contacted to assess the likely effects on their services prior to excavations commencing. The structural engineer undertaking the dilapidation survey should carefully consider the potential for adverse impacts on the adjacent structures due to site works. If equipment which generates significant vibrations (e.g. hydraulic rock hammers or vibratory roller) is to be used, vibration monitoring close to adjacent structures may be required to confirm that vibration levels are within tolerable limits.

9.11 Subsoil drainage and pavement maintenance

The subsoil drains should be located along the outside edge of the pavement shoulders and be in good contact with the pavement subbase, and any granular select subgrade where required. The collected water must be drained to suitable outlets in the stormwater collection system.

The subsoil drains along access roads or around perimeters of carparks that are separate to stormwater drains should be 400 mm wide and extend at least 200 mm below the underside of the pavement subgrade or any granular select subgrade layer.

Given the dispersive characteristics of the soils at the site, design of drainage to address potential for dispersive erosion should be considered.

The subsoil drains should comprise a 100mm slotted PVC pipe (Ag Pipe) surrounded by 20mm clean aggregate and the entire drain should be wrapped in a geotextile fabric (for example Bidim A24 or equivalent). All subsoil drains should fall at a minimum 2% grade to dedicated drainage pits.

Surface maintenance of the pavement asphalt wearing course should be periodically carried out and surface and subsoil drainage should be adequately constructed and maintained over the full design life. This would include localised infilling of minor surface cracks in the wearing course with emulsion routinely applied as part of normal pavement maintenance measures.

Based on our site observation, site is covered by small to medium size and a number of large size trees. Consideration should be given to the possible adverse effects of tree roots on the pavement should trees be located within one tree height from the pavement. Trees and other vegetation should be excluded from pavement verge areas or traffic islands if their roots are assessed as likely to enter subgrade areas beneath the road during the design life of the pavement.

Appendices

Appendix A – Figures

Paper Size ISO A4

0 20 40 60 80

Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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GHD

Health Infrastructure
Griffith Hospital Redevelopment
Geotechnical Investigation and Contamination Assessment

Project No. **21-27721**
Revision No. **A**
Date **14 Nov 2018**

Investigation Location Plan

FIGURE 1

Data source: General topo - NSW LPI DTDB 2012. Cadastre - NSW LPI DCDB 2012. Aerial imagery - Nearmap (Image date: 30 Sept 2018, Extraction date: 16 Oct 2018).
Existing borehole locations - JK Geotechnics, 2017 (Borehole Location Plan Report No. 30991L, Fig. No. 2) . Created by: kqvelasco

Appendix B – General notes

GENERAL NOTES

GHD GEOTECHNICS
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The report contains the results of a geotechnical investigation or study conducted for a specific purpose and client. The results may not be used or relied on by other parties, or used for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the report are excluded unless they are expressly stated to apply in the report.

TEST HOLE LOGGING

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information. Moreover, the location of test holes should be considered approximate, unless noted otherwise (refer report). Reference should also be made to the relevant standard sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc.).

GROUNDWATER

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeabilities (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

INTERPRETATION OF RESULTS

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data, often with only approximate locations (e.g. GPS). Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in ground conditions do occur in the natural environment, particularly between discrete test hole locations or available observation sites. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural processes.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to this firm for appropriate assessment and comment.

GEOTECHNICAL VERIFICATION

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system and/or to conduct monitoring as a result of this natural variability. Allowance for verification by appropriate geotechnical personnel must be recognised and programmed for construction.

FOUNDATIONS

Where referred to in the report, the soil or rock quality, or the recommended depth of any foundation (piles, caissons, footings etc.) is an engineering estimate. The estimate is influenced, and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions must include at least all of the relevant test hole and test data, together with the appropriate Standard Description sheets and remarks made in the written report of a factual or descriptive nature.

Ref: DS5.5.1 Issue 1.8 Date: 5/10/2012

GLOSSARY OF SYMBOLS

GHD GEOTECHNICS
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This standard sheet should be read in conjunction with all test hole log sheets and any idealised geological sections prepared for the investigation report.

GENERAL

Symbol	Description	Symbol	Description
D	Disturbed Sample	PZ	Piezometer Installation
U	Undisturbed Sampled (suffixed by sample size or tube diameter in mm if applicable)	R	Rising Head Permeability Test
		F	Falling Head Permeability Test
C	Core Sample (suffixed by diameter in mm)	PBT	Plate Bearing Test
SV	Shear Vane Test (suffixed by value in kPa)	▸—	Water Inflow (make)
SPT	Standard Penetration Test (with blows per 0.15m)	—◂	Water Outflow (loss)
N	SPT Value	▽	Temporary Water Level
HB	SPT hammer bouncing	▼	Final Water Level
PM	Pressuremeter Test	●	Point Load Test (axial)
PP	Pocket Penetrometer (suffixed by value in kPa)	○	Point Load Test (diametric)
PK	Packer Test	IMP	Impression Device Test

SOIL SYMBOLS

Main Components

SAND | CLAY | SILT
GRAVEL | FILL | TOPSOIL

Minor Components

sandy | clayey | silty
gravelly | vegetation, roots

Note: Natural soils are generally a combination of constituents, e.g. sandy CLAY

ROCK SYMBOLS

Sedimentary

SANDSTONE | SHALE
CLAYSTONE | CONGLOMERATE
SILTSTONE | COAL

Igneous

GRANITIC ROCK
IGNEOUS DYKE
BASALTIC ROCK

Note: Additional rock symbols may be allocated for a particular project.

NATURAL FRACTURES (Coding)

Fracture Type

JT	Joint
BP	Bedding Plane
Cb	Cross Bed
SS	Sheared Surface
SM	Seam
CS	Crushed Seam
FZ	Fragmented Zone
SZ	Shear Zone
VN	Vein

Orientation

For vertical non-oriented core ... "Dip" angle (eg. 5°) measured relative to horizontal
For inclined non-oriented core ... "Angle" measured relative to core axis.
For inclined oriented core ... "Dip" angle and "Dip Direction" angle (eg. 45°/225° mag.)

VT	Vertical
HZ or 0°	Horizontal
d	degrees

Infilling or Coating

CN	Clean
X	Carbonaceous
CLAY	Clay
KT	Chlorite
CA	Calcite
FE	Iron Oxide
MI	Micaceous
Mn	Manganese
Py	Pyrite
QZ	Quartz
VE	Veneer

Shape

PLN	Planar
CU	Curved
UN	Undulating
ST	Stepped
IR	Irregular

Roughness

POL	Polished
SLK	Slickensided
SO	Smooth
RF	Rough
VR	Very Rough

Others

DIS	Discontinuous
OP	Open
CL	Closed
TI	Tight

Ref: DS6.5.1 Issue 1.7 Date: 20/09/2010

SOIL DESCRIPTION

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This procedure involves the description of a soil in terms of its visual and tactile properties, and relates to both laboratory samples and field exposures as applicable. A detailed soil profile description, in association with local geology and experience, will facilitate the initial (and often complete) site assessment for engineering purposes.

The method involves an evaluation of each of the items listed below and is in general agreement with both Australian Standard AS 1726 (the Site Investigation Code) and ASTM D2487 and D2488.

MOISTURE

The moisture condition of the soil is most applicable for cohesive soils as a precursor to the assessment of consistency and workability. The moisture condition is described as:-

Dry (dusty, dry to the touch) ***Slightly Moist*** ***Moist*** (damp, no visible water) ***Very Moist*** or ***Wet*** (visible free water, saturated condition)

In addition, the presence of any seepage or free water is noted on the testhole logs.

COLOUR

Colour is important for correlation of data between testholes and during subsequent excavation operations. The prominent colour is noted, followed by (spotted, mottled, streaked etc.) then secondary colours as applicable. Colour is usually described at as-received moisture condition, though both wet and dry colours may also be appropriate.

CONSISTENCY / DENSITY INDEX

This assessment is based on the effort required to penetrate and/or mould the soil, and is an indicator of shear strength.

Granular soils are generally described in terms of density index as listed in AS 1726. These soils are inherently difficult to assess and normally a penetration test procedure (SPT, DCP or CPT) is used in conjunction with published correlations. Alternatively, in-situ density tests can be conducted in association with minimum and maximum densities performed in the laboratory.

Term	Symbol	Density Index (%)
Very Loose	VL	< 15
Loose	L	15 - 35
Medium Dense	MD	35 - 65
Dense	D	65 - 85
Very Dense	VD	>85

Cohesive soils can be assessed by direct measurement (shear vane, CPT etc), or estimated approximately by tactile means and/or the aid of a geological pick as given on the following table. It is emphasised that a "design shear strength" must take cognisance of the mode of testing and the in-situ moisture content with the possible variations of moisture with time.

Term	Symbol	Tactile Properties	Undrained Strength S_u (kPa)
Very Soft	VS	Extrudes between fingers when squeezed in hand	<12
Soft	S	Easily penetrated by thumb about 30-40 mm. Pick head can be pushed in up to shaft.	12-25
Firm	F	Penetrated by thumb 20-30mm with moderate effort. Sharp end of pick pushed in 30-40mm.	25-50
Stiff	St	Indented by thumb about 5mm with moderate effort. Pick pushed in up to 10mm.	50-100
Very Stiff	VSt	Readily indented by thumb nail. Slight indentation produced by pushing pick into soil.	100-200
Hard	H	Difficult to indent with thumb nail. Requires power tools for excavation.	>200

STRUCTURE/OTHER FEATURES

The soil structure is generally applicable to cohesive soils and mainly refers to the presence or absence of joints and layering. Typical terms use are intact (no joints), fissured (closed joints), shattered (open joints), slickensided (polished joints indicative of movement), and stratified/laminated. In addition, the presence of other features (ferricrete nodules, timber inclusions) should also be noted as applicable.

For granular soils, an assessment of grading (well, uniform or poor), particle size (fine, medium etc.) and angularity and shape may also be given.

SOIL TYPE

The soil is described in terms of its estimated grain size composition and the tactile behaviour (plasticity of any fines (less than *0.06 mm)). This system does not differentiate on grading below 0.06 mm, in accordance with the Unified Soil Classification (USC) procedure.

However, in some situations a soil can exhibit different characteristics between the undisturbed and disturbed/remolded condition (eg. 'sand' sized particles which break down a clay). The Soil Type generally relates to the latter state but the former condition should be noted where applicable.

Furthermore, as most natural soils frequently are combinations of various constituents, the primary soil is described and modified by minor components. In brief, the system is as follows:-

Coarse Grained Soils		Fine Grained Soils	
% Fines	Modifier	% Coarse	Modifier
<5	omit, or use "trace"	<15	omit, or use "trace"
5-12	describe as "with clay/silt" as applicable	15-30	described as "with sand/gravel" as applicable
>12	prefix soil as "silty/clayey" as applicable	>30	prefix soil as "sandy/gravelly" as applicable

(*The 200# sieve (0.075 mm) is commonly used in practice to differentiate between fine and coarse grained soils).

Note: For soils containing both sand and gravel the minor coarse fraction is omitted if less than 15%, or described as "with sand/gravel" as applicable when greater than 15%.

The appropriate USC symbol may also be given after the soil type description in accordance with ASTM D2487 and D2488.

ORIGIN

An attempt is made, where possible, to assess origin (transported, residual, pedogenic, or fill etc.) since this assists in the judgement of probable engineering behaviour. This assessment is generally restricted to field logging activities. An interpretation of landform is a useful guide to the origin of transported soils (e.g. colluvium, talus, slide debris, slope wash, alluvium, lacustrine, estuarine, aeolian and littoral deposits) while local geology and remnant fabric will assist identification of residual soils.

Ref: DS6.5.1.1 Issue 1.7 Date: 13/03/2012

ROCK DESCRIPTION

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This method is based on Australian Standard AS 1726 and is orientated to the field logging of diamond drill core, but may be used for the profiling of natural exposures and cuttings, as applicable. The procedure involves a visual and tactile assessment of the rock mass and the nature of defects within it in order to facilitate a prediction of engineering behaviour.

DESCRIPTION: Rock Type is described on the basis of origin (sedimentary, metamorphic and igneous) with the common types listed below:-

Sedimentary				Metamorphic	Igneous				
Clastic	**Non clastic (chemical)**	**Non clastic (organic)**	**Pyroclastic**			**Acid**	**Intermediate**		**Basic**
Conglomerate Sandstone Siltstone Shale Claystone	Limestone Chert Gypsum Salt	Coal Some Limestone	Tuff Agglomerate Volcanic Breccia	Slate Phyllite Schist Quartzite Gneiss	Extrusive	Rhyolite	Trachyte	Andesite	Basalt
					Intrusive (medium grained)	Quartz Porphyry	Porphyry	Porphyrite	Dolerite
					(coarse grained)	Granite	Syenite	Diorite	Gabbro

Colour is given to assist in rock identification and the interpolation of field data. Colour is usually described at as-received moisture condition, though both wet and dry colours may also be appropriate.

Texture refers to the degree of crystallinity and granularity (grain size) and the fabric relationship between the constituents of a rock. Often only grain size is given for simplified descriptions of certain sedimentary rocks.

Structure and texture are commonly used synonymously in describing rocks since there is no clear delineation between terms. In general, structure refers to large-scale features recognisable in the field (banding, lineation, massive, porphyritic, schistose etc.). For sedimentary rocks in particular, the thickness of sedimentary layering (bedding) is described as:-

Thinly laminated	<6mm	very thinly bedded	20-60mm	medium bedded	0.2-0.6m	very thickly bedded	>2m
Laminated	6-20mm	thinly bedded	60-200mm	thickly bedded	0.6-2m		

In addition, mineral composition, hardness, alteration, cementation is given as applicable.

WEATHERING: The assignment of weathering is somewhat subjective. Weathering assists identification and does not imply engineering behaviour. No distinction is drawn between chemical weathering and alteration for most engineering purposes. These procedures are collectively described as "weathering" using the following terms which do not describe the related strength change. This system is general, and in this format may not apply to all rock types. Carbonate rocks generally do not conform to this classification.

Term	Symbol	Definition
Completely Weathered	CW	Residual soil with rock fabric not visible.
Extremely Weathered	EW	The rock exhibits soil-like properties though the texture of the original rock is still evident.
Highly Weathered	HW	Limonite staining or colour change affects the whole of the rock mass and other signs of chemical or physical decomposition are evident.
Moderately Weathered	MW	Staining extends throughout the whole of the rock mass and the original colour is no longer recognisable.
Slightly Weathered	SW	Partial staining or discolouration of the rock mass, usually by limonite, has taken place.
Fresh	Fr	Rock mass unaffected by weathering.

ESTIMATED STRENGTH: This refers to the strength of the rock substance and not that of the rock mass. The strength of the rock substance is estimated by the Point Load Strength Index $I_S(50)$ and refers to the strength measured in the direction normal to the bedding for sedimentary rocks. A field guide is given below:-

Term	Symbol	$I_S(50)$ MPa	Field Guide (The core refers to a 150mm long x 50mm dia. sample)
Extremely Low	EL	<0.03	Remoulded by hand to a material with soil properties.
Very Low	VL	0.03-0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low	L	0.1-0.3	The core may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium	M	0.3-1.0	The core may be broken by hand with considerable difficulty. Readily scored with knife.
High	H	1-3	The core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
Very High	VH	3-10	The core may be broken readily with hand held hammer. Cannot be scratched with knife.
Extremely High	EH	>10	The core is difficult to break with hand held hammer. Rings when struck with a hammer.

DEFECTS: This important feature can control the overall engineering behaviour of a rock mass. All types of natural fractures across which the core is discontinuous are noted. These fractures include bedding plane partings, joints and other defects but exclude artificial fractures such as drilling breaks. The nature of the defects (joints, bedding partings, seams, zones and veins) is also noted with description, orientation, infilling or coating, shape, roughness, thickness, etc. given generally in accordance with AS 1726. The spacing of natural fractures excludes bedding partings unless there is evidence that they were separated prior to drilling. This notwithstanding, bedding partings maybe considered as planes of weakness in an engineering assessment.

Ref: DS6.5.2.1 Issue 1.7 Date: 13/03/2012

CORE LOG SHEET NOTES

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The intention of Core Log Sheets is to present factual information measured from the core or as recorded in the field. Some interpretative information is inevitable in the location of core loss, description of weathering and identification of drilling induced fractures. This should be noted in the use of Core Log Sheets and remembered in their utilisation.

DRILLING AND CASING

The types of drilling used to advance the drill hole are recorded for relevant intervals. The types of drilling may include: NMLC coring, NQTT (NQ triple tube wire line), HW, HX, NW and NX casing, wash boring (tri-cone roller bit, TC drag bit, TC blade bit), or auger drilling (V-bit, TC drag bit).

The relevant progress is shown by abbreviated dates in the column.

WATER

Water lost or water made during drilling is recorded and subsequent readings of water levels in the borehole or piezometers are recorded here with dates of observation.

DRILL DEPTH AND CORE LOSS

Drilling intervals are shown by depth increments and horizontal marker lines. Core loss is measured as a percentage of the drill run. If the location of the core loss is known or strongly suspected, it is shown in a region of the column bounded by dashed horizontal lines. If unknown, core loss is assigned to the bottom of a coring run.

SAMPLES AND FIELD TESTS

The location of samples taken for testing or the location of field tests are indicated by the appropriate symbol from the GLOSSARY OF SYMBOLS Standard Sheet (or as applicable for the project) and are shown at the relevant location or over the relevant depth interval.

DEPTH (RL)

Changes in rock types or the locations of piezometer tips, samples, test intervals or other depths are shown as appropriate in terms of depth from the hole collar or in terms of RL.

For inclined holes the depths shown on the log refer to the drilled length along the borehole. The RL, where used, is the only transformed reference to true vertical depth.

STRATA

Rock types are presented graphically using the symbols shown on the GLOSSARY OF SYMBOLS Standard Sheet or as assigned for the project.

DESCRIPTION

The rock type is described in accordance with the ROCK DESCRIPTION Standard Sheet.

WEATHERING

Weathering is described, by code letters, in accordance with the ROCK DESCRIPTION Standard Sheet. A weathering term or range of terms is usually assigned to various strata.

It is noted, however, that the assignment of a term of weathering is subjective and is normally used for identification and does not imply engineering behaviour (such behaviour being controlled principally by rock substances strength and defect frequency - collectively, rock mass strength). Consequently, boundaries are often not shown and weathering may even not be reported where potentially misleading.

ESTIMATED STRENGTH

The strength of the rock substance is estimated by a combination of Point Load testing and tactile appraisal in accordance with the ROCK DESCRIPTION Standard Sheet. The estimated strength is presented in a histogram form. Both axial and diametric point load test results can be presented using the symbols on the GLOSSARY OF SYMBOLS Standard Sheet and the variation between axial and diametric values is indicative of anisotropy or fissility of the rock unit.

NATURAL FRACTURES

The identification of natural fractures requires an endeavour to exclude drilling induced breaks in the core and, as such, can be somewhat subjective. Natural fractures exist prior to coring the rock, whereas artificial fractures occur either during coring, during placing core in the core boxes, or during examination or transportation, or core after being boxed.

The log of Natural Fractures is presented as a combination of Fracture Spacing, Visual and Description columns. Coding is presented on the GLOSSARY OF SYMBOLS Standard Sheet.

ROCK QUALITY DESIGNATION (RQD) INDEX OPTION

The Core Log Sheet has an optional field column to record the RQD index. For certain projects, such as tunnelling or underground mining investigations, rock mass ratings or classifications can be required as part of the design process. The Rock Quality Designation (RQD) Index forms a component of these rock mass ratings and provides a quantitative estimate of rock mass quality from rock core logs. The core must be a minimum of 54.7mm diameter (although NMLC-sized core is probably OK) for derivation of an RQD index.

The RQD index is expressed as a percentage of intact rock core (excludes extremely weathered rock/residual soil) greater than 100 mm in length over the total selected core length. The total selected core length should be based on identifiable engineering geological domain characteristics. Should this not be practicable, RQD can be measured on a per run basis.

Ref: DS6.2.1 Issue 1.6 Date: 13/03/2012

DYNAMIC CONE PENETROMETER (DCP) TESTING

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SCOPE

The Dynamic Cone Penetrometer (DCP) test comprises the measurement of the soil resistance to a steel rod driven into the ground by a dropped weight.

The DCP test is a simple manual test used in both sandy and clayey soils. The test is a measure of the shear strength of the soil at relatively shallow depth.

EQUIPMENT AND METHOD

A general description of the dynamic penetrometer apparatus used by our firm is presented in Australian Standard AS 1289.6.3.2. The equipment utilises a 9kg sliding weight with a drop height of 510mm. It is fitted with a conical tip. The equipment can be adjusted for a fall of 600mm and use of a blunt tip in accordance with AS 1289.6.3.3.

The test data are generally recorded as the number of blows (n) per 50mm of penetration. The test data are processed by our in-house computer software. For specific applications (such as pavement investigations), the data may be collected in the reverse form, i.e. as mm per blow. The results are presented either in tabular or graphic form for reporting purposes.

INTERPRETATION

The interpretation of the DCP results is generally based on the assumption that the measured resistance is a function of soil strength. A profile of soil strength (cohesive soils) or density index (cohesionless soils) can thus be established. The test often can be used to qualitatively indicate the presence of soft or loose zones within a soil profile.

The energy of the system per unit area is similar to that of an SPT approach. Thus, the common relationships of SPT and other parameters (say Dutch cone) can be utilised as a means of estimating soil properties, after appropriate site specific correlation. The interpretations from the test are approximate only, and this is particularly pertinent to sand profiles where the magnitude of confinement stress is important in the assessment of the results.

Interpretation of the DCP penetration rate at depth (up to 5m) must be conducted with due regard to side friction effects. In particular, care must be exercised with soft clay profiles where shaft resistance may have a significant unconservative impact upon the results.

In-situ California Bearing Ratio (CBR) values of clay soil subgrades are sometimes interpreted directly from DCP test results for use in road pavement design. In this case, the correlation between DCP and CBR based on that published in AUSTROADS Pavement Design Manual (1992) may be applied. This correlation should be verified by site specific laboratory testing, where appropriate. In addition, the effects of moisture content variations (in-situ verses design conditions) must be considered, as clearly the DCP test only reflects the shear strength of the soil at the time of testing.

Ref: DS5.4.3 Issue 1.3 Date: 04/06/2008

LABORATORY TESTING

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GENERAL

Samples extracted during the fieldwork stage of a site investigation may be "disturbed" or "undisturbed" (as generally indicated on the trial hole logs) depending upon the nature and purpose of the sample as well as the method of extraction, transportation, extrusion and testing. This aspect should be taken into account when assessing test results, which must of necessity reflect the effects of such disturbance.

All soil properties (as measured by laboratory testing) exhibit inherent variability and thus a certain statistical number of tests is required in order to predict an average property with any degree of confidence. The site variability of soil strata, future changes in moisture and other conditions and the discrete sampling positions must also be considered when assessing the representative nature of the laboratory programme.

Certain laboratory test results provide interpreted soil properties as derived by conventional mathematical procedures. The applicability of such properties to engineering design must be assessed with due regard to the site, sample condition, procedure and project in hand.

TESTING

Laboratory testing is normally carried out in accordance with Australian Standard AS 1289 as amended, or RTA Standards when specified. The routine Australian Standard tests are as follows:-

Moisture Content	AS1289 2.1.1	
Liquid Limit	AS1289 3.1.1)	
Plastic Limit	AS1289 3.2.1)	collectively known as Atterberg Limits
Plasticity Index	AS1289 3.3.1)	
Linear Shrinkage	AS1289 3.4.1	
Particle Density	AS1289 3.5.1	
Particle Size Distribution	AS1289 3.6.1, 3.6.2 and 3.6.3	
Emerson Class Number	AS1289 3.8.1)	
Percent Dispersion	AS1289 3.8.2)	collectively, Dispersive Classification
Pinhole Dispersion Classification	AS1289 3.8.3)	
Hole Erosion (HE)	GHD Method	
No Erosion Filter (NEF)	GHD Method	
Organic Matter	AS1289 4.1.1	
Sulphate Content	AS1289 4.2.1	
pH Value	AS1289 4.3.1	
Resistivity	AS1289 4.4.1	
Standard Compaction	AS1289 5.1.1	
Modified Compaction	AS1289 5.2.1	
Dry Density Ratio	AS1289 5.4.1	
Minimum Density	AS1289 5.5.1	
Density Index	AS1289 5.6.1	
California Bearing Ratio	AS1289 6.1.1 and 6.1.2	
Shear Box	AS1289 6.2.2	
Undrained Triaxial Shear	AS1289 6.4.1 and 6.4.2	
One Dimensional Consolidation	AS1289 6.6.1	
Permeability Testing	AS1289 6.7.1, 6.7.2 and 6.7.3	

Where tests are used which are not covered by appropriate standard procedures, details are given in the report.

LABORATORY

Our laboratory is NATA accredited to AS ISO / IEC17025 for the listed tests.

The oedometer, triaxial and shear box equipment are fully automated for continuous operation using computer controlled data acquisition, processing and plotting systems.

Ref: DS5.5.2 Issue 1.6 Date: 04/06/2008

Appendix C – Engineering logs of boreholes and test pits with DCP and PID results and accompanying soil and rock description

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH100

SHEET 1 **OF** 1

Position: 411995.0 E 6206267.0 N MGA94/ Z55 **Surface RL:** 140.50m AHD **Processed:** MAG

Method of Exploration: 5t Excavator **Hole Size:** 1.6m x 0.3m **Checked:** ML

Date: 02/11/18 **Logged by:** MB **Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
		Enviro	0.15			Fill: Gravelly SAND, grey dark mottled, fine to coarse grained, fine to coarse, angular to sub-angular gravel, trace low plasticity clay.	SM	L-MD		3	ROADBASE PID: 1.4
			0.25				SM	L		3	
		Enviro			CI	Fill: SAND, dark grey, fine to coarse grained, with fine to coarse, sub-rounded gravel.	SM	St		2	Fill
						Sandy CLAY, brown, medium plasticity, fine to medium grained sand, trace of rootlets (residual).				3	Residual PID: 2.0
		Enviro B								4	PID: 2.5
										3	
										5	
										7	
										8	
1	Groundwater Not Encountered		1.00		CI	Sandy CLAY/ Clayey SAND, pale brown, medium plasticity, fine to coarse grained sand, trace of fine to coarse sub-angular to sub-rounded gravel, trace of rootlets, trace of tree root (10-15mm) (residual).	D	VSt-H		18	Residual
										22	
										23	
										25	
											EW
			1.50								
			1.60		SP/ CL-CI	Clayey SAND/ Sandy CLAY, pale brown, fine to coarse grained sand, low to medium plasticity clay, with fine to coarse, sub-angular to angular gravel (possibly extremely weathered sandstone).	D	D			EW-HW slow progress
						End of Test pit at 1.6 metres. Target Depth.					
2											
3											

Note: * indicates signatures on original issue of log or last revision of log

See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-27721

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH101

SHEET 1 **OF** 1

Position: 412047.0 E 6206291.0 N MGA94/ Z55	**Surface RL:** 141.00m AHD	**Processed:** MAG
Method of Exploration: 5t Excavator	**Hole Size:** 1.6m x 0.3m	**Checked:** ML
Date: 02/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
1	Groundwater Not Encountered	Enviro	0.15		CL-CI	TOPSOIL: Silty Sandy CLAY, brown, low plasticity, fine to medium grained sand, with rootlets, trace gravel.	SM	F		3	Topsoil PID: 2.1
						Clayey SAND/ Sandy CLAY, brown-red, fine to coarse grained sand, low to medium plasticity, with rootlets, trace tree roots (10mm) (residual).	SM	VL-L		3	Residual
		Enviro								1	PID: 1.7
										1	
										0	
										1	
										2	
			0.75		CI-CH	Sandy CLAY, red, brown, medium to high plasticity, fine to medium grained sand, trace of rootlets (residual).	SM	St-VSt		6	Residual PID: 1.8
		Enviro								19	
										26	
			1.10		CI-CH	Sandy CLAY, red-brown, medium to high plasticity, fine to medium grained sand, trace rootlets, fine to coarse, sub-angular gravel, iron staining, trace of highly weathered sandstone (extremely weathered sandstone).	SM	VSt-H		23	Residual / EW
										26	
			1.60								HW - MW rock
2						End of Test pit at 1.6 metres. Target Depth.					
3											

Note: * indicates signatures on original issue of log or last revision of log

See standard sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH102

SHEET 1 OF 3

Position : 411958.0 E 6206198.0 N MGA94/ Z55 **Surface RL:** 140.00m AHD **Angle from Horiz. :** 90° **Processed :** MAG
Rig Type : Hanjin DB **Mounting:** Track **Contractor :** BG Drilling **Driller :** Sean **Checked :** ML
Date Started : 31/10/2018 **Date Completed :** 31/10/2018 **Logged by :** MB **Date:** 06/12/2018

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations
								FILL / TOPSOIL: Silty CLAY, brown, medium plasticity, trace of fine grained sand, with rootlets.	M	F	Topsoil / Fill PID: 8.3
				Enviro	0.25			FILL: Silty CLAY, brown, medium plasticity, with sand, trace of rootlets.	M	F-St	Fill PID: 10.5
				Enviro	0.50		CL	CLAY, brown, low plasticity, with sand, trace of rootlets (residual).	M	St-VSt	Residual PID: 7.1
				Enviro B SPT 15R HB N=ref Enviro	0.80		CL	CLAY, brown, red, low plasticity, with sand, trace of rootlets (residual).	D	H	Residual PID: 12.2
1	AD/TC	Nil	Groundwater Not Encountered		1.20		SP	SAND / Clayey SAND, pale brown, fine to medium grained sand, trace of fine to medium, sub-angular gravel (extremely weathered).	D	D-VD	EW
					1.50			SANDSTONE, pale brown, fine to medium grained, with interbedded clay bands, extremely to highly weathered sandstone.			EW-HW slow progress
2					2.76						
								Start of coring at 2.76 metres. For cored interval, see Core Log Sheet.			
3											
4											
5											

Note: * indicates signatures on original issue of log or last revision of log

See standard sheets for details of abbreviations & basis of descriptions

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CORE LOG SHEET

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH102

SHEET 2 OF 3

Position : 411958.0 E 6206198.0 N MGA94/ Z55	**Surface RL:** 140.00m AHD	**Angle from Horiz. :** 90°	**Processed :** MAG
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 31/10/2018	**Date Completed :** 31/10/2018	**Logged by :** MB	**Date Logged :** 30/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES		
Progress												
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength $Is_{(50)}$ MPa ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
1													
2													
						2.76		Start of coring at 2.76 metres. For Non Cored interval, see Borehole Log Sheet.					
3	NMLC coring			(0)				SANDSTONE, brown, medium grained.	SW-Fr				3.08m, BP, 5°, CN, ST, RF, Ti 3.31m, BP, 5°, CN, ST, RF, TI 3.60m, BP, 0°, CN, IR, RF, TI
4								4.00m, colour changed to pale grey, pale brown.	EW				4.00m, SM, Sandy CLAY, 250mm. 4.25m, BP, 5°, Clay, PLN, RF, TI
			4.64						MW-SW				4.61m, BP, 5°, Clay, ST, RF, TI 4.65m, BP, 5°, Clay, ST, RF, TI
5													

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CORE LOG SHEET

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH102

SHEET 3 OF 3

Position : 411958.0 E 6206198.0 N MGA94/ Z55	**Surface RL:** 140.00m AHD	**Angle from Horiz. :** 90°	**Processed :** MAG
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 31/10/2018	**Date Completed :** 31/10/2018	**Logged by :** MB	**Date Logged :** 30/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL			NATURAL FRACTURES		
Progress											
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength $Is_{(50)}$ MPa ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
6	NMLC coring			(0)				SANDSTONE, as previous. Brown colour change.	HW MW-SW SW-Fr				5.05m, BP, 0°, Clay, IR, RF, TI 5.22m, BP, 0°, Clay, IR, RF, TI 5.32m, BP, 0°, CN, IR, RF, TI 5.49m,BP, 0°, CN, IR, RF, TI 5.80m, 5.90m, 6.31m, BP, 0°, CN, ST, RF, TI 6.35m, JT, 0°, CN, IR, RF TI, 80mm.
			7.00			7.00							
7								End of Borehole at 7 metres. Target Depth					
8													
9													
10													

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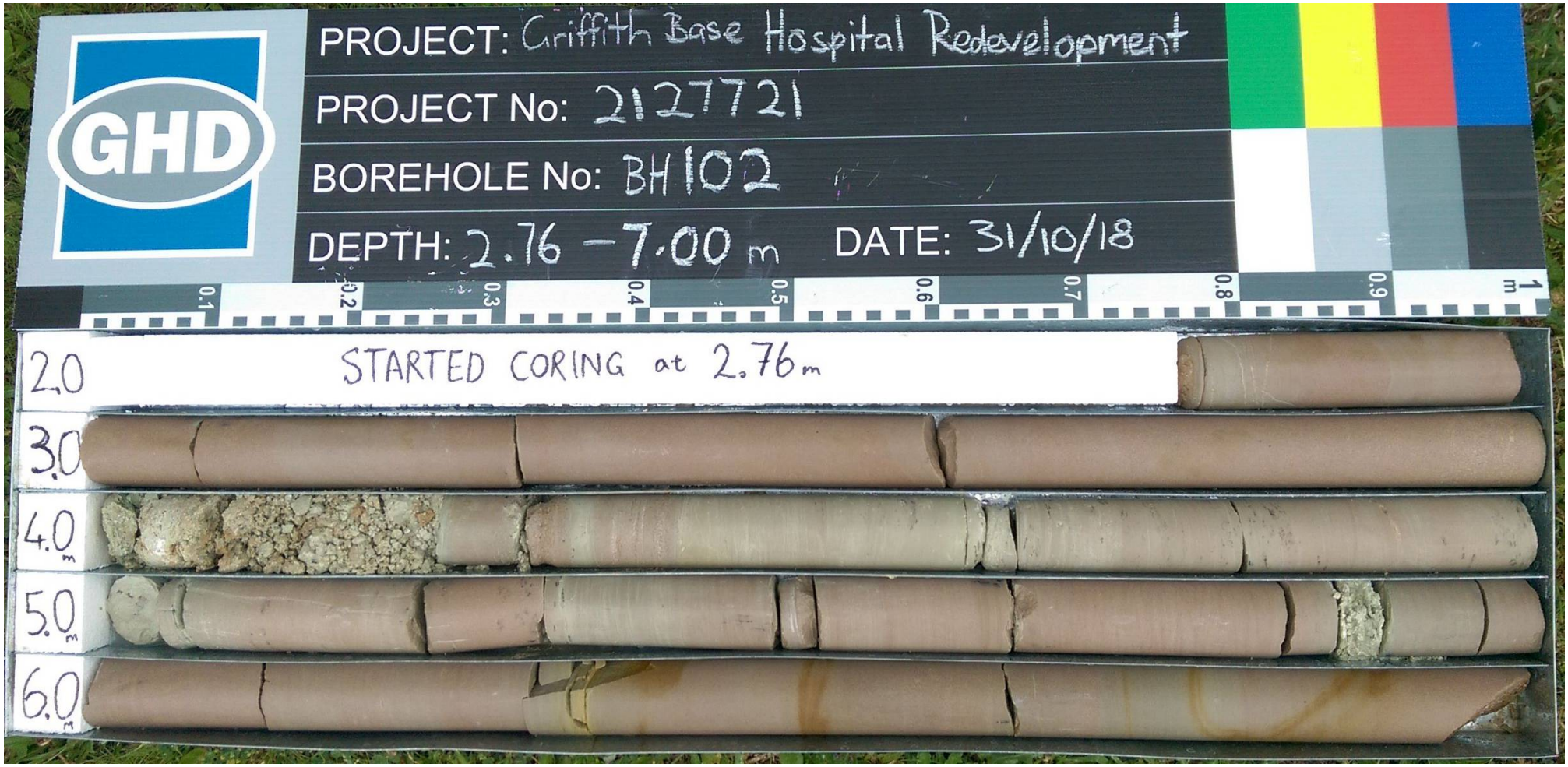

PointID : BH102 Depth Range: 2.76 - 7.00 m

TITLE: Health Infrastructure Griffith Base Hospital Redevelopment Griffith Base Hospital NSW CORE PHOTOGRAPH	DRAWN: H WARR	DATE: 28/11/2018	
	CHECKED: M BIANANI	DATE: 28/11/2018	
	SCALE: Not To Scale		A4
	PROJECT No: 2127721	FIGURE No: BH102 1/1	

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH103

SHEET 1 **OF** 1

Position: 412001.0 E 6206219.0 N MGA94/ Z55	**Surface RL:** 140.70m AHD	**Processed:** MAG
Method of Exploration: 5t Excavator	**Hole Size:** 1.4m x 0.3m	**Checked:** ML
Date: 02/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
			0.05			ASPHALT, 50mm thickness.	-	-		3	
		Enviro	0.20			FILL: Gravelly SAND, brown, fine to coarse grained, fine to coarse, angular to sub-angular gravel.	M	MD		3	ROADBASE PID: 1.4
					CI	Sandy CLAY, brown, medium plasticity, fine to coarse grained sand, trace of fine to medium, sub-angular gravel (residual).	M	F-St		2	Residual
		Enviro B	0.50		CL	Sandy CLAY, brown, low plasticity, fine to coarse grained sand, trace fine to medium, sub-angular gravel (residual).	M	St		3	PID: 2.0 Residual
		Enviro	0.75		CI	Sandy CLAY/ Clayey SAND, dark red brown, medium plasticity, fine to coarse grained sand, trace of fine to medium, sub-angular gravel (residual).	M	St-VSt		4	PID: 1.8 Residual
1	Groundwater Not Encountered		1.00		CI	Sandy CLAY/ Clayey SAND, red brown, brown, medium plasticity, fine to coarse grained sand, trace of fine to medium sub-angular gravel (extremely weathered sandstone).	-	VSt		5 6 9 10	PID: 1.8 Residual Residual / EW
			1.30			SANDSTONE, pale brown, fine to medium grained, with interbedded clay bands, extremely to highly weathered.				17 20	EW - HW
			1.40			End of Test pit at 1.4 metres. Refusal on HW sandstone.				28	
2											
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH104

SHEET 1 **OF** 1

Position: 412068.0 E 6206264.0 N MGA94/ Z55	**Surface RL:** 141.30m AHD	**Processed:** MAG
Method of Exploration: 5t Excavator	**Hole Size:** 1.3m x 0.3m	**Checked:** ML
Date: 02/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
1	Groundwater Not Encountered	Enviro	0.20		CI	TOPSOIL: Silty Sandy CLAY, brown, low plasticity, with fine to coarse, sub-angular gravel, trace rootlets.	M	F		4	Topsoil
										15	PID: 1.5
					CI	Sandy CLAY/ Clayey SAND, brown, medium plasticity, fine to coarse grained sand, trace gravel (residual).	M	F-St		10	Residual
		Enviro B								4	
										2	PID: 1.6
			0.70							9	
					CI	CLAY/ Sandy CLAY, brown red, medium plasticity, fine to medium grained sand, trace rootlets (residual).	M	St		7	
										4	Residual / EW
										4	
										5	
										7	
			1.25						R 90mm bouncing	24	
			1.30			SANDSTONE, pale brown, fine to medium grained, with interbedded clay bands, extremely to highly weathered.					EW / HW
2						End of Test pit at 1.3 metres. Refusal on HW sandstone.					
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH105

SHEET 1 **OF** 1

Position: 412093.0 E 6206212.0 N MGA94/ Z55	**Surface RL:** 141.00m AHD	**Processed:** MAG
Method of Exploration: 5t Excavator	**Hole Size:** 1.55m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
1	Groundwater Not Encountered	Enviro	0.20		CL-Cl	TOPSOIL: Silty Sandy CLAY, brown, low plasticity, fine to medium grained sand, trace rootlets.	M	F		4	Topsoil PID: 3.0
						Sandy CLAY, brown, low to medium plasticity, fine to medium grained sand, trace angular to sub-angular gravel (residual).	D	St		3	Residual
		Enviro								5	
										5	PID: 3.8
										5	
										6	
										6	
										7	PID: 3.3
		Enviro B								9	
			1.10		Cl	Sandy CLAY, brown and pale brown, orange, medium plasticity, fine to medium grained sand, with fine to coarse, angular to sub-angular gravel (residual / extremely weathered sandstone).	D	H		15	
										17	Residual / EW
			1.40			SANDSTONE, brown and pale brown, extremely weathered, low strength.			R 60mm bounding	21	
			1.55			End of Test pit at 1.55 metres. Target Depth.				30	
2											
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH106

SHEET 1 **OF** 1

Position: 412034.0 E 6206176.0 N MGA94/ Z55	**Surface RL:** 140.20m AHD	**Processed:** MAG
Method of Exploration: 5t Excavator	**Hole Size:** 1.5m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
1	Groundwater Not Encountered	Enviro	0.20		CL	TOPSOIL: Sandy CLAY, brown, low plasticity, fine to coarse grained sand, trace fine to coarse, sub-angular to sub-rounded gravel, rootlets.	SM	F		2	Topsoil
						CLAY / Sandy CLAY, brown, low plasticity, with fine to coarse, sub-angular gravel (residual).	M	VSt		8	PID: 3.2
		Enviro B								21	Residual
										20	
										20	
										10	PID: 2.8
										11	
										12	
										11	
			1.00		CI	CLAY / Sandy CLAY, brown, pale brown, dark brown mottled, medium plasticity, fine to medium grained sand, trace fine to coarse, angular to sub-angular gravel (residual / extremely weathered sandstone).	M	H		20	
										22	
										28	Residual / EW
			1.50			End of Test pit at 1.5 metres. Target Depth.					
2											
3											

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH107

SHEET 1 OF 3

Position : 412015.0 E 6206149.0 N MGA94/ Z55	**Surface RL:** 139.70m AHD	**Angle from Horiz. :** 90°		**Processed :** MAG
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Date Started : 30/10/2018	**Date Completed :** 30/10/2018		**Logged by :** MB	**Date:** 06/12/2018

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations
0	AD/TC	Nil	Groundwater Not Encountered	Enviro				TOPSOIL: Silty CLAY, brown, low to medium plasticity, with sand, with rootlets.	D	F	Topsoil PID: 2.4
				Enviro	0.40 0.50		CI CI	FILL: Silty Sandy CLAY, brown, medium plasticity, trace rootlets (fill/residual). Silty Sandy CLAY, brown, medium plasticity, fine to medium grained sand (residual).	D D	F-St St	Fill / Residual PID: 2.6 Residual PID: 2.3
				Enviro							
1				Enviro B						St-VSt	PID: 3.0
					1.50		CI	Silty Sandy CLAY, brown, medium plasticity, fine to medium grained sand (residual/extremely weathered sandstone).	D	H	Residual / EW
2				SPT 12/.22 for 30mm/R HB N=ref Enviro							PID: 3.3
				SPT 21 for 130mm N=ref	2.60			SANDSTONE, pale grey and pale brown, interbedded with clay, extremely weathered, highly weathered below 3.00m.			EW
3											EW Slow progress
											EW-HW Very slow progress
4					4.00			Start of coring at 4 metres. For cored interval, see Core Log Sheet.			
5											

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Job No. 21-27721

CORE LOG SHEET

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH107

SHEET 2 OF 3

Position : 412015.0 E 6206149.0 N MGA94/ Z55	**Surface RL:** 139.70m AHD	**Angle from Horiz. :** 90°	**Processed :** MAG
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 30/10/2018	**Date Completed :** 30/10/2018	**Logged by :** MB	**Date Logged :** 30/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES			
Progress													
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength $Is_{(50)}$ MPa ● - Axial O - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
1													
2													
3													
4						4.00		Start of coring at 4 metres. For Non Cored interval, see Borehole Log Sheet.					
	NMLC coring							SANDSTONE, pale brown, medium to coarse grained.	HW-MW				4.00m, BP, 0°, Sand, PLN, RF, TI 4.05m, BP, 0°, CLAY, ST, RF, TI 4.15m, BP, 0°, CLAY, IR, RF, TI 4.23m, JT, 80, CN, ST, RF, 60mm
									MW				4.57m, SM, CLAY, 30mm
								At 4.60m, colour changed to pale grey.	HW				4.65m, JT, 90°, CN, ST, RF, 100mm. 4.70m, BP, 0°. Sand, PLN, RF, TI
5								At 4.90m, colour change to pale brown.					

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Job No. 21-27721

CORE LOG SHEET

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH107

SHEET 3 OF 3

Position : 412015.0 E 6206149.0 N MGA94/ Z55	**Surface RL:** 139.70m AHD	**Angle from Horiz. :** 90°	**Processed :** MAG
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 30/10/2018	**Date Completed :** 30/10/2018	**Logged by :** MB	**Date Logged :** 30/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES		
Progress												
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength $Is_{(50)}$ MPa ● - Axial O - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
6	NMLC coring		6.00	(13)		5.75		SANDSTONE, as previous.	MW				5.05m, BP, Sand, IR, 100mm 5.21m, BP, Sand, ST, RF, TI 5.32m, JT, 60°, PLN, RF, 40mm 5.52m, BP, 5°, Sand, IR, RF, TI 5.70m, JT, 70°, Sand, ST, 100mm
						6.00		CORE LOSS 250mm.					
								SANDSTONE, pale brown, medium to coarse grained.	MW-SW				6.16m, BP, 15°, Sand, IR, RF 6.41m, BP, 0°, CN, PLN, RF, TI 6.45m, JT, 70°, CN, ST, RF, Ti, 80mm 6.80m, JT, 70-80°, CN, ST, RF, TI 6.90m, SM, CLAY, 100mm
7						7.00		CORE LOSS 210mm.					
				(7)		7.21		SANDSTONE, pale brown, medium to coarse grained.	MW SW-Fr				7.39m, 7.83m, SM, CLAY, 30mm 7.86m, BP, 0°, CLAY, PLN, RF, TI 8.57m, BP, 5°, CN, PLN, RF, TI 8.66m, BP, 0°, CN, ST, RF, TI
8													
9			9.00			9.00		End of Borehole at 9 metres. Target Depth					
10													

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PointID : BH107 Depth Range: 4.00 - 9.00 m

GHD	TITLE: Health Infrastructure Griffith Base Hospital Redevelopment Griffith Base Hospital NSW CORE PHOTOGRAPH	DRAWN: H WARR	DATE: 28/11/2018
		CHECKED: M BIANANI	DATE: 28/11/2018
		SCALE: Not To Scale	A4
		PROJECT No: 2127721	FIGURE No: BH107 1/1

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH108

SHEET 1 **OF** 1

Position: 412069.0 E 6206170.0 N MGA94/ Z55	**Surface RL:** 140.20m AHD	**Processed:** MAG
Method of Exploration: 5t Excavator	**Hole Size:** 1.0m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
1	Groundwater Not Encountered	Enviro	0.20		SC/ CL-CI	TOPSOIL: Sandy CLAY, brown, low to medium plasticity, fine to coarse grained sand, trace fine to coarse gravel, rootlets.	M	F		4	Topsoil PID: 3.6
						Clayey SAND/Sandy CLAY, brown-red, fine to coarse grained, low to medium plasticity clay, trace fine to coarse, sub-angular to sub-rounded gravel (residual).	D	F-St		6 3 1	Residual
		B; Enviro	0.70		SC	Clayey SAND, red-brown, fine to coarse grained, low to medium plasticity clay, trace gravel (residual / extremely weathered sandstone).		St		4 4	PID: 4.1
		QA3; Enviro	1.00			End of Test pit at 1 metres. Target Depth.	D	St		3 3 3 3	Residual / EW PID: 4.0
2											
3											
4											
5											

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Job No. 21-27721

BOREHOLE LOG SHEET

GEO_BOREHOLE 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH109

SHEET 1 OF 4

Position : 412073.0 E 6206097.0 N MGA94/ Z55	**Surface RL:** 136.60m AHD	**Angle from Horiz. :** 90°		**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Date Started : 30/10/2018	**Date Completed :** 30/10/2018		**Logged by :** MB	**Date:** 06/12/2018

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations
				Enviro				TOPSOIL: Silty CLAY, dark brown, low to medium plasticity, with rootlets, with fine grained sand.	M	F	Topsoil PID: 3.4
					0.25		SP-SC	Clayey SAND/SAND, pale brown, fine to medium grained, low to medium plasticity clay, trace rootlets, trace of iron staining (residual).	M	St-VSt	Residual
					0.50		CL	Sandy CLAY, red, brown, low plasticity, fine to medium grained sand, trace of fine to medium, sub-angular to sub-rounded gravel (residual).	D	H	Residual / EW
				SPT 6/7/6 N=13 Bx3							PID: 3.7
1				Enviro				1.20m, colour changed to pale brown, red mottled.			
				SPT 13/16/17 N=33	1.40		SC	Clayey SAND, pale brown, fine to medium grained, low plasticity clay (extremely weathered sandstone).	D	D	EW
					1.60		SP	SAND, pale brown, fine to medium grained, trace of low plasticity clay (extremely weathered sandstone).	D	D-VD	
				Enviro							PID: 4.1
2	AD/TC	Nil	Groundwater Not Encountered	SPT 16 for 65mm N=ref							
3					3.00		SP	SAND, pale brown, pale grey, fine to medium grained, trace of fine to medium, sub-rounded to sub-angular gravel.	-	VD	EW/HW sandstone very slow progress
				SPT 12 for 40mm N=ref							
4					4.00		SP/SC	SAND/Clayey SAND, pale grey, fine to medium grained, low plasticity clay, trace of fine to coarse, sub-rounded to sub-angular gravel (extremely to highly weathered sandstone).	M	MD	EW sandstone
5											

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Job No. 21-27721

BOREHOLE LOG SHEET

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH109

SHEET 2 OF 4

Position : 412073.0 E 6206097.0 N MGA94/ Z55	**Surface RL:** 136.60m AHD	**Angle from Horiz. :** 90°		**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Date Started : 30/10/2018	**Date Completed :** 30/10/2018		**Logged by :** MB	**Date:** 06/12/2018

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations
6	AD/TC	Nil	Not Encountered	SPT 6/7/7 N=14			SP/ SC	SAND/Clayey SAND, as previous.	M	MD	
7					7.00		CI	Sandy CLAY, brown, medium plasticity, fine to medium grained sand.	M	St-VSt	EW sandstone
			Groundwater		7.56			Start of coring at 7.56 metres. For cored interval, see Core Log Sheet.			
8											
9											
10											

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CORE LOG SHEET

GEO_COREHOLE_VISUAL 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH109

SHEET 3 OF 4

Position : 412073.0 E 6206097.0 N MGA94/ Z55	**Surface RL:** 136.60m AHD	**Angle from Horiz. :** 90°	**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 30/10/2018	**Date Completed :** 30/10/2018	**Logged by :** MB	**Date Logged :** 30/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES		
Progress												
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength $Is_{(50)}$ MPa ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
6													
7								Start of coring at 7.56 metres. For Non Cored interval, see Borehole Log Sheet.					
						7.56		SANDSTONE, red, fine to medium grained.					7.74m, BP, 5°, clay, ST, RF 7.85m, BP, 0°, clay, PLN, RF, TI
8	NMLC coring							8.00m, colour changed to pale brown.	MW-SW				8.32m, BP, 0°, sand, PLN, RF, TI 8.55m, BP, sand, IR, RF, TI
9				(0)					SW-Fr				8.95m, BP, 0°, sand, ST, RF, TI
								9.40m, colour changed to red.					9.39m, BP, 5°, sand, PLN, RF, TI 9.76m, BP, 5°, sand, PLN, RF, TI
10													

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Job No. 21-27721

CORE LOG SHEET

Client : Health Infrastructure

Project : Griffith Base Hospital Redevelopment

Location : Griffith Base Hospital, NSW

HOLE No. BH109

SHEET 4 OF 4

Position : 412073.0 E 6206097.0 N MGA94/ Z55	**Surface RL:** 136.60m AHD	**Angle from Horiz. :** 90°	**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 30/10/2018	**Date Completed :** 30/10/2018	**Logged by :** MB	**Date Logged :** 30/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES		
Progress												
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	**Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	**Estimated Strength $Is_{(50)}$ MPa** ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	**Spacing (mm)** 20 40 100 300 1000	Visual	**Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
10	NMLC coring		10.59			10.59		SANDSTONE, as previous. At 10.35m, colour changed to pale brown.	SW-Fr				10.00m, JT, 70°, sand, ST, RF, 180mm 10.31m, BP, 0°, sand, PLN, RF, TI 10.45m, BP, 0°, sand, PLN, RF, TI
								End of Borehole at 10.59 metres. Target Depth					
11													
12													
13													
14													
15													

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Job No. 21-27721

PointID : BH109 Depth Range: 7.56 - 10.59 m

	TITLE: Health Infrastructure Griffith Base Hospital Redevelopment Griffith Base Hospital NSW CORE PHOTOGRAPH	DRAWN: H WARR	DATE: 28/11/2018
		CHECKED: M BIANANI	DATE: 28/11/2018
		SCALE: Not To Scale	A4
		PROJECT No: 2127721	FIGURE No: BH109 1/1

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH110

SHEET 1 **OF** 1

Position: 412050.0 E 6206102.0 N MGA94/ Z55	**Surface RL:** 136.80m AHD	**Processed:** AJET
Method of Exploration: 5t Excavator	**Hole Size:** 0.8m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20			TOPSOIL: Sandy Silty CLAY, brown, low plasticity, fine to coarse grained sand, trace rootlets.	SM	F		2	Topsoil PID: 3.0
					SP	Gravelly Clayey SAND, brown, fine to coarse grained, fine to coarse, sub-angular to sub-rounded gravel, low plasticity clay (residual).	SM	MD		2 5	Residual
		B; Enviro	0.50		SP	Gravelly Clayey SAND, brown, fine to coarse grained, fine to coarse, sub-angular to sub-rounded gravel, low plasticity clay (extremely weathered sandstone).	D	D	for 60mm bouncing	18 13 24	EW PID: 3.8
			0.70 0.80			SANDSTONE, pale grey, fine to coarse grained (highly weathered sandstone bedrock).	-	-			HW sandstone Auger spinning
1						End of Test pit at 0.8 metres. Refusal.					
2											
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH111

SHEET 1 **OF** 1

Position: 412085.0 E 6206166.0 N MGA94/ Z55	**Surface RL:** 140.00m AHD	**Processed:** AJET
Method of Exploration: 5t Excavator	**Hole Size:** 1.0m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20		SC	FILL / TOPSOIL: Silty SAND, brown, fine to coarse grained, trace rootlets.	SM	F		2	Topsoil
						Clayey SAND, brown-red, fine to coarse grained, low plasticity clay, trace fine to coarse, sub-angular to sub-rounded gravel (residual).	D	St		2	PID: 3.2
										5	Residual
		B; Enviro	0.60		CL	Gravelly Sandy CLAY, red-brown, low plasticity, fine to coarse grained sand, fine to coarse, sub-angular to sub-rounded gravel (residual / extremely weathered sandstone).	D	VSt		5	
										8	PID: 4.4
										12	
										15	Residual / EW
		Enviro	1.00							18	PID: 3.3
1						End of Test pit at 1 metres. Target Depth.				17	
										19	
2											
3											

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Job No. 21-27721

BOREHOLE LOG SHEET

GEO_BOREHOLE 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH112

SHEET 1 OF 3

Position : 412090.0 E 6206210.0 N MGA94/ Z55	**Surface RL:** 140.50m AHD	**Angle from Horiz. :** 90°		**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Date Started : 31/10/2018	**Date Completed :** 31/10/2018		**Logged by :** MB	**Date:** 06/12/2018

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Note: * indicates signatures on original issue of log or last revision of log Comments/ Observations
1	AD/TC	Nil	Groundwater Not Encountered	Enviro Enviro B Enviro SPT 25 for 100mm N=R	0.20 0.75 1.50 1.77		CL CL-CI / SC	TOPSOIL: Silty CLAY, dark brown, medium plasticity, with rootlets, trace of fine grained sand. Silty CLAY, brown, low plasticity, with rootlets, with fine grained sand (residual). Sandy CLAY/Clayey SAND, brown, pale brown, low to medium plasticity clay, fine to medium grained sand, trace of fine to coarse, sub-rounded to sub-angular gravel (residual / extremely weathered). SANDSTONE, pale brown, fine to medium grained, with interbedded clay bands, extremely to highly weathered.	M D D	F F-St St VSt H	Topsoil PID: 8.2 Residual PID: 7.2 EW PID: 11.1 EW - HW Slow progress
2								Start of coring at 1.77 metres. For cored interval, see Core Log Sheet.			
3											
4											
5											

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CORE LOG SHEET

GEO_COREHOLE_VISUAL 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH112

SHEET 2 OF 3

Position : 412090.0 E 6206210.0 N MGA94/ Z55	**Surface RL:** 140.50m AHD	**Angle from Horiz. :** 90°	**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 31/10/2018	**Date Completed :** 31/10/2018	**Logged by :** MB	**Date Logged :** 31/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING

Progress

SCALE (m) | Drilling & Casing | Water | Drill Depth (m) | (Core Loss / Run %) | SAMPLES & TESTS

MATERIAL

Depth / (RL) metres | Graphic Log | **Description** ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin) | Weathering | **Estimated Strength $Is_{(50)}$ MPa** ● - Axial ○ - Diametral (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)

NATURAL FRACTURES

Spacing (mm) (20, 40, 100, 300, 1000) | Visual | **Additional Data** (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.

Depth / (RL)	Description	Weathering	Drill Depth	(Core Loss / Run %)	Additional Data
1.77	Start of coring at 1.77 metres. For Non Cored interval, see Borehole Log Sheet.				
1.77	SANDSTONE, pale brown, fine to medium grained.	EW			1.77m, SZ, sand, 60mm
		Fr			2.04m, BP, 0°, sand, PLN, RF, TI
					2.19m, BP, 0°, sand, PLN, RF, TI
					2.34m, BP, 0°, sand, ST, RF, TI
		EW			2.43m, SZ, sand, 100mm
		SW-Fr		(0)	2.64m, BP, 0°, sand, ST, RF, TI
		EW			2.85m, SZ, sand, 250mm
			3.25		3.17m, JT, 90°, sand, ST, RF, 140mm
					3.46m, BP, 0°, ST, RF, CN, TI
					3.66m, BP, 5°, PLN, RF, CN, TI
		SW-Fr			4.11m, BP, 0°, PLN, RF, CN, TI
				(0)	4.21m, BP, 5°, PLN, RF, CN, TI
					4.73m, BP, 5°, PLN, RF, CN, TI
					4.77m, BP, 5°, PLN, RF, CN, TI

NMLC coring

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CORE LOG SHEET

Client : Health Infrastructure

Project : Griffith Base Hospital Redevelopment

Location : Griffith Base Hospital, NSW

HOLE No. BH112

SHEET 3 OF 3

Position : 412090.0 E 6206210.0 N MGA94/ Z55	**Surface RL:** 140.50m AHD	**Angle from Horiz. :** 90°	**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 31/10/2018	**Date Completed :** 31/10/2018	**Logged by :** MB	**Date Logged :** 31/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES		
Progress												
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength $Is_{(50)}$ MPa ● - Axial O - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
	NMLC coring		5.52			5.52		SANDSTONE, as previous.	SW-Fr				5.26m, JT, 60-90°, sand, RF, 520mm
								End of Borehole at 5.52 metres. Target Depth					

6 7 8 9 10

GEO_COREHOLE_VISUAL 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

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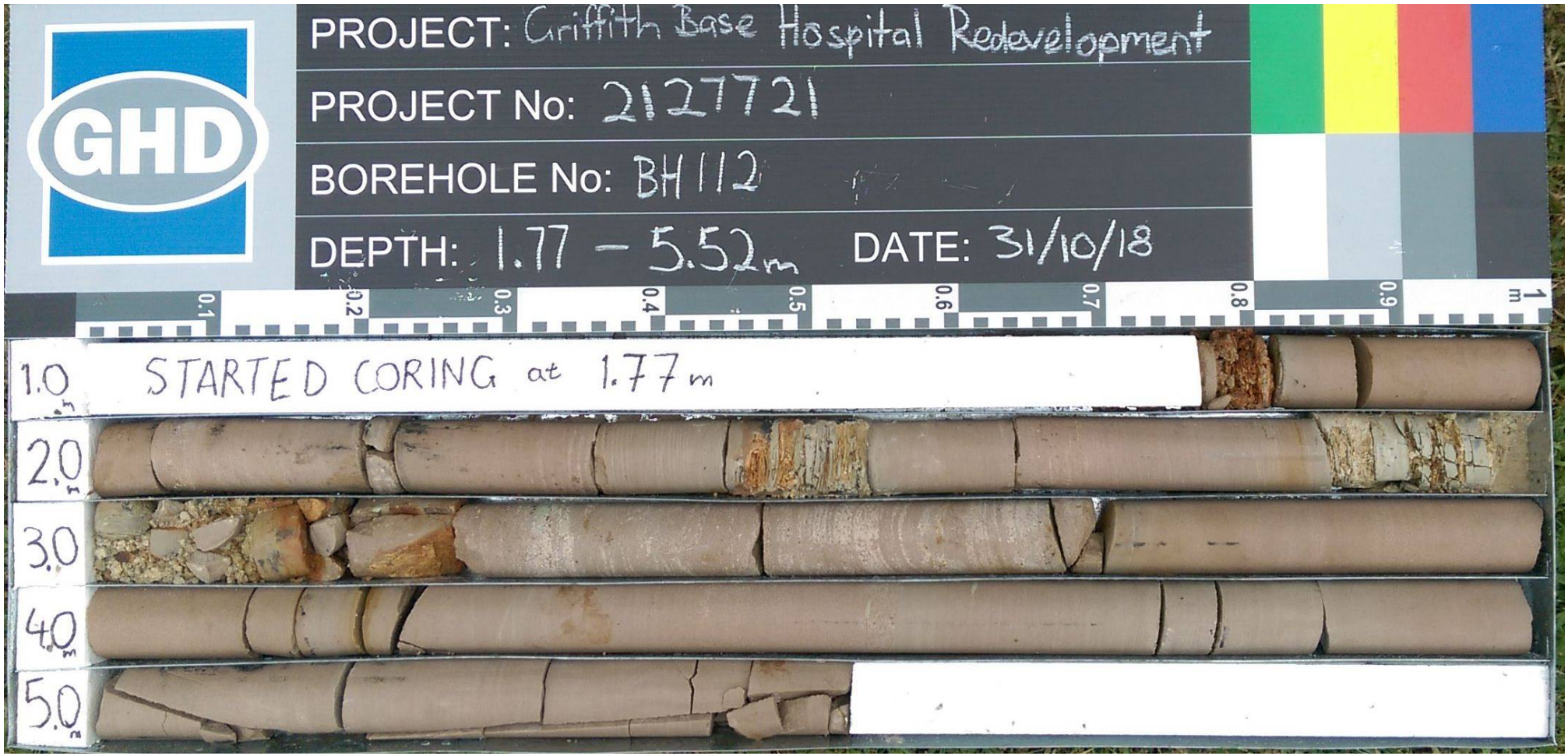

PointID : BH112 Depth Range: 1.77 - 5.52 m

TITLE: Health Infrastructure Griffith Base Hospital Redevelopment Griffith Base Hospital NSW CORE PHOTOGRAPH	DRAWN: H WARR	DATE: 28/11/2018	
	CHECKED: M BIANANI	DATE: 28/11/2018	
	SCALE: Not To Scale		A4
	PROJECT No: 2127721	FIGURE No: BH112 1/1	

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH113

SHEET 1 **OF** 1

Position: 412058.0 E 6206223.0 N MGA94/ Z55	**Surface RL:** 140.70m AHD	**Processed:** AJET
Method of Exploration: 5t Excavator	**Hole Size:** 1.2m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20			TOPSOIL: Silty Sandy CLAY, brown, low plasticity, trace rootlets.	M	F-St		4	Topsoil
					CL-CI	Sandy CLAY, brown, low to medium plasticity, with silt, trace fine to coarse, angular to sub-angular gravel (residual).	D	St-VSt		11	PID: 3.3
										19	Residual
		Enviro								12	
										8	PID: 4.2
										8	
										11	
										11	
		B								14	
1		Enviro	1.00			SANDSTONE, pale brown, grey, fine to coarse grained, extremely weathered.			for 40mm	24	PID: 4.1
			1.20							20	EW
						End of Test pit at 1.2 metres. Target Depth.					
2											
3											

Note: * indicates signatures on original issue of log or last revision of log

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. BH114

SHEET 1 **OF** 1

Position: 412024.0 E 6206283.0 N MGA94/ Z55	**Surface RL:** 140.80m AHD	**Processed:** AJET
Method of Exploration: 5t Excavator	**Hole Size:** 1.1m x 0.3m	**Checked:** ML
Date: 02/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20		CL	TOPSOIL: Silty Sandy CLAY, brown, low plasticity, fine to medium grained sand, with rootlets, trace fine to coarse gravel.	M	F-St		3	Topsoil
						Sandy CLAY, red-brown, low plasticity, fine to medium grained sand, trace fine to coarse gravel, rootlets (residual).	M	St		4	PID: 1.6
										6	Residual
		Enviro B								3	
								VSt		5	PID: 1.9
										16	
			0.75							15	
1					CI-CH/ SC	Sandy CLAY/Clayey SAND, pale brown, brown, medium to high plasticity, fine to medium grained sand, with fine to coarse, angular to sub-angular gravel (residual / extremely weathered).	D	H	for 80mm bouncing	30	Residual / EW
			1.00			SANDSTONE, pale brown, fine to medium grained, with interbedded clay bands, extremely to highly weathered.					EW-HW slow progress
			1.10			End of Test pit at 1.1 metres. Refusal.					
2											
3											

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BOREHOLE LOG SHEET

GEO_BOREHOLE 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH115

SHEET 1 OF 3

Position : 412025.0 E 6206250.0 N MGA94/ Z55	**Surface RL:** 140.80m AHD	**Angle from Horiz. :** 90°		**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Date Started : 31/10/2018	**Date Completed :** 31/10/2018		**Logged by :** MB	**Date:** 06/12/2018

DRILLING					MATERIAL						
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations Note: * indicates signatures on original issue of log or last revision of log
1	AD/TC	Nil	Groundwater Not Encountered	Enviro	0.20			TOPSOIL: Silty Sandy CLAY, dark brown, medium plasticity, fine to medium grained sand, with rootlets.	M	F	Topsoil
				Enviro			CI-CH	CLAY/Sandy CLAY, brown, red, medium to high plasticity, fine to medium grained sand, trace of rootlets (residual).	M	St	PID: 1.9 Residual
				Enviro					D	St-VSt	PID: 2.6
				Enviro	1.00						PID: 2.4
				SPT 14/22/25 N=47 B			CI-CH	Sandy CLAY, pale brown, medium to high plasticity, fine to medium grained sand, trace of fine to medium, sub-rounded to sub-angular gravel (residual).	D	H	Residual / EW
2					1.50		CI	Sandy CLAY/Clayey SAND, pale brown, medium plasticity, fine to medium grained sand (residual / extremely weathered).	D	H	EW Rock Slow progress
				SPT 20 for 150mm N=R	2.00		SP	Clayey SAND, pale brown, brown mottled, fine to medium grained, low to medium plasticity clay, trace of fine to medium sub-angular to sub-rounded gravel (extremely weathered sandstone).	D	D-VD	Slow progress
					2.50			SANDSTONE, pale brown, fine to medium grained, with interbedded clay bands, extremely to highly weathered.			EW-HW Rock
					2.76			Start of coring at 2.76 metres. For cored interval, see Core Log Sheet.			
3											
4											
5											

See standard sheets for details of abbreviations & basis of descriptions

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CORE LOG SHEET

GEO_COREHOLE_VISUAL 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH115

SHEET 2 OF 3

Position : 412025.0 E 6206250.0 N MGA94/ Z55	**Surface RL:** 140.80m AHD	**Angle from Horiz. :** 90°	**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 31/10/2018	**Date Completed :** 31/10/2018	**Logged by :** MB	**Date Logged :** 31/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL				NATURAL FRACTURES		
Progress												
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength $Is_{(50)}$ MPa ● - Axial ○ - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
1													
2						2.76		Start of coring at 2.76 metres. For Non Cored interval, see Borehole Log Sheet.					
3	NMLC coring		3.95	(0)				SANDSTONE, brown, fine to medium grained.	SW				2.83m, BP, 0°, clay, IR, RF, TI 3.18m, JT, 80°, sand, ST, RF, 160mm 3.53m, BP, 0°, clay, ST, RF, TI 3.85m, JT, 80-90°, sand, ST, 300mm
4													
5													

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CORE LOG SHEET

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH115

SHEET 3 OF 3

Position : 412025.0 E 6206250.0 N MGA94/ Z55	**Surface RL:** 140.80m AHD	**Angle from Horiz. :** 90°	**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Casing Dia. : HQ	**Barrel (m) :** 3.0m	**Bit :** Diamond (stepfaced)	**Bit Condition :** Good	**Date:** 06/12/2018
Date Started : 31/10/2018	**Date Completed :** 31/10/2018	**Logged by :** MB	**Date Logged :** 31/10/2018	Note: * indicates signatures on original issue of log or last revision of log

DRILLING						MATERIAL			NATURAL FRACTURES		
Progress											
SCALE (m)	Drilling & Casing	Water	Drill Depth (m)	(Core Loss / Run %)	SAMPLES & TESTS	Depth / (RL) metres	Graphic Log	Description ROCK TYPE, colour, grain size, structure (texture, mineral composition, hardness, alteration, cementation, etc. as applicable) and SOIL TYPE, moisture, colour, consistency, structure, minor components (origin)	Weathering	Estimated Strength $Is_{(50)}$ MPa ● - Axial O - Diametral EL 0.03 VL 0.1 L 0.3 M 1 H 3 VH 10 EH	Spacing (mm) 20 40 100 300 1000	Visual	Additional Data (joints, partings, seams, zones and veins) Fracture type, orientation, infilling or coating, shape, roughness, other.
6	NMLC coring			(0)				SANDSTONE, as previous.					
								From 5.40-5.75m, coarse grained.	SW				5.45m, BP, 0°, sand, PLN, RF, TI
								From 5.75m, fine grained.					5.76m, BP, 0°, sand, ST, RF, TI
								At 6.00, colour changed to red.	Fr				
			6.45			6.45		End of Borehole at 6.45 metres. Target Depth					
7													
8													
9													
10													

GEO_COREHOLE_VISUAL 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

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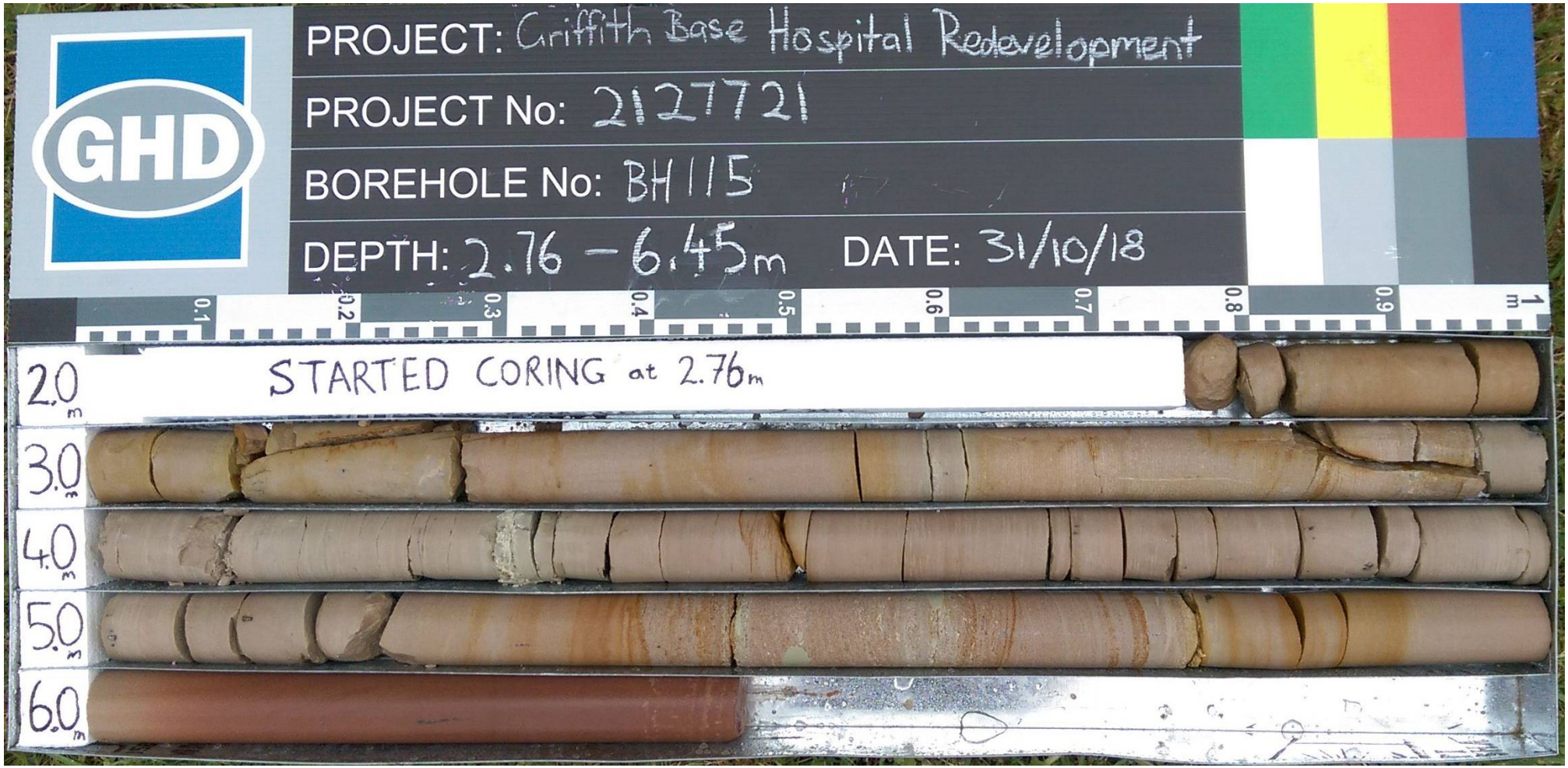

PointID : BH115 Depth Range: 2.76 - 6.45 m

TITLE: Health Infrastructure Griffith Base Hospital Redevelopment Griffith Base Hospital NSW CORE PHOTOGRAPH	DRAWN: H WARR	DATE: 28/11/2018	
	CHECKED: M BIANANI	DATE: 28/11/2018	
	SCALE: Not To Scale		A4
	PROJECT No: 2127721	FIGURE No: BH115 1/1	

BOREHOLE LOG SHEET WITH STANDPIPE PIEZOMETER

GEO_BOREHOLE 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH116

SHEET 1 OF 2

Position : 411977.0 E 6206267.0 N MGA94/ Z55	**Surface RL:** 140.50m AHD	**Angle from Horiz. :** 90°	**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Date Started : 1/11/2018	**Date Completed :** 1/11/2018	**Logged by :** MB	**Date:** 06/12/2018

DRILLING					MATERIAL								PIEZOMETER	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations		Piezometer Log	Components
1	AD/TC	Nil	Groundwater Not Encountered	Enviro Enviro Enviro SPT 10 for 100mm N=R	0.10			FILL: Gravelly SAND, grey, medium to coarse grained, fine to coarse, sub-angular to angular gravel.	D M	MD L-MD	ROADBASE no odour PID: 1.9 Fill			Grout backfill
								FILL: SAND, brown, medium to coarse grained, trace of fine to coarse, sub-angular gravel, trace of low plasticity clay.			PID: 2.6			
					0.60		CI-CH	CLAY, brown, medium to high plasticity, trace of fine grained sand, trace tree roots (residual).	M	St	Residual			
					0.80		CI-CH	CLAY/Sandy CLAY, brown, medium to high plasticity, fine to medium grained sand (residual / extremely weathered).	-	VSt	Residual / EW PID: 2.4			
2					1.25			SANDSTONE, brown, fine to medium grained (highly to moderately wathered).			HW-MW very slow progress			Bentonite
3	Rock Roller													Sand Backfill
4					4.00			SANDSTONE, brown, fine to medium grained (moderately to slightly weathered).			MW-SW very slow progress			
5														

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BOREHOLE LOG SHEET WITH STANDPIPE PIEZOMETER

Client : Health Infrastructure
Project : Griffith Base Hospital Redevelopment
Location : Griffith Base Hospital, NSW

HOLE No. BH116

SHEET 2 OF 2

Position : 411977.0 E 6206267.0 N MGA94/ Z55	**Surface RL:** 140.50m AHD	**Angle from Horiz. :** 90°	**Processed :** AJET
Rig Type : Hanjin DB	**Mounting:** Track	**Contractor :** BG Drilling	**Driller :** Sean	**Checked :** ML
Date Started : 1/11/2018	**Date Completed :** 1/11/2018	**Logged by :** MB	**Date:** 06/12/2018

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DRILLING					MATERIAL							PIEZOMETER	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations	Piezometer Log	Components
6								SANDSTONE, as previous.					
7	Rock Roller		Groundwater Not Encountered										6m Slotted screen 50mm PVC casing
8													
9													
10					10.00			Target Depth.					Base of piezo @10m
								End of borehole at 10 metres.					

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP130

SHEET 1 **OF** 1

Position: 411929.0 E 6206271.0 N MGA94/ Z55	**Surface RL:** 139.60m AHD	**Processed:** AJET
Method of Exploration: 5t Excavator	**Hole Size:** 1.0m x 0.3m	**Checked:** ML
Date: 31/10/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
1	Groundwater Not Encountered	Enviro	0.10		SP	FILL: Gravelly SAND, grey, fine to coarse grained, fine to coarse, angular to sub-angular gravel.	D	MD		14	ROADBASE
			0.20				D	F-St		22	PID: 1.5
		B / Enviro			CL-Cl	FILL: Sandy CLAY, red, brown, low to medium plasticity, fine to coarse grained sand, with fine to coarse, sub-angular to sub-rounded gravel.	SM	St-VSt	bouncing	10	Residual / EW PID: 1.7
			0.50			Sandy CLAY, brown, low to medium plasticity, fine to coarse grained sand, with fine to coarse, sub-angular to sub-rounded gravel (residual / extremely weathered rock).	-	MD-D			HW Sandstone Very slow progress
			1.50			SANDSTONE, white, pale grey, fine to medium grained (extremely weathered).					
2						End of Test pit at 1.5 metres. Refusal.					
3											

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GEO_TEST PIT_DCP (NO PHOTOS) 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP131

SHEET 1 **OF** 1

Position:	419000.0 E 6206265.0 N MGA94/ Z55	**Surface RL:**	139.00m AHD
Method of Exploration:	5t Excavator	**Hole Size:**	0.5m x 0.3m
Date:	31/10/18	**Logged by:**	AH

Processed: HAL

Checked: ML

Date: 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered		0.10		SP	FILL: Gravelly SAND, grey, fine to coarse grained, fine to coarse, angular to sub-angular gravel.	D	MD			ROADBASE
		Enviro				FILL: Clayey SAND, brown, red, fine to coarse grained, with fine to coarse, sub-angular to sub-rounded gravel, cobbles.	D	MD	for 20mm bouncing	8 30	
		B	0.40		SP	Clayey Gravelly SAND, red, brown, fine to coarse grained, fine to coarse, sub-angular, sub-rounded gravel, low plasticity clay, sandstone blocks, pale brown grey, fine to medium grained (residual / extremely weathered sandstone).	D	D			Residual / EW rock
		Enviro	0.50			End of Test pit at 0.5 metres. Refusal.					Refusal on HW sandstone
1											
2											
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP132

SHEET 1 **OF** 1

Position: 411872.0 E 6206229.0 N MGA94/ Z55	**Surface RL:** 138.00m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 1.0m x 0.3m	**Checked:** ML
Date: 31/10/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20		CL	TOPSOIL / FILL: Sandy CLAY, brown, red, high plasticity, fine to coarse grained sand, trace rootlets, sub-angular to sub-rounded gravel.	SM	F		11	Topsoil / Fill
						Sandy CLAY, brown, red, low plasticity, fine to coarse grained sand, trace gravel (residual).	-	St		8	PID: 1.5
		B; Enviro	0.50		SP	Gravelly SAND, red, brown, fine to coarse grained, fine to coarse, sub-angular to sub-rounded gravel, with clay and silt (residual).	-	D		5	Fill / Residual
										4	
										11	
										22	Residual PID: 1.9
										28	
										35	
		Enviro	1.00						R 40mm	9	PID: 1.7
1						End of Test pit at 1 metres. Target Depth.					
2											
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP133

SHEET 1 **OF** 1

Position: 411915.0 E 6006252.0 N MGA94/ Z55	**Surface RL:** 138.90m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 0.6m x 0.3m	**Checked:** ML
Date: 31/10/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.10		SP	FILL: Gravelly SAND, brown, red, fine to coarse grained sand, fine to coarse, sub-angular to sub-rounded gravel, trace cobbles	D	MD		9	ROADBASE PID: 2.2
					CL-CI	FILL:Sandy Gravelly CLAY, brown, red, low to medium plasticity, fine to coarse grained sand, fine to coarse, sub-angular to sub-rounded gravel, trace cobbles (fill/residual).	D	H		24 27 32	Fill / Residual
		QA2; Enviro	0.60						R 80mm bouncing	15	PID: 2.3
1						End of Test pit at 0.6 metres. Refusal Auger jamming and bouncing..					
2											
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP134

SHEET 1 **OF** 1

Position: 419330.0 E 6206244.0 N MGA94/ Z55	**Surface RL:** 140.00m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 0.5m x 0.3m	**Checked:** ML
Date: 31/10/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered				SP	FILL: Gravelly SAND, brown, grey, fine to coarse grained, fine to coarse angular to sub-angular gravel, trace of low to medium plasticity clay.		Fr		3	ROADBASE
		Enviro	0.25		CI-CL	FILL: Sandy Gravelly CLAY, brown, red, low to medium plasticity, fine to coarse grained sand, fine to coarse, sub-angular to sub-rounded gravel (fill / residual).	-	VSt	10 RQ Bouncing	9	PID: 2.6
		Enviro	0.50			Auger refusal at 0.50m	-	-	RQ Bouncing	24	Fill / Residual PID: 1.9
						SANDSTONE, pale brown, grey, orange, fine to medium grained. End of Test pit at 0.5 metres. Refusal.				9	
1											
2											
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP135

SHEET 1 **OF** 1

Position:	411892.0 E 6206223.0 N MGA94/ Z55	**Surface RL:**	138.00m AHD
Method of Exploration:	5t Excavator	**Hole Size:**	1.0m x 0.3m
Date:	31/10/18	**Logged by:**	AH

Processed: HAL

Checked: ML

Date: 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.10		SP	FILL: Gravelly SAND, grey, fine to coarse grained, fine to coarse, angular to sub-angular gravel.	D	MD		14	ROADBASE PID: 2.1
		Enviro	0.20		SP		D	MD		16	
					CL-CI	FILL: Silty SAND, brown, red, fine to coarse grained, with low to medium plasticity clay, with fine to coarse, sub-rounded gravel.	D	VSt		17	Fill / Residual PID: 2.6
		Enviro	0.50		SC	FILL: Sandy CLAY, brown, red, low to medium plasticity, trace sub-rounded gravel (fill/residual).	SM	MD-D		18	
						Clayey SAND, brown, red, fine to coarse grained, medium plasticity, trace sub-angular to sub-rounded gravel (residual).				20	
										40	Residual
										32	
										23	
		B; Enviro	1.00							19	PID: 2.7
1						End of Test pit at 1 metres. Target Depth.				22	
2											
3											

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Job No. 21-27721

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP136

SHEET 1 **OF** 1

Position: 411920.0 E 6206227.0 N MGA94/ Z55	**Surface RL:** 138.90m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 1.1m x 0.3m	**Checked:** ML
Date: 31/10/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
1	Groundwater Not Encountered	Enviro	0.10		SP	FILL: Gravelly SAND, grey, fine to coarse grained, fine to coarse, angular to sub-angular gravel.	D	MD		2	ROADBASE PID: 1.7
			0.20		CL-CI	FILL: Sandy CLAY, brown, red, low to medium plasticity, fine to coarse grained sand, with fine to coarse, sub-angular to sub-rounded gravel.	D	St		17	
		QA1; B; Enviro			CL-CI	Gravelly Sandy CLAY, brown, red, low to medium plasticity, fine to coarse grained sand, fine to coarse, sub-angular to sub-rounded gravel (residual). 0.70m, extremely weathered sandstone.	D	VSt		12	Residual
										18	
										13	PID: 2.0
										22	
										17	
										14	
		Enviro								9	PID: 1.8
			1.10							12	
2						End of Test pit at 1.1 metres. Target Depth.			End of probe@1m		At 1.10m, fragments breaking off at auger, max reach.
3											

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GEO_TEST PIT_DCP (NO PHOTOS) 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP137

SHEET 1 **OF** 1

Position: 411857.0 E 6206229.0 N MGA94/ Z55	**Surface RL:** 137.00m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 1.0m x 0.3m	**Checked:** ML
Date: 31/10/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20		CL-CI	TOPSOIL: Sandy Silty CLAY, brown-red, low to medium plasticity, trace fine to coarse gravel, rootlets.	SM	F		11	Topsoil PID: 2.7
					CL-CI	Sandy CLAY, brown-red, low to medium plasticity, with fine to coarse, sub-angular to sub-rounded gravel (natural).	D	VSt-H		9 15 20 19 21 19 19 24	Residual
		Enviro									PID: 2.7
		Bx2	1.00							19	
1						End of Test pit at 1 metres. Target Depth.					
2											
3											

Note: * indicates signatures on original issue of log or last revision of log

GEO_TEST PIT_DCP (NO PHOTOS) 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

See standard sheets for details of abbreviations & basis of descriptions

GHD
Level 11 200 Crown Street, Wollongong NSW 2500 Australia
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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-27721

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP138

SHEET 1 **OF** 1

Position: 418375.0 E 6206218.0 N MGA94/ Z55	**Surface RL:** 136.00m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 0.8m x 0.3m	**Checked:** ML
Date: 31/10/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20			TOPSOIL: Sandy Silty CLAY, brown, low plasticity, fine to coarse grained sand, trace rootlets.	D	St		5	Topsoil PID: 1.6
					CL	Sandy CLAY, brown-red, low plasticity, fine to coarse grained sand, trace fine to coarse, sub-angular to sub-rounded gravel (residual).	SM	VSt		4 5 14	Residual
		B Enviro								20	PID: 1.8
			0.70							20	
			0.80			SANDSTONE, pale grey, fine to coarse grained.	-	D-VD	R 20mm bouncing	20	EW - HW
						End of Test pit at 0.8 metres. Refusal.					
1											
2											
3											

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-27721

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP139

SHEET 1 **OF** 1

Position: 411845.0 E 6206204.0 N MGA94/ Z55	**Surface RL:** 136.30m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 1.0m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20		CL	TOPSOIL: Sandy Silty CLAY, brown, low plasticity, fine to coarse grained sand, with fine to coarse, sub-angular to sub-rounded gravel, trace plant matter.	SM	St		4	Topsoil
						Sandy CLAY, brown-red, low plasticity, fine to medium grained sand, with fine to coarse, sub-angular to sub-rounded gravel, trace boulders (residual).	SM	St		5	PID: 2.4
										5	Residual
		B; Enviro								8	
								VSt		9	PID: 5.9
										21	
										19	
										17	
										21	
1			1.00			End of Test pit at 1 metres. Target Depth.				28	
2											
3											

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See standard sheets for details of abbreviations & basis of descriptions

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Job No. 21-27721

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP140

SHEET 1 **OF** 1

Position: 418965.0 E 6206210.0 N MGA94/ Z55	**Surface RL:** 137.70m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 1.0m x 0.3m	**Checked:** ML
Date: 31/10/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20			TOPSOIL: Silty SAND, dark brown, fine to coarse grained, trace rootlets.	D	MD		5	Topsoil PID: 2.0
						Sandy CLAY, brown, red, low to medium plasticity, trace fine to coarse, sub-angular to sub-rounded gravel, rootlets (residual).	SM	VSt		23	Fill / Residual
		Enviro								20	
										13	
										12	PID: 2.0
		B	1.00							15	
1						End of Test pit at 1 metres. Target Depth.				16	
										18	
										21	
										24	
2											
3											

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-27721

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP141

SHEET 1 **OF** 1

Position: 411895.0 E 6206181.0 N MGA94/ Z55	**Surface RL:** 137.00m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 0.8m x 0.3m	**Checked:** ML
Date: 02/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.05			ASPHALT.	-	-			ROADBASE PID: 1.6
						FILL: Gravelly SAND, brown, fine to medium grained, fine to coarse, sub-angular to sub-rounded gravel, trace low plasticity clay.	-	MD-D		5 20 15	400 mm pavement
		Enviro	0.40		CL	Clayey SAND/Sandy CLAY, brown, low plasticity, fine to coarse grained sand, trace gravel (residual).	-	St-VSt		10 12	Residual PID: 1.9
		B	0.60		CL	Sandy CLAY/Clayey SAND, brown, pale brown, low plasticity, fine to coarse grained sand, trace sub-angular to sub-rounded gravel (extremely weathered sandstone).	-	VSt		14	EW
			0.70				-	D		17	EW-HW
			0.80			SANDSTONE, brown-pale brown, fine to medium grained, extremely to highly weathered. End of Test pit at 0.8 metres. Refusal on EW-HW rock.				20 22 25	
1											
2											
3											

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Job No. 21-27721

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP142

SHEET 1 **OF** 1

Position: 412053.0 E 6206100.0 N MGA94/ Z55	**Surface RL:** 136.60m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 0.3m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20			TOPSOIL/FILL: Silty Sandy CLAY, low plasticity, fine to coarse grained sand, trace rootlets.	SM	F		2	Topsoil / Fill PID: 3.3
			0.30			SANDSTONE, pale grey, fine to medium grained, highly weathered.	-	D-VD	R bouncing 80mm	5	EW-HW
						End of Test pit at 0.3 metres. Refusal on EW-HW rock.					
1											
2											
3											

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TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. IP143

SHEET 1 **OF** 1

Position: 411999.0 E 6206064.0 N MGA94/ Z55	**Surface RL:** 134.50m AHD	**Processed:** HAL
Method of Exploration: 5t Excavator	**Hole Size:** 1.0m x 0.3m	**Checked:** ML
Date: 01/11/18	**Logged by:** AH	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
	Groundwater Not Encountered	Enviro	0.20		CL	TOPSOIL: Silty Sandy CLAY, brown, low plasticity, fine to coarse grained sand, trace rootlets.	SM	F-St		3	Topsoil PID: 2.9
					CL	FILL: Sandy CLAY, brown, low plasticity, fine to coarse grained sand, trace fine to coarse, sub-angular to sub-rounded gravel (fill/residual).	D	VSt-H	R 80mm bounding	11 30	Fill / Residual
		B; Enviro	0.60		CL-CI	Sandy Gravelly CLAY, low to medium plasticity, fine to coarse grained sand, fine to coarse, sub-angular to sub-rounded gravel, trace boulders and cobbles (residual).	D	H			Floater at 0.40m PID: 4.6 Residual
1			1.00			End of Test pit at 1 metres. Target Depth.					
2											
3											

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Job No. 21-27721

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. TP120

SHEET 1 **OF** 1

Position: 411927.0 E 6206123.0 N MGA94/ Z55	**Surface RL:** 137.00m AHD	**Processed:** SBO
Method of Exploration: Test Pitting	**Hole Size:** 0.3m x 0.3m	**Checked:** ML
Date: 03/11/18	**Logged by:** MB	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	DCP Test Results blows per 100mm (0 20 40)	Recorded Blows	Comments Observations
					-	CONCRETE SLAB.	-	-			
	Groundwater Not Encountered		0.12		-	FILL: Gravelly SAND, brown, fine to coarse grained, fine to coarse, angular to sub-angular gravel.	M	MD		4	ROADBASE
			0.20		CL-CI	Sandy CLAY, brown, grey/orange mottled, low to medium plasticity, fine to medium grained sand, trace of fine to medium, sub-rounded gravel (residual / extremely weathered).	D	St-VSt		4 5 3 7	Residual / EW
			0.60			End of Test pit at 0.6 metres. Limit of reach of equipment.			R 30mm bouncing	7 4 5 3 3 3 10 15 10	
1											
2											
3											

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Job No. 21-27721

GEO_TEST PIT_DCP (NO PHOTOS) 2127721 GRIFFITH BASE HOSPITAL.GPJ GHD_GEO_TEMPLATE.GDT 7/12/18

TEST PIT LOG SHEET

Client: Health Infrastructure

Project: Griffith Base Hospital Redevelopment

Location: Griffith Base Hospital, NSW

HOLE No. TP121

SHEET 1 **OF** 1

Position: 412059.0 E 6206125.0 N MGA94/ Z55	**Surface RL:** 138.40m AHD	**Processed:** SBO
Method of Exploration: Test Pitting	**Hole Size:** 1.5m x 1.0m	**Checked:** ML
Date: 02/11/18	**Logged by:** MB	**Date:** 06/12/2018

Scale (m)	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Material Description (SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength)	Moisture Condition	Consistency / Density Index	Comments Observations
			0.10		-	FILL: Gravelly SAND, grey, fine to coarse grained, fine to coarse, angular to sub-angular gravel.	D	MD	FILL
1	Groundwater Not Encountered				-	FILL: Clayey Gravelly SAND, brown, fine to coarse grained, fine to coarse, angular to sub-angular gravel, low to medium plasticity clay, trace of rootlets.	D	L-MD	FILL
			1.10			End of test pit at 1.1 metres. Limit of reach of equipment			
2									
3									

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CONSULTING GEOTECHNICAL ENGINEERS AND GEOLOGISTS

Job No. 21-27721

Appendix D – Geotechnical laboratory tests reports

Sydney Laboratory
Unit 5/43 Herbert St
Artarmon NSW 2064
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web: www.ghd.com.au/ghdgeotechnics
Tel: (02) 9462 4860
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Aggregate/Soil Test Report

Report No: SYD1802266
Issue No: 1
This report replaces all previous issues of report no 'SYD1802266'.

Client:
Health Infrastructure
PO Box 1060
North Sydney NSW 1060

Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-02
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	BH102
Depth (m)	0.5 - 1.0
Soil Description	Clayey SAND: trace gravel red brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	12.5	
Date Tested		12/11/2018	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	Not Tested	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	23	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	8	
Date Tested		20/11/2018	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		Red Clayey sand with trace gravels	
Type of Water		distilled	
Temperature of Water (°C)		25	
Date Tested		14/11/2018	

Comments

N/A

Sydney Laboratory
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Aggregate/Soil Test Report

Report No: SYD1802300
Issue No: 1
This report replaces all previous issues of report no 'SYD1802300'.

Client:
Health Infrastructure
PO Box 1060
North Sydney NSW 1060

Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-12
Sampled By	Sampled by GHD
BH / TP No.	BH103
Depth (m)	0.5 - 0.8
Soil Description	Sandy CLAY: trace gravel red brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	12.0	
Date Tested		12/11/2018	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	Not Tested	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	21	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	9	
Emerson Class Number	AS 1289.3.8.1	3	
Soil Description		CLAY	
Type of Water		distilled	
Temperature of Water (°C)		25	
Date Tested		14/11/2018	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.94	
Standard Optimum Moisture Content (%)		12.5	
Retained Sieve 19.0mm (%)		0	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**8**	
CBR At 5.0mm (%)		**8**	
Maximum Dry Density (t/m³)		1.94	
Optimum Moisture Content (%)		12.5	
Dry Density before Soaking (t/m³)		1.91	
Density Ratio before Soaking (%)		98.5	

Comments

N/A

Sydney Laboratory
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Aggregate/Soil Test Report

Report No: SYD1802300
Issue No: 1
This report replaces all previous issues of report no 'SYD1802300'.

Client:
Health Infrastructure
PO Box 1060
North Sydney NSW 1060

Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-12
Sampled By	Sampled by GHD
BH / TP No.	BH103
Depth (m)	0.5 - 0.8
Soil Description	Sandy CLAY: trace gravel red brown

Test Results

Description	Method	Result	Limits
Moisture Content before Soaking (%)		11.9	
Moisture Ratio before Soaking (%)		94.5	
Dry Density after Soaking (t/m³)		1.91	
Density Ratio after Soaking (%)		98.5	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		13.2	
Moisture Content of Remaining Depth (%)		12.8	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		0.3	
Date Tested		19/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802267
Issue No: 1
This report replaces all previous issues of report no 'SYD1802267'.

Client:
Health Infrastructure
PO Box 1060
North Sydney NSW 1060

Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-03
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	BH108
Depth (m)	0.4 - 0.6
Soil Description	Clayey SAND: trace gravel red brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	5.7	
Date Tested		9/11/2018	
Emerson Class Number	AS 1289.3.8.1	3	
Soil Description		clayey SAND	
Type of Water		distilled	
Temperature of Water (°C)		25	
Date Tested		14/11/2018	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.95	
Standard Optimum Moisture Content (%)		10.0	
Retained Sieve 19mm (%)		0	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**12**	
CBR At 5.0mm (%)		**13**	
Maximum Dry Density (t/m³)		1.95	
Optimum Moisture Content (%)		10.2	
Dry Density before Soaking (t/m³)		1.91	
Density Ratio before Soaking (%)		98.0	
Moisture Content before Soaking (%)		10.5	
Moisture Ratio before Soaking (%)		103.5	
Dry Density after Soaking (t/m³)		1.90	
Density Ratio after Soaking (%)		97.5	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		13.2	
Moisture Content of Remaining Depth (%)		12.1	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802267
Issue No: 1
This report replaces all previous issues of report no 'SYD1802267'.

Client:
Health Infrastructure
PO Box 1060
North Sydney NSW 1060

Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-03
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	BH108
Depth (m)	0.4 - 0.6
Soil Description	Clayey SAND: trace gravel red brown

Test Results

Description	Method	Result	Limits
Oversize Material (%)		0.4	
Date Tested		19/11/2018	

Comments

N/A

Sydney Laboratory
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Aggregate/Soil Test Report

Report No: SYD1802265
Issue No: 1
This report replaces all previous issues of report no 'SYD1802265'.

Client:
Health Infrastructure
PO Box 1060
North Sydney NSW 1060

Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-01
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	BH109
Depth (m)	0.5 - 1.0
Soil Description	Sandy CLAY: trace gravel white with red mottle

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	9.5	
Date Tested		9/11/2018	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	Not Tested	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	24	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	9	
Date Tested		20/11/2018	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.86	
Standard Optimum Moisture Content (%)		14.0	
Retained Sieve 19mm (%)		1	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**5.0**	
CBR At 5.0mm (%)		**6**	
Maximum Dry Density (t/m³)		1.86	
Optimum Moisture Content (%)		13.9	
Dry Density before Soaking (t/m³)		1.81	
Density Ratio before Soaking (%)		97.0	
Moisture Content before Soaking (%)		15.9	
Moisture Ratio before Soaking (%)		114.5	
Dry Density after Soaking (t/m³)		1.81	
Density Ratio after Soaking (%)		97.0	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802265
Issue No: 1
This report replaces all previous issues of report no 'SYD1802265'.

Client:
Health Infrastructure
PO Box 1060
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Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-01
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	BH109
Depth (m)	0.5 - 1.0
Soil Description	Sandy CLAY: trace gravel white with red mottle

Test Results

Description	Method	Result	Limits
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		16.5	
Moisture Content of Remaining Depth (%)		16.7	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		0.8	
Date Tested		19/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802301
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Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

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Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-13
Sampled By	Sampled by GHD
BH / TP No.	BH110
Depth (m)	0.4 - 0.6
Soil Description	Gravelly sandy CLAY: red brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	9.0	
Date Tested		9/11/2018	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		gravelly sandy clay	
Type of Water		distilled	
Temperature of Water (°C)		25	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.94	
Standard Optimum Moisture Content (%)		11.0	
Retained Sieve 19.0mm (%)		14	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**8**	
CBR At 5.0mm (%)		**9**	
Maximum Dry Density (t/m³)		1.94	
Optimum Moisture Content (%)		10.8	
Dry Density before Soaking (t/m³)		1.89	
Density Ratio before Soaking (%)		98.0	
Moisture Content before Soaking (%)		11.1	
Moisture Ratio before Soaking (%)		102.5	
Dry Density after Soaking (t/m³)		1.89	
Density Ratio after Soaking (%)		97.5	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		12.7	
Moisture Content of Remaining Depth (%)		12.4	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		13.8	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802301
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NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-13
Sampled By	Sampled by GHD
BH / TP No.	BH110
Depth (m)	0.4 - 0.6
Soil Description	Gravelly sandy CLAY: red brown

Test Results

Description	Method	Result	Limits
Date Tested		19/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802268
Issue No: 1
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Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-04
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	BH112
Depth (m)	0.5 - 1.0
Soil Description	CLAY: red brown trace sand & gravel

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	Not Tested	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	22	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	11	
Plasticity Index (%)	AS 1289.3.3.1	11	
Date Tested		21/11/2018	
Emerson Class Number	AS 1289.3.8.1	2	
Soil Description		CLAY	
Type of Water		distilled	
Temperature of Water (°C)		25	
Date Tested		14/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802269
Issue No: 1
This report replaces all previous issues of report no 'SYD1802269'.

Client:
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Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-05
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	BH114
Depth (m)	0.4 - 0.7
Soil Description	CLAY: with sand trace gravel red brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	9.5	
Date Tested		12/11/2018	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	Not Tested	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	24	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	12	
Date Tested		21/11/2018	
Emerson Class Number	AS 1289.3.8.1	3	
Soil Description		CLAY with sand	
Type of Water		distilled	
Temperature of Water (°C)		25	
Date Tested		14/11/2018	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.90	
Standard Optimum Moisture Content (%)		13.0	
Retained Sieve 19.0mm (%)		0	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**6**	
CBR At 5.0mm (%)		**5.0**	
Maximum Dry Density (t/m³)		1.90	
Optimum Moisture Content (%)		12.9	
Dry Density before Soaking (t/m³)		1.85	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802269
Issue No: 1
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Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-05
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	BH114
Depth (m)	0.4 - 0.7
Soil Description	CLAY: with sand trace gravel red brown

Test Results

Description	Method	Result	Limits
Density Ratio before Soaking (%)		97.5	
Moisture Content before Soaking (%)		13.6	
Moisture Ratio before Soaking (%)		105.5	
Dry Density after Soaking (t/m³)		1.85	
Density Ratio after Soaking (%)		97.5	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		15.4	
Moisture Content of Remaining Depth (%)		14.9	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		0.4	
Date Tested		19/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802270
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Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-06
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	IP132
Depth (m)	0.3 - 0.6
Soil Description	Sandy CLAY:trace gravel red brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	6.4	
Date Tested		9/11/2018	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.97	
Standard Optimum Moisture Content (%)		10.5	
Retained Sieve 19.0mm (%)		0	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**4.5**	
CBR At 5.0mm (%)		**5.0**	
Maximum Dry Density (t/m³)		1.97	
Optimum Moisture Content (%)		10.4	
Dry Density before Soaking (t/m³)		1.92	
Density Ratio before Soaking (%)		97.5	
Moisture Content before Soaking (%)		10.8	
Moisture Ratio before Soaking (%)		104.5	
Dry Density after Soaking (t/m³)		1.93	
Density Ratio after Soaking (%)		98.0	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		13.0	
Moisture Content of Remaining Depth (%)		11.4	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material (%)		0.0	
Date Tested		19/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802271
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This report replaces all previous issues of report no 'SYD1802271'.

Client:
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Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-07
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	IP136
Depth (m)	0.4 - 0.7
Soil Description	Sandy CLAY: with gravel red brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.0	
Date Tested		9/11/2018	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.74	
Standard Optimum Moisture Content (%)		17.5	
Retained Sieve HO1mm (%)		4	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**3.0**	
CBR At 5.0mm (%)		**2.5**	
Maximum Dry Density (t/m³)		1.74	
Optimum Moisture Content (%)		17.5	
Dry Density before Soaking (t/m³)		1.70	
Density Ratio before Soaking (%)		97.5	
Moisture Content before Soaking (%)		17.9	
Moisture Ratio before Soaking (%)		102.5	
Dry Density after Soaking (t/m³)		1.67	
Density Ratio after Soaking (%)		96.0	
Swell (%)		1.5	
Moisture Content of Top 30mm (%)		24.3	
Moisture Content of Remaining Depth (%)		20.3	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		3.7	
Date Tested		19/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802272
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This report replaces all previous issues of report no 'SYD1802272'.

Client:
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Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-08
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	IP137
Depth (m)	0.7 - 1.0
Soil Description	Sandy CLAY: trace gravel red brown

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	Not Tested	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	30	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	13	
Plasticity Index (%)	AS 1289.3.3.1	17	
Date Tested		21/11/2018	
Emerson Class Number	AS 1289.3.8.1	3	
Soil Description		sandy CLAY	
Type of Water		distilled	
Temperature of Water (°C)		25	
Date Tested		14/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802273
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This report replaces all previous issues of report no 'SYD1802273'.

Client:
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NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-09
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	IP138
Depth (m)	0.3 - 0.6
Soil Description	sandy CLAY: with gravel red brown

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	6.4	
Date Tested		9/11/2018	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	2.02	
Standard Optimum Moisture Content (%)		10.0	
Retained Sieve 19.0mm (%)		18	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**11**	
CBR At 5.0mm (%)		**13**	
Maximum Dry Density (t/m³)		2.02	
Optimum Moisture Content (%)		9.8	
Dry Density before Soaking (t/m³)		1.99	
Density Ratio before Soaking (%)		98.5	
Moisture Content before Soaking (%)		9.0	
Moisture Ratio before Soaking (%)		92.5	
Dry Density after Soaking (t/m³)		1.99	
Density Ratio after Soaking (%)		99.0	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		11.5	
Moisture Content of Remaining Depth (%)		10.3	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Excluded	
Oversize Material (%)		18.0	
Date Tested		19/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802274
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This report replaces all previous issues of report no 'SYD1802274'.

Client:
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Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-10
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	IP141
Depth (m)	0.4 - 0.8
Soil Description	Sandy CLAY: with gravel

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	5.8	
Date Tested		12/11/2018	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	Not Tested	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	21	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	9	
Date Tested		21/11/2018	
Emerson Class Number	AS 1289.3.8.1	3	
Soil Description		clay with gravel / sand	
Type of Water		distilled	
Temperature of Water (°C)		25	
Date Tested		14/11/2018	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.99	
Standard Optimum Moisture Content (%)		10.5	
Retained Sieve 19.0mm (%)		6	
Compactive Effort		standard	
Date Tested		13/11/2018	
CBR At 2.5mm (%)	AS 1289.6.1.1 - 2014	**4.0**	
CBR At 5.0mm (%)		**3.5**	
Maximum Dry Density (t/m³)		1.99	
Optimum Moisture Content (%)		10.6	
Dry Density before Soaking (t/m³)		1.95	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1802274
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Client:
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Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-10
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	IP141
Depth (m)	0.4 - 0.8
Soil Description	Sandy CLAY: with gravel

Test Results

Description	Method	Result	Limits
Density Ratio before Soaking (%)		98.0	
Moisture Content before Soaking (%)		11.2	
Moisture Ratio before Soaking (%)		105.0	
Dry Density after Soaking (t/m³)		1.95	
Density Ratio after Soaking (%)		98.0	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		13.4	
Moisture Content of Remaining Depth (%)		12.0	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material		Replaced	
Oversize Material (%)		5.6	
Date Tested		19/11/2018	

Comments

N/A

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Aggregate/Soil Test Report

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PO Box 1060
North Sydney NSW 1060

Project: 2127721/02 - Griffith Base Hospital

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: D.P Brooke (Sydney Laboratory Manager)

Date of Issue: 26/11/2018

Sample Details

GHD Sample No	SYD18-0486-11
Date Sampled	30/10/2018
Sampled By	Sampled by GHD
BH / TP No.	IP143
Depth (m)	0.4 - 0.6
Soil Description	Sandy CLAY: trace gravel

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	4.4	
Date Tested		12/11/2018	
Emerson Class Number	AS 1289.3.8.1	3	
Soil Description		sandy CLAY	
Type of Water		distilled	
Temperature of Water (°C)		25	
Date Tested		14/11/2018	

Comments

N/A

Appendix E – Aggressivity testing results

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30 years Testing For Life 1987–2017
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Certificate of Analysis

GHD Pty Ltd NSW
Level 15, 133 Castlereagh Street
Sydney
NSW 2000

NATA Accredited
Accreditation Number 1261
Site Number 18217

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

Attention: **Mike Leung**

Report **627469-S**
Project name GRIFFITH HOSPITAL DSI
Project ID 2127721
Received Date Nov 05, 2018

Client Sample ID			**BH102 0.5-1.0M**	**BH106 0.4-0.7M**	**BH110 0.4-0.6M**	**BH112 1.0-1.1M**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-No06778**	**S18-No06779**	**S18-No06780**	**S18-No06781**
Date Sampled			**Oct 31, 2018**	**Nov 01, 2018**	**Nov 01, 2018**	**Oct 31, 2018**
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	< 10	30	15	30
Conductivity (1:5 aqueous extract at 25°C as rec.)	5	uS/cm	47	40	64	260
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	8.3	7.7	7.2	7.6
Resistivity*	0.5	ohm.m	1100	1300	780	200
Sulphate (as SO4)	10	mg/kg	12	< 10	< 10	150
% Moisture	1	%	14	3.4	7.5	6.5

Client Sample ID			**BH114 0.8-1.0M**	**IP137 0.7-1.0M**	**TP120 0.3-0.4M**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**S18-No06782**	**S18-No06783**	**S18-No06784**
Date Sampled			**Nov 02, 2018**	**Oct 31, 2018**	**Nov 03, 2018**
Test/Reference	LOR	Unit			
Chloride	10	mg/kg	24	12	< 10
Conductivity (1:5 aqueous extract at 25°C as rec.)	5	uS/cm	72	46	150
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	7.8	7.5	8.5
Resistivity*	0.5	ohm.m	700	1100	330
Sulphate (as SO4)	10	mg/kg	13	< 10	43
% Moisture	1	%	6.2	9.4	10

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
Chloride	Sydney	Nov 20, 2018	28 Day
- Method: E045 /E047 Chloride			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Sydney	Nov 15, 2018	7 Day
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Sydney	Nov 15, 2018	7 Day
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Sydney	Nov 20, 2018	28 Day
- Method: E045 Anions by Ion Chromatography			
% Moisture	Sydney	Nov 13, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

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NATA # 1261 Site # 20794

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NATA # 1261
Site # 23736

Company Name: GHD Pty Ltd NSW
Address: Level 15, 133 Castlereagh Street
Sydney
NSW 2000

Project Name: GRIFFITH HOSPITAL DSI
Project ID: 2127721

Order No.:
Report #: 627469
Phone: 02 9239 7100
Fax: 02 9239 7199

Received: Nov 13, 2018 11:09 AM
Due: Nov 20, 2018
Priority: 5 Day
Contact Name: Mike Leung

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Chloride	Conductivity (1:5 aqueous extract at 25°C as rec.)	pH (1:5 Aqueous extract at 25°C as rec.)	Resistivity*	Sulphate (as SO4)	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794											
Perth Laboratory - NATA Site # 23736											
External Laboratory											
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
1	BH102 0.5-1.0M	Oct 31, 2018		Soil	S18-No06778	X	X	X	X	X	X
2	BH106 0.4-0.7M	Nov 01, 2018		Soil	S18-No06779	X	X	X	X	X	X
3	BH110 0.4-0.6M	Nov 01, 2018		Soil	S18-No06780	X	X	X	X	X	X
4	BH112 1.0-1.1M	Oct 31, 2018		Soil	S18-No06781	X	X	X	X	X	X
5	BH114 0.8-1.0M	Nov 02, 2018		Soil	S18-No06782	X	X	X	X	X	X
6	IP137 0.7-	Oct 31, 2018		Soil	S18-No06783	X	X	X	X	X	X

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		Fax:	02 9239 7199	**Contact Name:**	Mike Leung
Project Name:	GRIFFITH HOSPITAL DSI				
Project ID:	2127721				

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						Chloride	Conductivity (1:5 aqueous extract at 25°C as rec.)	pH (1:5 Aqueous extract at 25°C as rec.)	Resistivity*	Sulphate (as SO4)	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271											
Sydney Laboratory - NATA Site # 18217						X	X	X	X	X	X
Brisbane Laboratory - NATA Site # 20794											
Perth Laboratory - NATA Site # 23736											
	1.0M										
7	TP120 0.3-0.4M	Nov 03, 2018		Soil	S18-No06784	X	X	X	X	X	X
Test Counts						7	7	7	7	7	7

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Chloride	mg/kg	< 10			10	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	uS/cm	< 5			5	Pass	
Sulphate (as SO4)	mg/kg	< 10			10	Pass	
LCS - % Recovery							
Conductivity (1:5 aqueous extract at 25°C as rec.)	%	105			70-130	Pass	
Resistivity*	%	105			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
Chloride	S18-No18525	NCP	%	108			70-130	Pass	
Sulphate (as SO4)	S18-No18525	NCP	%	109			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S18-No18525	NCP	mg/kg	28	28	1.0	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	S18-No19615	NCP	pH Units	8.5	8.3	pass	30%	Pass	
Sulphate (as SO4)	S18-No18525	NCP	mg/kg	110	110	2.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Conductivity (1:5 aqueous extract at 25°C as rec.)	S18-No06784	CP	uS/cm	150	150	1.0	30%	Pass	
Resistivity*	S18-No06784	CP	ohm.m	330	330	1.0	30%	Pass	
% Moisture	S18-No06784	CP	%	10	10	1.0	30%	Pass	

Comments

Eurofins | mgt accreditation number 1261, corporate site 1254 is currently in progress of a controlled transition to a new custom built location at 6 Monterey Road, Dandenong South, Victoria 3175. All results on this report denoted as being performed by Eurofins | mgt 2-5 Kingston Town Close, Oakleigh Victoria 3166 corporate site 1254, will have been performed on either Oakleigh or new Dandenong South site.

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Nibha Vaidya	Analytical Services Manager
Gabriele Cordero	Senior Analyst-Inorganic (NSW)

Glenn Jackson
General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

GHD

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2127221-REP-0_Geotechnical Investigation Report

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M Biabani	M Leung	On file*	S Mortimer	On file*	7/12/2018

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