GEOTECHNICAL INVESTIGATION REPORT

John Hunter Health and Innovation Precinct

Prepared for Health Infrastructure

Prepared by RCA Australia

RCA ref 14399-207/1

December 2019

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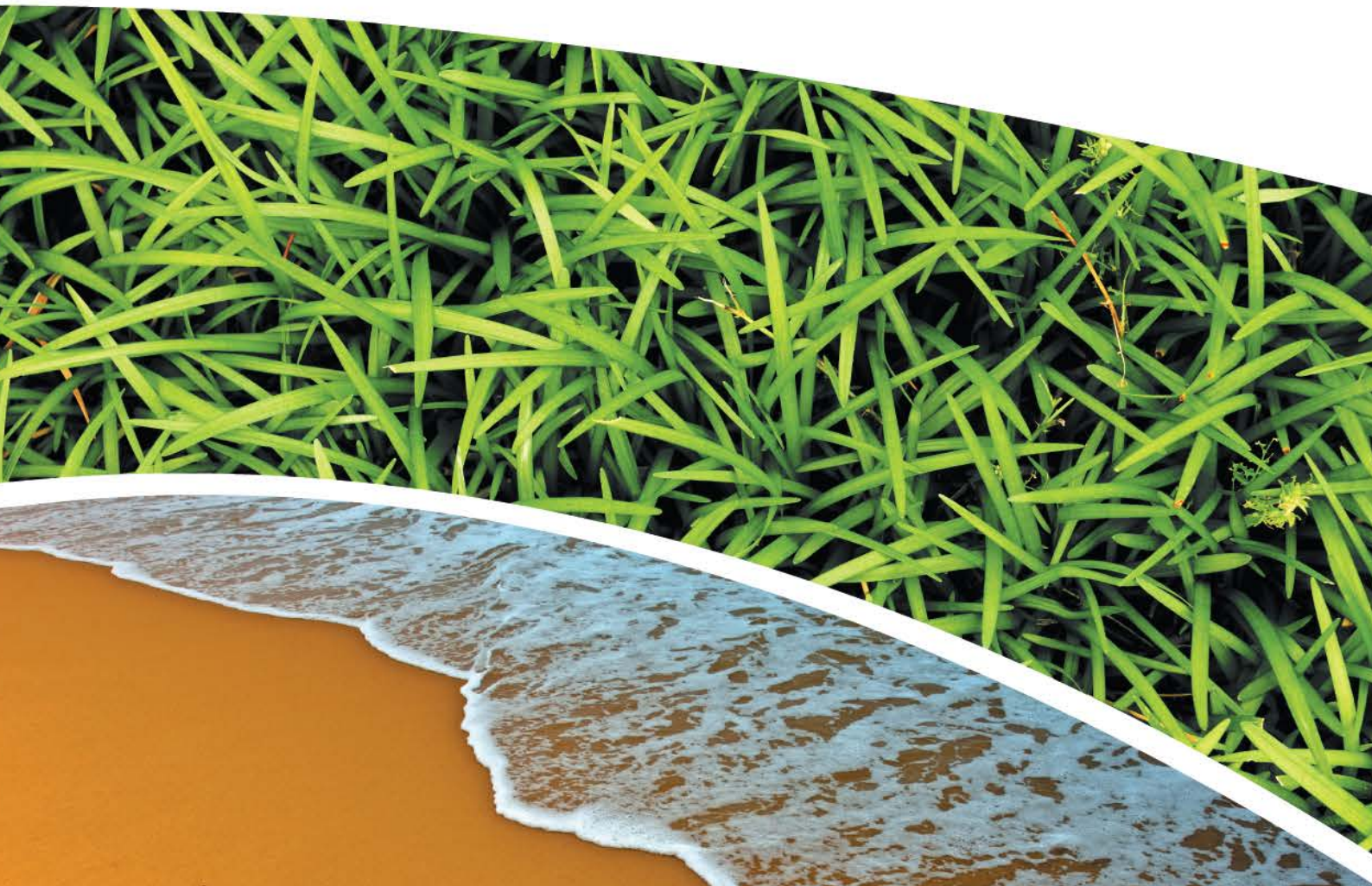

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Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Sound & Vibration
Occupational Hygiene

RCA ref 14399-207/1
Client ref HI19320

4 December 2019

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GEOTECHNICAL INVESTIGATION REPORT
JOHN HUNTER HEALTH AND INNOVATION PRECINCT

1 INTRODUCTION

This report describes geotechnical studies carried out for Health Infrastructure on the proposed John Hunter Heath and Innovation Project at the John Hunter Hospital.

The investigation was undertaken at the request of Health Infrastructure under Contract HI19320.

Plans provided to RCA Australia (RCA) by Health Infrastructure indicate that the proposed development at the site is to include the construction of a multi-storey clinical services building along with associated new road networks within the site. The proposed multi-storey building lies to the north of the existing main John Hunter Hospital building while the road network traverses the northern portion of the site. The current schematic masterplan development layout is shown on **Drawing 1** attached in **Appendix A**.

Data provided in relation to the project comprised preliminary plans of the site showing potential development layouts along with a range of documentation relating to the site.

This report contains descriptions of the surface and subsurface conditions at the site together with recommendations for site preparation, earthworks, excavation retention, foundation design and pavement design. The factual data on which this report is based is presented in the attached appendices.

As part of preliminary phases of this investigation a Desktop Geotechnical Assessment Report was prepared (RCA Report 14399-201/0, September 2019). Reference to that report is suggested to obtain an understanding of available geotechnical data of relevance to the development.

It is noted that the development site is underlain by abandoned mine workings. A Desktop Geotechnical Mine Subsidence Assessment (RCA ref 14399-202/2, December 2019) has been prepared. Additionally a parallel detailed investigation and report are being undertaken on the mine subsidence issues at the site and will be issued subsequent to this report.

The investigation is understood to be for the planning phases of the JHHIP Project to support the endorsed Masterplan.

2 FIELD AND LABORATORY INVESTIGATIONS

Fieldwork was conducted over the period 24 September to 15 October, and consisted of:

- Geological mapping of site conditions.
- Drilling of 10 bores to depths ranging 19.95m (BH109) to 22.3m (BH106). Bores were drilled using continuous flight augers until TC bit refusal was encountered and were then extended by diamond rock coring to termination depth. Rock core was recovered from all 10 bores. Point load strength testing was undertaken on representative core samples together with photography of the core.
- Excavation of 9 test pits by excavator to depths ranging from 0.7m (TP104) to 2.2m (TP102).
- In situ sampling and testing involving standard penetration testing and recovery of bulk soil and weathered rock samples.
- Dynamic penetrometer tests were conducted at each test pit location to assess in situ soil strength/density.
- Installation of piezometers in two bores (BH102 and BH103) to facilitate measurement of groundwater levels.

All fieldwork was carried out by and in the presence of RCA Australia (RCA) personnel. Test locations are shown on the attached site plans (**Drawings 1 and 2**).

Borehole and test pit locations have been surveyed by Monteath Powys with a register of survey data attached in **Appendix B** and coordinates and levels are also included on bore and test pit logs.

Bore and test pit depths have been recorded relative to the existing ground surface at the time of investigation.

All test pits were backfilled on completion.

Boreholes are currently open pending completion of the ongoing mine subsidence investigation and will be filled and made good at the completion of that investigation.

It is noted that BH106 and BH108 were extended to greater depths than recorded on the bore logs in this report as part of the parallel mine subsidence investigation.

Engineering logs of bores and test pits are presented in **Appendix B**, together with explanation sheets. Groundwater conditions/levels have been noted on the bore and test pit logs at the time of fieldwork. Fluctuations in groundwater conditions may be expected due to variations in rainfall and site conditions.

Laboratory testing of samples recovered during fieldwork consisted of:

- 11 Atterberg Limit tests for soil classification;
- 9 Emerson aggregate tests to assess clay dispersion;
- 9 California bearing ratio (CBR) tests to assess subgrade strength;
- 19 soil / water aggressivity to steel and concrete structures;
- 20 Uniaxial Compressive Strength (UCS) tests to assess rock strength.
- 20 Acid sulfate screen tests
- 7 SPOCAS/CRS acid sulfate tests

Laboratory test result sheets are attached in **Appendix C**.

A summary of laboratory test results are presented in **Table 1** to **Table 5**.

The results of the ASS/ASR testing are presented and discussed in Section 4.7.

Table 1 *Summary of Moisture Content and Atterberg Limits Test Results*

Test Pit	Depth (m)	Soil Type	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
TP101	0.2-0.4	Sandy CLAY	16.0	51	21	30
TP102	0.3-0.4	Silty SAND	12.2	17	15	2
TP103	0.2-0.4	CLAY	24.7	41	21	20
TP104	0.4-0.5	CLAY with sand	19.7	41	20	21
TP105	0.6-0.9	Sandy CLAY	18.0	41	23	18
TP106	0.2-0.5	CLAY	33.4	86	23	63
TP107	0.4-0.6	CLAY with sand	26.3	70	26	44
TP108	0.3-0.6	CLAY	24.0	60	21	39
TP109	0.4-0.7	CLAY with gravel	20.2	57	21	36
BH105	1.5-1.95	Tuffaceous CLAY	-	61	26	35
BH105	6.0-6.15	EW Tuffaceous SILTSTONE	-	47	22	25

Table 2 *Summary of Compaction and CBR Test Results*

Test Pit	Depth (m)	Soil Type	FMC (%)	MDD (t/m^3)	SOMC (%)	CBR (%)	Swell (%)
TP101	0.2-0.4	Sandy CLAY	16.0	1.623	20.6	5	0.5
TP102	0.3-0.4	Silty SAND	12.2	1.86	13.9	11	0
TP103	0.2-0.4	CLAY	24.7	1.542	23.8	2	2.5
TP104	0.4-0.5	CLAY with sand	19.7	1.579	20.1	4	2.0
TP105	0.6-0.9	Sandy CLAY	18.0	1.634	17.9	4	2.0
TP106	0.2-0.5	CLAY	33.4	1.421	28.9	2	4.0
TP107	0.4-0.6	CLAY with sand	26.3	1.584	22.0	1	2.5
TP108	0.3-0.6	CLAY	24.0	1.561	24.3	2.5	1.5
TP109	0.4-0.7	CLAY with gravel	20.2	1.714	20.0	2.5	2.0

NOTES: FMC – field moisture content
MDD – maximum dry density (Standard compaction)
SOMC – Standard optimum moisture content
CBR – California bearing ratio, penetration 2.5 / 5.0mm

Table 3 *Summary of Rock UCS Test Results*

Bore	Depth (m)	Rock Type	UCS (MPa)
BH101	6.0-6.17	Sandstone / Siltstone	5.0
BH103	4.63-4.85	Sandstone	21.8
BH103	8.07-8.24	Siltstone	22.9
BH103	16.71-16.92	Sandstone	48.0
BH104	5.21-5.38	Sandstone / Siltstone	38.3
BH104	9.47-9.64	Siltstone	3.94
BH104	10.2-10.45	Sandstone	28.5
BH105	6.70-7.00	Sandstone	9.61
BH105	7.25-7.41	Sandstone	3.31
BH105	9.00-9.23	Sandstone	18.0
BH106	11.72-11.89	Sandstone	13.7
BH106	12.40-12.75	Sandstone	38.5
BH106	16.05-16.22	Sandstone / Siltstone	33.1
BH106	14.50-14.78	Sandstone / Siltstone	19.9
BH106	15.25-15.54	Sandstone / Siltstone	51.4
BH107	14.14-14.40	Sandstone	58.3
BH107	16.60-16.83	Pebbly Sandstone	49.0
BH109	11.00-11.18	Sandstone	12.1
BH109	13.07-13.32	Sandstone	72.2

NOTES: UCS – Uniaxial Compressive Strength

Table 4 *Summary of soil Emerson class results*

Location	Depth (m)	Soil Type	Emerson Class
TP101	0.2-0.4	Sandy CLAY	2
TP102	0.3-0.4	Silty SAND	2
TP103	0.2-0.4	CLAY	5
TP104	0.4-0.5	CLAY with sand	5
TP105	0.6-0.9	Sandy CLAY	5
TP106	0.2-0.5	CLAY	5
TP107	0.4-0.6	CLAY with sand	5
TP108	0.3-0.6	CLAY	5
TP109	0.4-0.7	CLAY with gravel	1

Table 5 *Summary of Soil Chemistry Test Results*

Location	Depth (m)	Soil Type	EC (µS/cm)	$pH_{(1:5)}$	Chloride (mg/kg)	Sulfate (mg/kg)
BH101	7.00-7.15	SANDSTONE	84	6.4	60	50
BH102	3.30-3.37	Tuffaceous SILTSTONE	428	4.8	970	130
BH104	0.5-0.95	CLAY	102	5	80	50
BH105	9.67-9.90	SILTSTONE	26	7.3	<10	<10
BH106	3.50-3.63	Tuffaceous CLAYSTONE	181	5.9	240	60
BH106	13.00-13.16	SILTSTONE / SANDSTONE	53	9.1	10	10
BH107	3.00-3.37	SANDSTONE	600	5.1	980	350
BH109	5.80-6.00	COAL (weathered to Clayey SILT)	180	5.2	200	280
BH109	7.70-7.80	COAL	89	5.3	120	10
BH110	5.85-6.00	Tuffaceous SANDSTONE	32	7.1	10	<10

Notes EC – Electrical Conductivity

Key findings of the laboratory testing are:

- The site soils are of medium to high plasticity. Clay associated with tuffaceous strata are likely to be of very high plasticity.
- Soil moisture content across the site varies with some soil wet of optimum and some dry of optimum.
- CBR of soils is in the range 1% to 4%.
- Rock strength of UCS samples is in the range from low to very high.

- Emerson class of samples tested was 1, 2 or 5 indicating that there are soils prone to dispersion and erosion present on the site.

3 SITE DESCRIPTION

3.1 REGIONAL GEOLOGY

The Newcastle 1:100,000 series coalfield geology map indicates that the JHHC lies over outcrops of the Kotara Formation of the Adamstown Subgroup of the Newcastle Coal Measures. The Adamstown subgroup is generally noted to comprise conglomerate, sandstone, siltstone, tuff and coal rock types. The Lambton subgroup lies beneath the Adamstown Subgroup and is generally noted to comprise sandstone, siltstone, claystone, tuff and coal rock types.

In summary, reference to the Newcastle 1:100,000 series coalfield geology map indicates that the bedrock sequence below the site comprises the lower part of the Adamstown Subgroup and the upper sequence of the Lambton Subgroup of the Permian aged Newcastle Coal Measures. The subgroups are separated by the Victoria Tunnel (VT) coal seam. The VT seam is expected to dip at about 2-3^{o} to the south west and subcrop on the slopes approximately 20m to 30m below the level of the existing John Hunter Hospital and on that basis may be in close proximity to the basement levels of the proposed development.

It is noted that conglomerate forms the bedrock below much of the existing John Hunter Hospital development and may be observed outcropping on the slopes below the existing John Hunter Hospital.

As a general guide it is noted that the Newcastle Coal Measures were formed by a transgressive (rising sea level), regressive (falling sea level) depositional environment. The interbedded nature of the geology indicates that the sea level has been subject to a succession of rises and falls, depositing coarse size particles in higher energy flow environments (beach), and the finer grained particles in low energy flows (lagoonal / deep sea). The various coal seams in the stratigraphic sequence are likely to have been deposited on land or in swamps during periods of low sea level (regression).

Complicating this interbedded sedimentary sequence, are the tuffaceous deposits, layers of volcanic origin that were deposited during and following eruptions. The sediments are often deposited over a period of time as the volcanic ash cloud settles allowing the tuffaceous sediments to be deposited alongside the transgressive and regressive sediments, ultimately becoming integrated with the strata. These materials are typically described as tuffaceous siltstone or sandstone. The depositional environment and composition of the geological materials are likely to lead to varying engineering properties of the materials within each unit and are likely to exhibit different characteristics.

It is noted that published information on the geotechnical conditions associated with this part of stratigraphy of the Newcastle Coal Measures sequence indicates that the tuffaceous sediments associated with the VT seam and other seams have been associated with slope instability.

It is noted that the site is undermined by abandoned coal workings which are likely to result in constraints being imposed on development. A desktop assessment of mine constraints has been prepared (RCA Report 14399-202rev2 Desktop Mine Report, December 2019) and a separate detailed investigation is in progress and will be reported under separate cover.

3.2 SURFACE CONDITIONS

The John Hunter Hospital (JHH) site is located in New Lambton Heights in Newcastle and is situated 9km to the west of Newcastle CBD. The site is bound by bushland to the north, west and south and Lookout Road to the east.

Significant infrastructure already exists on the site including John Hunter Hospital, John Hunter Children Hospital, Royal Newcastle Centre, HMRI and associated infrastructure.

The broader JHH site topography is dominated by a prominent west to east trending ridge with the main JHH building lying near the crest with slopes at the site to the south and north off the ridge with increasing slope angles marked by pronounced changes (breaks) in the slope angle. The natural slopes on and adjacent to the ridge vary from less than 10° on the ridge where the existing John Hunter Hospital is located and approximately 10° on the flanks of the ridge above the break in slope to 15° to 20° below the break in the slopes. The highest point of the site is located near the main building at the top of the ridge at about 105m AHD. The majority of the existing hospital is built on a natural plateau at the ridge crest with levels over the main building footprint varying from about 85m AHD to 100m AHD. The lowest point on the JHHC site to the south is around 65m AHD, while the lowest point on the northern boundary is around 50m AHD.

The main building of the proposed development lies on the NNE facing slope to the north of the main existing building. This area slopes down away from the existing main building at a slope of approximately 10°.

Undeveloped areas of the site are heavily vegetated by mature eucalyptus. Access into the vegetated areas is limited to a series of fire trails and in steeper areas of the site access can be expected to be difficult especially in adverse weather.

There is a significant amount of published information on slope instability within the Newcastle Coal Measures. The key factors are noted as being:

- Low shear strength tuffaceous claystone beds.
- Bedding dipping down out of slope.
- Perched groundwater over tuffaceous beds, either within jointed sandstone and conglomerate or within closely spaced joints in coal seams.

It is noted that these conditions exist at the JHH site.

Photographs of the site of the proposed Stage 1 building are provided in **Photograph 1** and **Photograph 2**.

Photograph 1 *View to the east from near the western limit of the Stage 1 building footprint.*

Photograph 2 *View to the west from near the eastern limit of the Stage 1 building footprint.*

3.3 SUBSURFACE CONDITIONS

The subsurface profile encountered on the site is detailed on the attached test pit and bore logs and subsurface conditions encountered in test pits is summarised in **Table 6** and in the bore holes in **Table 7**.

The subsurface profile encountered in the boreholes has been separated into stratigraphic units based on geologic descriptions. A general description of the various stratigraphic units is provided in **Table 8**.

Table 6 *Summary of Subsurface Conditions at Test Pit Locations*

Test Pit Location	Depth of Topsoil (m)	Depth of Slopewash (m)	Depth to Rock (m)	Depth to Excavator Refusal (m)	Depth to Groundwater (m)
TP101	0.1	ne	0.7	0.85	ne
TP102	0.1	0.1-1.2	>2.2	ne (>2.2)	ne
TP103	0.1	ne	0.8	1.0	ne
TP104	0.3	ne	0.6	0.7	ne
TP105	0.2	ne	0.9	1.4	ne
TP106	0.2	ne	1.2	1.6	ne
TP107	0.4	ne	1.5	1.6	ne
TP108	0.05	ne	0.9	1.1	ne
TP109	0.4	ne	1.1	ne (>2.1)	ne

Notes:

ne not encountered

Table 7 *Summary of Stratigraphic Units at Borehole Locations*

Borehole	Stratigraphic Unit Depth (Unit Thickness) (m)						Termination Depth (m)
	Fill	Kotara Formation	Victoria Tunnel Seam	Shepherds Hill Formation	Nobby's Seam	Bar Beach Formation	
BH101	ne	ne	0-2.7	2.7-10.64 (7.94)	10.64-11.6 (1.04)	11.6->20.2	20.2
BH102	ne	0-3.6	3.6-7.28 (3.68)	7.28-15.22 (7.94)	15.22-16.2 (0.98)	16.2->20.93	20.93
BH103	ne	0-13.38	13.38-15.7 (2.32)	15.7->20.11	ne	ne	20.11
BH104	ne	ne	ne	0-7.08	7.08-8.34 (1.26)	8.34->20.57	20.57
BH105	ne	0-??	??-4.3	4.3-13.34	13.34-14.53 (1.19)	14.53->20.83	20.83
BH106(1)	ne	0-6.61	6.61-9.81 (3.2)	9.81-19.06 (9.25)	19.06-19.85 (0.79)	19.85->22.3	22.3
BH107	ne	ne	0-3.28	3.28-10.48 (7.2)	10.48-11.56 (1.08)	11.56-20.14	20.14
BH108(1)	0-1.2	ne	1.2-4.0	4.0-11.52 (7.52)	11.52-12.63 (1.09)	12.63->20.7	20.7
BH109	0-2.4	2.4-5.3	5.3-8.68 (3.38)	8.68-18.25 (9.57)	18.25-19.41 (1.16)	19.41->19.95	19.95
BH110	0-0.37	0.37-8.02	8.02-11.60 (3.58)	11.60->20.17	ne	ne	20.17

Notes:

ne note encountered
?? not able to be determined

(1) Bore extended by PCD drilling during mine subsidence investigation

Table 8 *Description of Stratigraphic Units*

Stratigraphic Unit	Description	Typical Characteristics/Extent
Fill	Silty sand and gravelly sandy clay	Likely to be limited to the western end of the Stage 1 area
Kotara Formation	Interbedded tuffaceous claystone, siltstone, with large beds of sandstone and conglomerate	The lower part of the formation typically comprises sequences of medium strength siltstone and sandstone. Where weathered the material is high plasticity and generally described as clay or silty clay.
Victoria Tunnel Seam	Coal	Typically between 3 and 4m thick, low to medium strength coal with interbedded tuff, claystone/siltstone and where weathered is of high plasticity
Shepherds Hill Formation	Interbedded tuffaceous claystone, siltstone, and sandstone	Typically between 7 and 10m thick, medium to high strength tuff, siltstone and sandstone.
Nobby's Seam	Coal	Ranging in thickness between about 0.8 and 1.2m, low strength, and where weathered is typically high plasticity.
Bar Beach Formation	Interbedded sandstone and conglomerate	Medium to high strength interbedded siltstones and sandstones, grading into high strength sandstone and conglomerate.

Geotechnical sections across the Stage 1 building site are defined on **Drawing 2** and provided on **Drawings 3-5**.

3.4 GROUNDWATER / SEEPAGE

Coffey 1983 (Ref 7) noted seepage emanating from the ground surface on the north east and south west slopes of the site generally at or below the break in the slopes. In addition, groundwater level in BH1 of Ref 7 is recorded in the log at approximately RL83.1m.

At the time of the fieldwork for this investigation no groundwater/seepage was encountered in any of the test pits. All boreholes were drilled with the addition of water and groundwater conditions at the time of drilling were difficult to assess. Subsequent observations as part of the mine subsidence investigation confirm that the regional groundwater level lies at a level below RL 0m (ie at depths of over 70m below ground surface). Minor seepage from the coal seams was observed at higher levels. It is noted that the fieldwork and observations were made during an extended period of dry weather.

It is considered that a detailed understanding of the groundwater conditions at the site is very important. The principal factors for the need to understand groundwater at this site are:

- Excavations up to in the order of 8m to 10m are proposed into the slopes downhill and north of the existing hospital development.
- The presence of low strength claystone units which are associated with the VT seam are present in the profile to be excavated.

For geotechnical background on potential stability issues in subsurface profiles of this type reference is made to:

- Landsliding in the Gosford-Lake Macquarie-Newcastle Area (Fell, 1995).
- Geotechnical consequences of the Newcastle Coal Measures Rocks (McNally & Branagan, 2013).

The papers identify multiple regional instabilities related to claystone associated with coal seams. Several examples are given in the papers in Rankin Park. Other well known cases are in Speers Point and at Bareki Road. A key finding of the papers is the influence that piezometric rises following rainfall play in triggering instability. Well documented nearby instabilities are at Carnley Avenue/Carisbrooke Avenue and Tickhole Tunnel. Each of these instabilities are triggered by wet weather but both followed excavation of conglomerate/sandstone overlying tuff and claystone (Tickhole – a quarry and Carnley Avenue – a cutting for the road).

Piezometers were installed in two bores (BH102 and BH103) to facilitate measurement of groundwater levels over time. Details of the piezometers are provided in **Appendix B**.

4 DISCUSSION AND COMMENTS

4.1 PROPOSED DEVELOPMENT

Geotechnical significant features of the proposed development include the following:

- Excavations up to in the order of 8m to 10m into the slopes downhill of the existing hospital development.
- Support of the excavations by retaining and basement walls.
- Founding of multi storey buildings via footings in the slopes comprising coal seams and associated weathered tuffaceous claystone layers.

As the design levels are unknown at this stage, the comments below are of a preliminary nature only and should be revised when the layout of the structure is known.

4.2 SITE CLASSIFICATION

The laboratory test results indicate that the residual clay soils encountered at the site are highly plastic. Additionally, a deeply weathered soil profile was encountered in some locations at the site including tuffaceous clay (eg BH105). No shrink swell testing was undertaken, however, based on the material types encountered and experience with these materials the soils are expected to be highly reactive in some locations. The swell results from the CBR testing across the site summarised in **Table 2** confirm this while suggesting that the soil reactivity is variable.

As discussed in Section 3 the site is undermined by abandoned mine workings in the Borehole Coal Seam. In addition, as noted in Section 3, mature vegetation covers the development site. In consideration of the presence of the mine workings at the site and the vegetation, and in accordance with AS 2870-2011, the site at JHH is classified as a **Class P** site.

Based on the soil profiles encountered in the bores and in accordance with *AS 2870-1996*, the site in its existing condition and in the absence of abnormal moisture conditions would be classified as Class H1, highly reactive, provided that all footings are founded below any topsoil or fill. A characteristic surface movement of up to about 60mm has been estimated.

The above site classification is for the site conditions present at the time of fieldwork and consequently the site classification may need to be reviewed in consideration of site works that may be undertaken subsequent to this report. Site works may include:

- changes to the existing soil profile by cutting and filling;
- landscaping, including trees removed from the general building area and those planted;
- drainage and watering systems.

Designs and design methods presented in *AS 2870-2011* are based on the performance requirement that significant damage can be avoided provided that site conditions are properly maintained. Performance requirements and foundation maintenance are outlined in Appendix B of *AS 2870-2011*. The above site classification assumes that the performance requirements as set out in Appendix B are acceptable and that site foundation maintenance is undertaken to avoid extremes of wetting and drying.

Details on appropriate site and foundation maintenance practices are presented in Appendix B of *AS 2870-2011* and in CSIRO information sheet BTF 18.

4.3 SITE EARTHWORKS

4.3.1 EXCAVATION

It is understood that the development may include excavations up to in the order of 8m to 10m into the slopes downhill of the existing hospital development

It is noted that the soils encountered at the site are indicated by Emerson Class testing to be potentially dispersive and likely to be susceptible to erosion and should be protected by vegetation or similar together with adequate drainage where exposed. Appropriate lined site surface drainage should be installed to intercept upslope overland surface flows and to restrict overland surface flows from flowing on to areas adjacent to the site.

4.3.1.1 EXCAVATABILITY

Reference to the geotechnical sections in **Drawings 3, 4 and 5** indicate that materials that will be excavated for the Stage 1 building will be highly variable in type and strength. Assuming an excavation level of the order of 70m AHD the excavation for the proposed Stage 1 Building will be entirely in the Kotara Formation and Victoria Tunnel Seam. The materials excavated will comprise variable strength rock comprising sandstone, siltstone, tuffaceous claystone and coal. In fact at an excavated level of about 70m AHD much of the exposed excavated base will be in the weathered Victoria Tunnel Seam and associated tuffaceous clay and siltstone.

It is expected that:

- Excavation of the weathered VT Seam and associated low strength or weaker claystone and siltstone layers will be possible by conventional equipment such as excavators and bulldozers.

- Excavation in medium to high strength sandstone and pebbly sandstone (present in the Kotara and Shepherds Hill Formations) will require heavy ripping by a D10 bulldozer or equivalent and heavy rock breaking pneumatic equipment for confined / detailed excavations. It is noted that for a depth of excavation of about 70m AHD these rock types are likely to be only present in the excavation depth zone within the eastern half of the Stage 1 site.

Avoidance of over break along the design excavation line can prove difficult in medium and high strength rock. Experience has shown that the use of excavator-mounted saws or milling heads can often successfully overcome over break problems. Regular inspections of the excavation works by an experienced engineering geologist/geotechnical engineer are suggested to check for potential unstable rock wedges.

Noise and vibration will be generated by excavation work on the site and allowance for this should be made during design and construction given the close proximity to hospital buildings.

4.3.1.2 EXCAVATION SUPPORT

It is suggested that full height retaining structures will be required as part of the final structure and may be used to temporarily support the excavation during the excavation and construction phase.

Short-term excavations in soil and rock may be constructed at maximum batters of 1H:1V and 1H:4V respectively and cuts greater than 1.5m in depth should be subject to specific geotechnical assessment.

Long-term excavations should be battered at 2H:1V and revegetated or retained by an engineer designed retaining wall.

It is suggested that excavations greater than 2m in depth that are proposed to be supported by retaining systems should have excavation support installed progressively as they are excavated or that the support system should be installed prior to excavation. This is expected to include contiguous pile walls or soldier walls through the soil and weathered rock and meshing and pattern rock bolting, meshing and dental shotcrete in the moderately weathered to fresh rock. The VT Coal Seam will require rock bolted meshing and covering by shotcrete. Owing to the possibly presence of perched groundwater the installation of strip drains between the shotcrete and the rock face is recommended.

Excavations into and below the VT seam are likely to require stabilization measures comprising horizontal drains perpendicular to the excavation face in combination with rock anchors to provide a suitable factor of safety against sliding of the overlying sandstone / conglomerate rock mass on the claystone layers within the VT seam.

For deep excavation works such as is proposed for the Stage 1 building some movement may be experienced behind the excavation face. Even with shoring the release of stresses in rock at depth is generally accompanied by lateral movement which can give rise to observed displacement behind the excavation face. Generally is can be expected that lateral movements at the rock face could be of the order of 1-2mm per metre of excavation.

Parameters for retaining walls, shoring and rock anchors are provided in Section 4.4.

4.3.2 FILLING

Any filling on the site should be placed and compacted in accordance with *AS 3798–2007, Guidelines on Earthworks for Commercial and Residential Development*.

All fill should be supported by properly designed and constructed retaining walls or else battered at 2H:1V or flatter and protected against erosion by vegetation or similar and the provision of adequate drainage provided with lining to minimise erosion.

Where fill is placed on slopes of surface gradient greater than about 8H:1V (about 7°) a benched (stepped) foundation should be cut into the slope to provide a level platform for the fill.

4.3.3 REUSE OF SITE SOILS AND ROCKS

With the exception of coal and high plasticity clays it is expected that the material won from excavations below the topsoil / slopewash and deleterious material may be considered for reuse as structural filling. The use of coal and high plasticity clay materials will be subject to special considerations as discussed later in this section.

Reference to the geotechnical sections in **Drawings 3, 4 and 5** indicate that materials that will be excavated for the Stage 1 building will be highly variable and will require careful management during excavation to maximize opportunity for reuse. It is assumed that reuse options across the development may comprise use in embankments for roads and as structural fill for building platforms. Assuming an excavation level of the order of 70m AHD the excavation for the proposed Stage 1 Building will be entirely in the Kotara Formation and Victoria Tunnel Seam. The materials excavated will comprise variable strength rock comprising sandstone, siltstone, tuffaceous claystone and coal. Any excavation beneath the VT Seam is likely to encounter sandstone / pebbly sandstone within the depth of interest.

The VT seam and adjacent strata are typically highly weathered and of low strength in the vicinity of the subcrop with the ground surface.

Potentially problematic materials include:

- Coal material is recommended to be reused through blending with general fill and placed within zoned embankments to isolate the combustible material from potential sources of ignition. For preliminary purposes, it is recommended that general fill contain no more than 15% coal by volume.
- Weathering products of tuffaceous materials on site are known to comprise expansive soils. Tuffaceous material is recommended to be reused as core material in zoned embankment fill with careful moisture control.

4.3.4 WORKING PLATFORM

Depending on excavation level the exposed excavation base may comprise weathered coal and or tuffaceous rock and may be susceptible to rapid degradation on exposure providing poor trafficability and loss of strength if the moisture content increases (following rain events, or if water is allowed to pond on the weathered rock surface). In those conditions consideration could be given to the provision of a nominal working platform of 300 mm thickness of crushed rock or crushed concrete to improve trafficability of the site.

A more substantial working platform may be required for the operation of heavy plant on the exposed material. The specific requirements will depend on the particular loading applied by the plant and subgrade conditions at the time of loading and will require assessment at that stage.

4.4 RETAINING STRUCTURES

4.4.1 DESIGN PARAMETERS

Design of retaining walls should:

- Consider surcharge loading from slopes, structures above and backfill behind the wall.
- Provide adequate subsurface and surface drainage.
- Utilise materials that are not susceptible to deterioration.
- Provide for full drainage or make provision to support full hydrostatic load.

Retaining wall footings should be founded on/in bedrock. Preliminary geotechnical design parameters for retaining wall design are presented in **Table 9**. Note that the parameters provided in Table 9 do not include allowance for surcharge loads, slopes above the wall and hydrostatic pressure.

Table 9 *Preliminary Geotechnical Parameters for Retaining Wall Design*

Material	Geotechnical Parameters				
	Bulk Unit Weight (kN/m^3)	**Cohesion c' (kPa)**	**Friction Angle ϕ' (degrees)**	**At Rest (1) Coefficient of Lateral Earth Pressure**	**Active (2) Coefficient of Lateral Earth Pressure**
Angular 20mm aggregate backfill	21	0	40	0.36	0.22
Residual CLAY / Sandy CLAY soils	19	5	25	0.58	0.4
Extremely to Low strength rock (Class V/IV)	21	5	25	0.65(3)	0.4
Medium to High Strength rock (Class III)	22	10	35	0.43	0.27

(1) At Rest Lateral Earth Pressure for design of rigid and permanent walls.

(2) Active Lateral Earth Pressure for design of temporary flexible walls (eg cantilever walls).

(3) Includes allowance for clay swelling if applicable.

Lateral earth pressure on the developments basement walls below the ground surface will arise from granular backfill and possibly the expansion of clay seams in the rock mass due to moisture content increases. Accordingly, it is recommended that the retaining wall and basement walls of the structure should be designed based on at rest earth pressures. Foundations for retaining structures may be based on the parameters presented in **Table 10** and **Table 11.**

4.4.2 ROCK ANCHORS

As described in Section 4.3.1 excavations are likely to require rock anchor support.

Anchoring of soldier piles can be accomplished by prestressed type anchors and it is suggested that these be inclined as steeply as possible, but preferably not exceeding 30°, to allow anchoring in the stronger rock where available. Anchoring at more than 30° tends to increase the vertical loading in the pile. For estimating purposes it is suggested that an allowable bond stress of 150kPa be adopted in low strength rock and 1000kPa in medium to high strength rock.

In relation to rock anchors the following is noted:

- It is the contractor's responsibility to ensure that the correct design values (specific to the anchor system and method of installation) are used and that the anchor holes are carefully cleaned out prior to grouting.
- It is recommended that anchors be tested to 125% of nominal working load and then locked off at between 60% and 80% of their working loads.
- Checks are recommended to ensure that anchor load is maintained throughout the construction period and is not lost due to creep effects or to other causes.

4.5 FOUNDATIONS

4.5.1 GENERAL

The development is to include the construction of a multi-storey building supported by concrete columns supporting suspended post-tensioned concrete slabs in the order of 200-250 thick. A reinforced concrete lift shaft is also proposed.

Maximum service column/footing loads are expected to be in the order of 11,000 to 12,000kN downward and 5,000kN upward.

It is understood that the structure will be supported on a combination of pad and strip footings and/ or piled raft foundations.

The following sections provide commentary and design parameters for foundations.

4.5.2 HIGH-LEVEL FOOTINGS

High-level footing alternatives could be expected to comprise slabs on ground with edge beams or pad footings for the support of concentrated loads. These high-level footing types could be founded on the residual clays or rock below any topsoil, slopewash or existing fill. High-level footings could also be founded on engineered fill that is placed and compacted in accordance with *AS 3798–2007*.

It is suggested that high-level footings may be proportioned based on the allowable bearing pressures shown on **Table 10.**

Table 10 *Allowable Bearing Pressures for High Level Footings*

Founding Strata	Allowable Bearing Pressure (kPa)
Engineered fill placed and compacted in accordance with AS 3798-2007	100
Residual clay soils below any existing fill or topsoil	150
Very Low to Low strength rock	500
Medium strength rock	1500
High strength rock	3000

Inspection of high-level footing excavations should be undertaken during construction to confirm founding conditions. The base of all footing excavations should be cleaned of fall-in prior to formation of the footing.

The alternative to deep edge beams or high-level footings is piered footings.

4.5.3 PIERED FOOTINGS

Piered footings could be considered as an alternative to deep edge beams or high-level footings. For preliminary design it is suggested that piered footings founded in the weathered rock could be designed based on the design parameters shown on **Table 11**.

Table 11 *Design Parameters for Bored Piers*

Material	End Bearing Pressure (MPa)		Ultimate Shaft Adhesion[1,3] (kPa)		Young's Modulus[4] (MPa)	Spring Constant[5] (kPa/m)
	Ultimate[1]	Serviceability[2]	Compression	Tension[6]		
Residual Soil/Extremely Weathered Material	-	-	30	15	30	-
Extremely low to very low strength siltstone (Class V)	3	0.7	100	50	50	50,000
Low strength siltstone and sandstone (Class IV)	4	1.5	250	125	150	150,000
Medium strength siltstone and sandstone (Class III)	20	3	1000	500	500	500,000
High strength sandstone and conglomerate (Class II)[7]	60	6	2000	1000	1000	1,000,000

Notes

- indicates parameter not applicable

(1) Ultimate values occur at large settlement (>5% of minimum footing dimensions). The ultimate shaft adhesion and ultimate end bearing shall be multiplied by the geotechnical materials factors (Rg) to derive the design strength (Rg*)

(2) End bearing pressure to cause settlement of <1% of minimum footing dimension.

(3) Clean socket of roughness category R2 or better.

(4) E' is stress dependent and should be selected from the appropriate stress range as required.

(5) The spring constant parameter is not an intrinsic property of a material as it is a function of the loaded area and modulus. The above values are approximate and should be used with caution and with oversight by experienced structural engineers.

(6) Ultimate shaft adhesion in tension is recommended at 50% of compression values for preliminary design. It is noted that where assurance can be assured of at least R2 roughness and that sidewalls can be confirmed to be free of smeared material and crushed rock then tension values of up to 70% of compression values may be applicable.

(7) Adoption of design parameters for Class II rock would require core testing at pier locations to confirm the availability of bearing capacity and the absence of clay seams and defects.

At this stage it is recommended that a geotechnical strength reduction factor (ϕ_g) of 0.5 be adopted. Depending on the proposed structural design system and proposed pile testing and construction verification level the geotechnical strength reduction factor will be able to be revised for detailed design.

For the purposes of preliminary design it is suggested that:

- Where the base of the building excavations is in proximity to the VT seam it is expected that pile foundations into the sandstone of the Shepherds Hill Formation sandstone below the VT seam will be required.
- Foundations should be founded a minimum of 5m above the Nobby's Seam or be taken through the Nobby's Seam into the sandstone of the Bar Beach Hill Formation. It is noted that the thickness of the Shepherds Hill Formation at the bore locations is of the order of 8m.

4.5.4 EARTHQUAKE DESIGN

In accordance with *AS 1170.4-2007* the site in its existing state is classified as a Subsoil Class C_e – shallow soil site.

Assuming that the main structure is founded in rock, the Subsoil Class for that structure, as defined in AS1170.4 - 2007, would be classified as a Class B_e – rock site.

4.5.5 SOIL AGGRESSIVITY

Soil and rock samples were submitted for laboratory testing to assess potential for aggressive soil conditions that could impact on buried concrete and steel elements. Results of the analysis were compared to aggressivity levels in the Piling – Design and Installation Standard (AS2159-2009). The laboratory test reports for aggressivity are attached in **Appendix C** and results are summarized in **Table 5**.

Exposure classifications based on AS2159-2009 are presented in **Table 12**.

Table 12 *Summary of Soil and Rock Aggressivity Results*

Bore	Depth (m)	Soil Type	Aggressivity to buried steel elements	Aggressivity to buried concrete elements
BH101	7.00-7.15	SANDSTONE	Non aggressive	Non aggressive
BH102	3.30-3.37	Tuffaceous SILTSTONE	Non aggressive	Mild
BH104	0.5-0.95	CLAY	Non aggressive	Mild
BH105	9.67-9.90	SILTSTONE	Non aggressive	Non aggressive
BH106	3.50-3.63	Tuffaceous CLAYSTONE	Non aggressive	Non aggressive
BH106	13.00-13.16	SILTSTONE / SANDSTONE	Non aggressive	Non aggressive
BH107	3.00-3.37	SANDSTONE	Mild	Mild
BH109	5.80-6.00	COAL (weathered to Clayey SILT)	Non aggressive	Mild
BH109	7.70-7.80	COAL	Non aggressive	Mild
BH110	5.85-6.00	Tuffaceous SANDSTONE	Non aggressive	Non aggressive

From the results presented above, the soil and rock conditions are generally non-aggressive to buried steel elements. One test for sandstone suggested mild conditions to steel elements.

For buried concrete elements a number of soil tests indicate mild aggressivity due to pH less than 5.5. It is suggested that at least mild conditions for concrete elements be allowed for in design.

4.6 PAVEMENTS

With reference to **Drawing 1** the masterplan for the site include provision of new roads within the site particularly along the northern boundary of the site and also providing connection between the existing roads and the proposed Newcastle Inner City Bypass that passes immediately to the west of the site. To provide data for preliminary assessment and design of pavements, nine test pits (TP101-TP109) were undertaken along the proposed roads alignments.

4.6.1 SUBGRADE CONDITIONS

The natural subgrade conditions encountered in the test pits at the site comprised high plasticity clay and low plasticity sandy clay. Rock was encountered in the tests pits at depths ranging from 0.6m at TP104 to over 2.2 at TP102. Rock type was variable and included sandstone, siltstone, shale and carbonaceous siltstone.

The results of the laboratory CBR tests undertaken on samples of soil and rock indicate:

- The high plasticity clay subgrade materials encountered at the site indicated a soaked CBR value in the range 1% to 4%.

- The low plasticity sandy clay subgrade materials encountered at the site indicated a soaked CBR value of 4% to 5%.

Based on the results of the laboratory CBR testing a design subgrade CBR of 2% is suggested for clay subgrade, 5% for siltstone and shale subgrade and 10% for sandstone and conglomerate subgrade.

4.6.2 DESIGN TRAFFIC LOADING

Traffic loadings for the pavements within the site are not known, however it is expected that given the nature of the site the pavements will be subject to heavy loading during the life of the pavements.

Based on Newcastle City Council guidelines for a Collector Classified Road design traffic of 8×10^5 equivalent standard axles (ESA) has been assumed for preliminary design purposes.

The pavement design provided is preliminary and will need to be reviewed based on detailed traffic assessment at the appropriate stage of design.

4.6.3 PAVEMENT DESIGN

For the purpose of planning design options for an unbound flexible pavement are considered.

Pavement compositions for an unbound flexible pavement for the proposed pavement rehabilitation works are shown on **Table 13**.

Table 13 *Pavement Compositions for Unbound Flexible Pavement*

Pavement Layer	**Thickness of Pavement Layer**			
Subgrade Type and Assumed CBR	High plasticity clay subgrade 2%	Low plasticity sandy clay subgrade 4%	Siltstone or shale rock subgrade 5%	Sandstone or conglomerate subgrade 10%
Wearing course	40mm dense graded AC14	40mm dense graded AC14	40mm dense graded AC14	40mm dense graded AC14
Basecourse	150mm	150mm	150mm	120mm
Subbase	430mm	260mm	210mm	100mm
Total Pavement Thickness	620mm	450mm	400mm	260mm

A 7mm primer seal should be placed over the basecourse prior to placement of the asphaltic concrete wearing course.

It is noted that the thickness of the asphaltic concrete wearing course shown on **Table 13** is based on the asphaltic concrete wearing course thicknesses typically indicated in Council's engineering guidelines and is considered to be the minimum required wearing course thickness. In our experience there is a risk with the use of a thin asphaltic concrete wearing course associated with deformations / distress of the asphaltic concrete wearing course, particularly from turning / screwing loads at locations such as corners and intersections. Accordingly, periodic maintenance / rehabilitation of the asphaltic concrete wearing course may be required and it is suggested that allowance should be made in this

regard. Alternatively, consideration could be given to the use of a thicker asphaltic concrete wearing course in order to increase the life and improve the performance of the asphaltic concrete wearing course, with the use of a suitably toughened or heavy duty asphaltic concrete wearing course in areas, e.g., sharp bends and intersections, which may be subject to turning / screwing loads.

4.6.4 PAVEMENT MATERIALS AND COMPACTION REQUIREMENTS

Pavement material specifications and compaction requirements for unbound pavement materials are shown on **Table 14**.

Table 14 *Pavement Materials and Compaction Requirements*

Pavement Layer	Material Specification	Compaction Requirements
Basecourse High quality crushed rock or base quality gravel	Material complying with RMS QA Specification 3051 (Ref [1]). CBR > 80% PI < 6%	Min 98% Modified (AS 1289 5.2.1)
Subbase Subbase quality gravel	Material complying with RMS QA Specification 3051 (Ref [1]). CBR > 30% PI < 12%	Min 95% Modified (AS 1289 5.2.1)
Fill Select subgrade or subgrade replacement	CBR > 15%	Min 100% Standard (AS 1289 5.1.1)
Subgrade		Min 100% Standard (AS 1289 5.1.1)

CBR – California bearing ratio, PI – Plasticity index.

4.6.5 PAVEMENT DRAINAGE

The moisture regime associated with a pavement has a major influence on the performance of the pavement since the stiffness/strength of the pavement materials and subgrade is very dependent on the moisture content of the materials. Accordingly, to protect the pavement materials and subgrade from wetting up and softening, particular care would be required to provide a waterproof seal for the pavement materials and adequate surface and subsurface drainage of the pavement and adjacent area.

It is recommended that subsoil drains should be provided at the edge of pavements and interface with adjoining pavements.

Where subsoil drains will be subject to traffic it is suggested that no fines concrete be used for the drainage material.

4.6.6 SUBGRADE PREPARATION

Subgrade preparation for pavement construction could generally be expected to comprise the following:

- Excavation to subgrade formation level.
- Ripping of any weathered rock exposed at subgrade formation level to a minimum depth of 300mm below subgrade formation level.

- Proof rolling of the exposed subgrade with a heavy (minimum 10 tonne static) roller. Soft or weak areas detected during the proof rolling should be excavated and replaced with compacted select fill/subgrade replacement.
- Compaction of the subgrade to achieve a minimum dry density ratio of 100% Standard (AS 1289 5.1.1).
- Formation of the pavement in accordance with the above recommendations and specifications.

Based on the subsurface conditions encountered in the boreholes, weathered rock is likely to be exposed at subgrade formation level at some locations. Where rock is exposed at subgrade formation level, subgrade preparation should include ripping of the exposed rock subgrade to a minimum depth of 300mm below subgrade formation level and compaction of the ripped rock subgrade to achieve a minimum dry density ratio of 100% Standard. Any abrupt changes between subgrade conditions, e.g., transition from rock subgrade to soil subgrade, should be eliminated during subgrade preparation. This could be expected to involve subgrade preparation practices such as selective grading or mixing of material to provide a transition between material types and moisture / density control of subgrade compaction.

4.7 ACID SULFATE ASSESSMENT

4.7.1 ACID SULFATE RISK

The site lies at elevated RL and would not be considered to be at risk of acid sulfate soil conditions. The Wallsend Acid Sulfate Risk Map indicates that there has been no known occurrence of Acid Sulfate soil materials within the site.

Rocks from coal measures are often associated with some potential for acid potential and limited testing was undertaken to assess this risk.

The action criteria for acid sulfate soils (ASS), as specified by Ahern et al. (1998) where more than 1,000 tonnes of soil is to be disturbed, is as follows:

- Sulfur trail 0.03% S
- Acidity trail 18 mole H+/t

For the purpose of the investigation this criterion has been applied to acid sulfate soil ASS and rock (ASR). Acid sulfate soil and rock samples were collected from boreholes and tested by:

- Acid sulfate screen tests
- SPOCAS/CRS acid sulfate tests

Results and discussion are presented below.

4.7.2 RESULTS

Acid sulfate screening tests were undertaken on twenty soil/rock samples recovered from the boreholes. The results of the screening are shown above in **Table 15**. The ASSMAC guidelines (1998) (Ref 6) indicate that potential acid sulfate soil conditions are present where the pH of soil in peroxide is less than 3 and/or the pH change during the test is greater than 1. The screening test results indicated:

- None of the samples tested had a pH in water of less than 4 indicating that no actual acid sulfate material was tested.

- Eighteen samples indicated a change of pH of greater than 1 and seven samples indicated an oxidised pH of less than 3. It is therefore expected that the soil or rocks that would be classified as potential ASS/ASR may be present at the site.

Based on the results of the acid sulfate screening tests seven samples were selected for further chromium suite laboratory testing. The results of the chromium suite laboratory testing are presented in **Table 16**.

Table 15 *Acid Sulfate Rock Screening Test Results*

Borehole	Depth	Rock Type	pH_F	pH_{FOX}	ΔpH	Reaction Rate
BH101	5.05-5.25	SILTSTONE	5.5	3.8	1.7	Moderate
BH102	3.43-3.62	Tuffaceous SILTSTONE	4.8	2.5	2.3	Moderate
BH103	7.65-7.85	SANDSTONE / SILTSTONE	6.7	2.3	4.4	High
BH103	9.25-9.47	Tuffaceous CLAYSTONE	6.1	2.8	3.3	Vigorous
BH103	9.65-9.85	Tuffaceous CLAYSTONE	6.5	3.6	2.9	Moderate
BH106	3.63-3.80	Tuffaceous CLAYSTONE	5.4	3.7	1.7	Moderate
BH106	3.80-4.00	SILTSTONE	5.4	2.5	2.9	Moderate
BH106	5.00-5.20	Tuffaceous CLAYSTONE	4.9	3.4	1.5	Moderate
BH106	6.80-7.00	COAL	4.4	2.8	1.6	Moderate
BH106	10.00-10.20	SILTSTONE	5.8	3.2	2.6	Vigorous
BH106	11.41-11.55	SILTSTONE	6.4	5.7	0.7	High
BH107	10.31-10.48	SANDSTONE	9.1	8	1.1	Vigorous
BH107	13.00-13.20	Pebbly SANDSTONE	7.3	6.3	1	Vigorous
BH108	6.54-6.77	SANDSTONE	6.3	5.1	1.2	Moderate
BH109	8.00-8.20	COAL	5.2	3.2	2	Moderate
BH109	8.85-9.00	SILTSTONE	6	3.2	2.8	High
BH109	14.00-14.15	SANDSTONE	8.1	6.7	1.4	Moderate
BH110	2.80-3.00	Pebbly SANDSTONE	6.5	4.4	2.1	Moderate
BH110	7.83-8.00	SILTSTONE	6	2.4	3.6	Moderate
BH110	8.75-8.90	COAL	5.2	2.3	2.9	High

Notes: Results shown in shaded cells exceed The Acid Sulfate Soils Management Advisory Committee's "Acid Sulfate Soils Assessment Guidelines" (Ref 6) action criteria.

Table 16 *Summary of Chromium Suite Laboratory Test Results*

Borehole	Depth	Rock Type	pH_{KCl}	TAA (molH+/t)	CRS (%S)	Net Acidity	
						(molH+/t)	(%S)
BH102	3.43-3.62	Tuffaceous SILTSTONE	4.3	56	0.007	60	0.10
BH103	7.65-7.85	SANDSTONE / SILTSTONE	4.6	30	0.009	36	0.06
BH103	9.25-9.47	Tuffaceous CLAYSTONE	5.2	8	0.046	37	0.06
BH106	3.80-4.00	SILTSTONE	4.7	22	0.012	29	0.05
BH106	6.80-7.00	COAL	3.5	1020	0.015	1030	1.65
BH110	7.83-8.00	SILTSTONE	4.3	92	0.006	96	0.15
BH110	8.75-8.90	COAL	3.4	1100	0.015	1100	1.77

Notes: CRS – Chromium Reducible Sulfur is a measure of inorganic sulfur content, TAA – Titratable Actual Acidity, Shaded cells exceed trigger values in ASSMAC 1998 Guidelines (Ref 6) for a disturbance of greater than 1000 Tonnes.

The results of the chromium suite laboratory testing summarised in **Table 16** indicate that the samples of site materials tested exceed the action criteria. However, it is noted that most of the acidity that is present is actual acidity while only one sample indicated the presence of inorganic sulfur content that triggers the action criteria. In particular the high TAA readings for the coal samples may be ascribed to the presence of organics rather than sulfur. The results are considered to indicate a low potential for acid sulfate rock drainage.

5 LIMITATIONS

This report has been prepared for Health Infrastructure in accordance with the agreement with RCA Australia (RCA). The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of Health Infrastructure for the specific purpose and the specific development described in the report. The report may not contain sufficient information for purposes or developments other than that described in the report or for parties other than Health Infrastructure. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without permission.

The information in this report is considered accurate at the date of issue with regard to the current conditions of the site. The conclusions drawn in the report are based on interpolation between boreholes or test pits. Conditions can vary between test locations that cannot be explicitly defined or inferred by investigation.

Yours faithfully
RCA AUSTRALIA

Robert Carr
Principal Geotechnical Engineer

Dr Mark Allman
Principal Geotechnical Engineer

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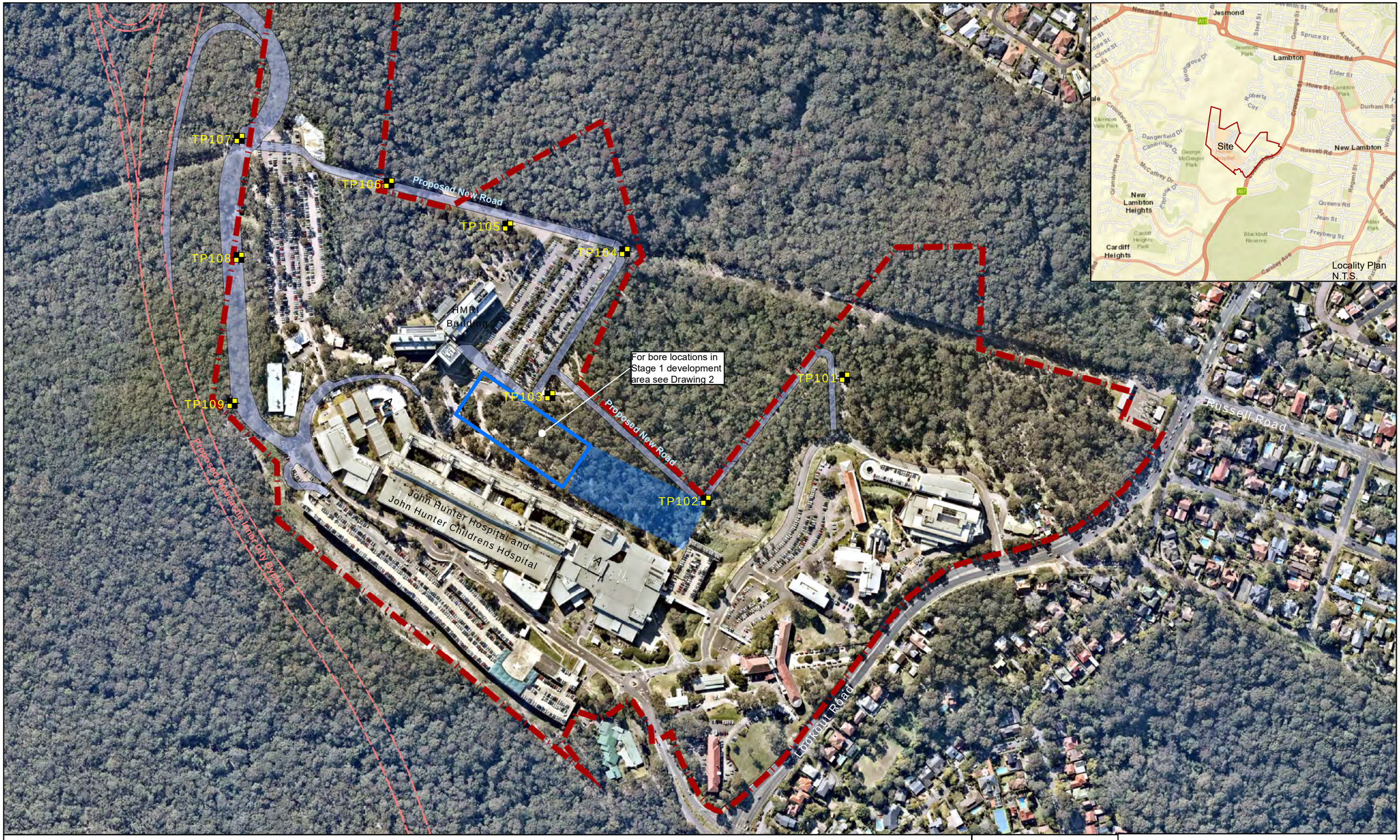
Appendix A

Drawings



LEGEND

- Approximate site boundary
- Proposed development - Stage 1
- Proposed development - Stage 2
- Test pit location
- Proposed roads
- Proposed Newcastle Inner City Bypass

Aerial image taken from Nearmap, August 15 2019
(used in accordance with commercial licence)

0 25 50 100 150 200
metres

N

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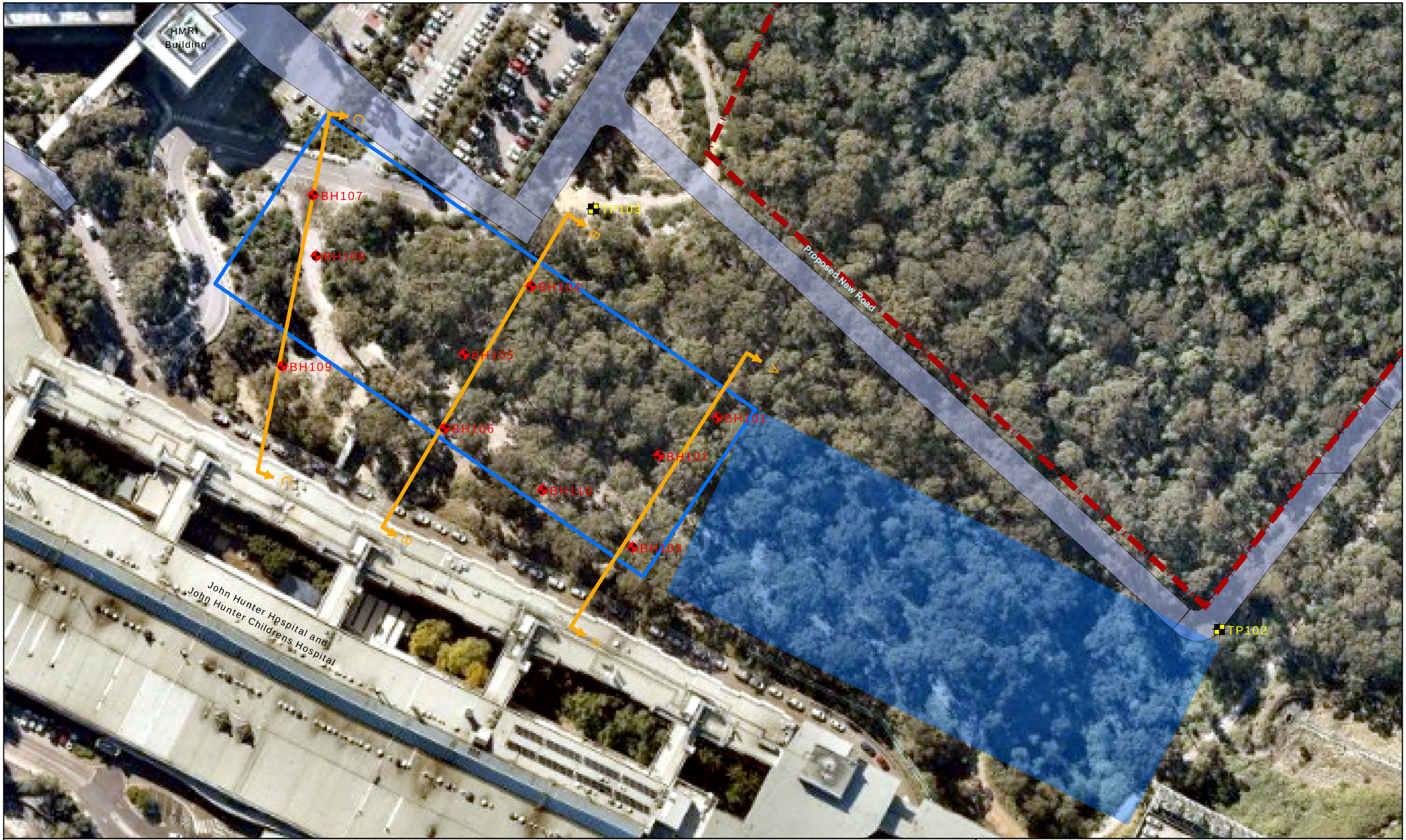
SITE AND TEST LOCATION PLAN
GEOTECHNICAL INVESTIGATION REPORT
JOHN HUNTER HEALTH AND INNOVATION PRECINCT

CLIENT	Health Infrastructure			RCA Ref	14399-207/1
DRAWN BY	BG	SCALE	1:4,000 (A3)	DRAWING No 1	REV 0
APPROVED BY	MA	DATE	3/12/2019	OFFICE	NEWCASTLE



LEGEND

- Approximate site boundary
- Proposed development - Stage 1
- Propsed development - Stage 2
- Borehole location
- Test pit location
- Sections
- Proposed roads

Aerial image taken from Nearmap, August 15 2019
(used in accordance with commercial licence)

0 5 10 20 30 40
metres

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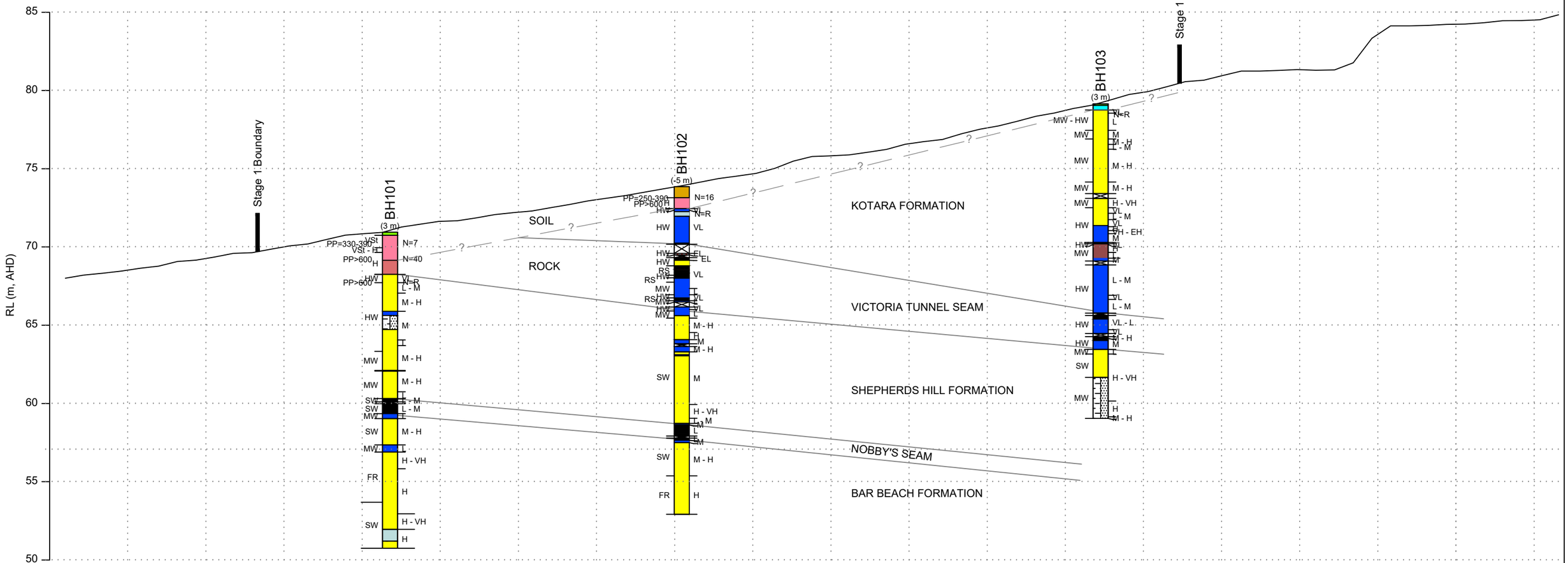
STAGE 1 TEST LOCATION PLAN
GEOTECHNICAL INVESTIGATION REPORT
JOHN HUNTER HEALTH AND INNOVATION PRECINCT

CLIENT	Health Infrastructure			RCA Ref	14399-207/1
DRAWN BY	RC	SCALE	1:1,000 (A3)	DRAWING No 2	REV 0
APPROVED BY	MA	DATE	3/12/2019	OFFICE	NEWCASTLE



LEGEND

Geotechnical Units

Soil

- FILL
- TOPSOIL
- SLOPEWASH
- RESIDUAL
- Extremely Weathered Material

Rock

- CLAYSTONE/Tuffaceous CLAYSTONE
- SILTSTONE/Tuffaceous SILTSTONE/LAMINITE
- SANDSTONE/Tuffaceous SANDSTONE/Pebbly SANDSTONE
- Interbedded SILTSTONE/SANDSTONE
- CONGLOMERATE/Tuffaceous CONGLOMERATE
- COAL
- Interbedded COAL and SILTSTONE
- CORE LOSS

BOREHOLE ID (1m)

Hole offset

Soil consistency/ density xx

N=00 SPT N value R=SPT refusal

Pocket Penetrometer PP=

Rock weathering xx

xx Estimated Rock Strength

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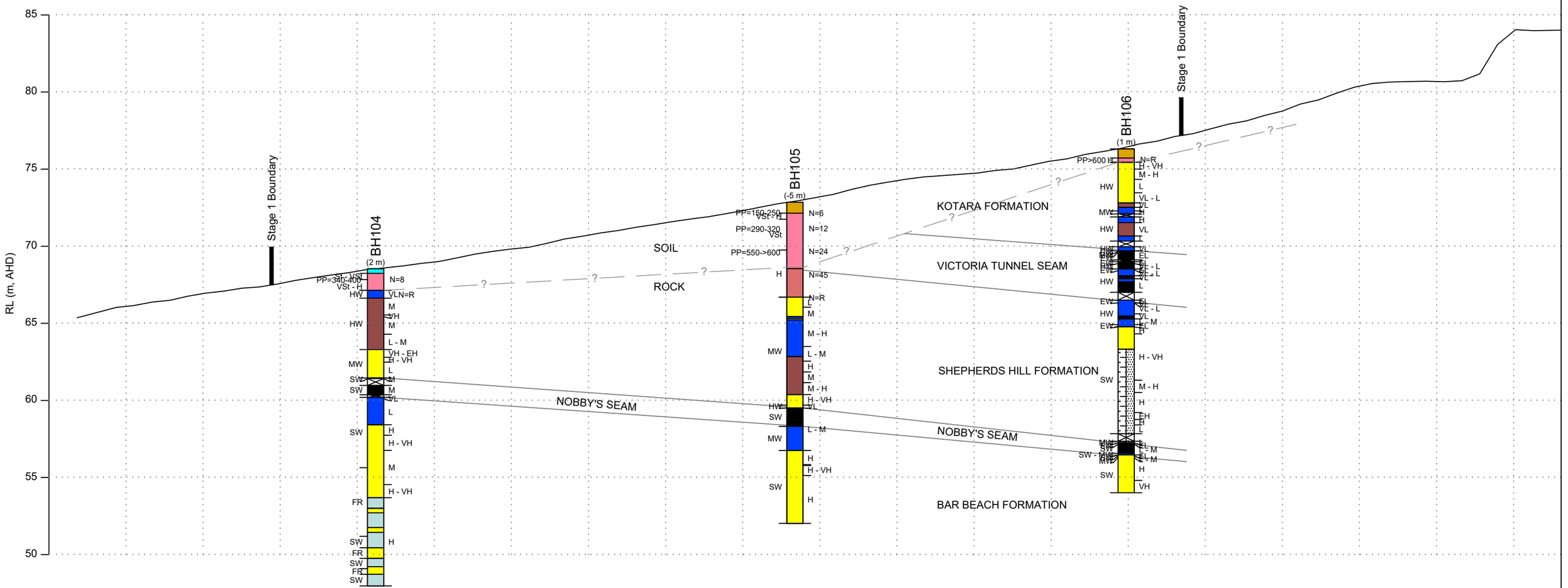
GEOTECHNICAL • ENVIRONMENTAL

GEOTECHNICAL SECTION A-A JOHN HUNTER HEALTH AND INNOVATION PRECINCT

CLIENT	Health Infrastructure			RCA Ref	14399-207/1
DRAWN BY	MA	SCALE	1 : 250 (A3)	DRAWING No 3	REV 0
APPROVED BY	RJC	DATE	3/12/2019	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1



LEGEND

Geotechnical Units

Soil

- FILL
- TOPSOIL
- SLOPEWASH
- RESIDUAL
- Extremely Weathered Material

Rock

- CLAYSTONE/Tuffaceous CLAYSTONE
- SILTSTONE/Tuffaceous SILTSTONE/LAMINITE
- SANDSTONE/Tuffaceous SANDSTONE/Pebbly SANDSTONE
- Interbedded SILTSTONE/SANDSTONE
- CONGLOMERATE/Tuffaceous CONGLOMERATE
- COAL
- Interbedded COAL and SILTSTONE
- CORE LOSS

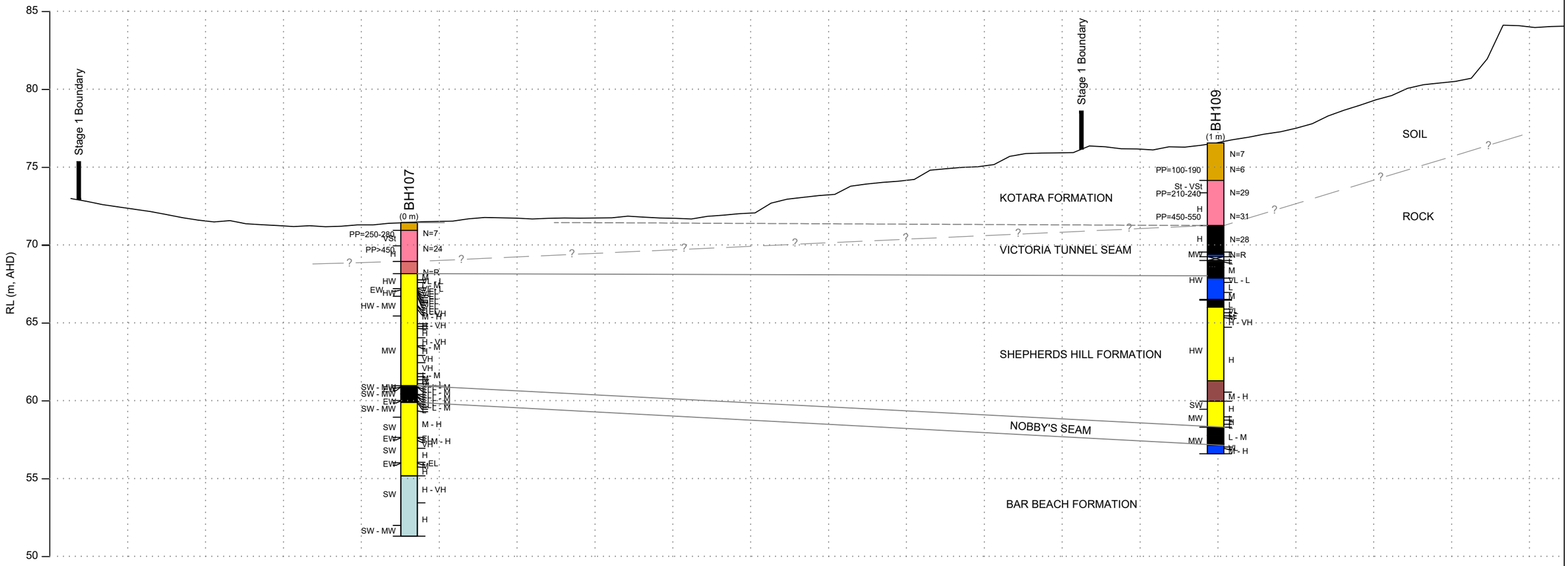
BOREHOLE ID
(1m) Hole offset
Soil consistency/ density xx
N=00 SPT N value R=SPT refusal
Pocket Penetrometer PP=
Rock weathering xx
xx Estimated Rock Strength

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

GEOTECHNICAL SECTION B-B JOHN HUNTER HEALTH AND INNOVATION PRECINCT

CLIENT	Health Infrastructure			RCA Ref	14399-207/1
DRAWN BY	MA	SCALE	1 : 250 (A3)	DRAWING No 4	REV 0
APPROVED BY	RJC	DATE	3/12/2019	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1



LEGEND

Geotechnical Units

Soil

- FILL
- TOPSOIL
- SLOPEWASH
- RESIDUAL
- Extremely Weathered Material

Rock

- CLAYSTONE/Tuffaceous CLAYSTONE
- SILTSTONE/Tuffaceous SILTSTONE/LAMINITE
- SANDSTONE/Tuffaceous SANDSTONE/Pebbly SANDSTONE
- Interbedded SILTSTONE/SANDSTONE
- CONGLOMERATE/Tuffaceous CONGLOMERATE
- COAL
- Interbedded COAL and SILTSTONE
- CORE LOSS

BOREHOLE ID

(1m) Hole offset

Soil consistency/ density xx

N=00 SPT N value R=SPT refusal

Pocket Penetrometer PP=

Rock weathering xx

xx Estimated Rock Strength

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

GEOTECHNICAL SECTION C-C JOHN HUNTER HEALTH AND INNOVATION PRECINCT

CLIENT	Health Infrastructure			RCA Ref	14399-207/1
DRAWN BY	MA	SCALE	1 : 250 (A3)	DRAWING No 5	REV 0
APPROVED BY	RJC	DATE	3/12/2019	OFFICE	NEWCASTLE

CDT-DWG-A3H-001/1

Appendix B

Register of Test Location Coordinates and Levels

Test Pit Logs

Borehole Logs

Piezometer Logs

Core Photographs

Explanatory Notes

Monteath & Powys Pty Ltd

FORM 200
ISSUE 2
17/1/2012

19/0575 - John Hunter Hospital Geotechnical Test Pit Locations

Job Number: 19/0575
Client: 18/10/2019
Site: John Hunter Hospital

Date of report: 18/10/2019
Issue: 1

Date of Survey: 16/10/2019
Surveyed: MJ
Checked: TR

	MGA coordinates (Ground Coords)		RL (AHD)
Borehole ID	Easting	Northing	Ground level
BH101	377909.9	6356635.8	70.95
BH102	377892.8	6356624.6	73.85
BH103	377885.1	6356597.7	79.15
BH104	377855.3	6356674.3	68.70
BH105	377835.7	6356654.3	72.75
BH106	377830.0	6356632.7	76.60
BH107	377791.5	6356701.0	71.40
BH108	377792.3	6356683.2	71.40
BH109	377782.4	6356650.9	76.03
BH110	377858.7	6356614.5	77.95
BH111a	377889.7	6356615.5	75.85
BH111b	377898.8	6356621.4	73.70
HA1	377787.4	6356655.7	75.00
HA2	377787.9	6356702.2	71.75
HA3	377820.8	6356686.0	66.98
HA4	377832.0	6356686.5	67.20
HA5	377823.7	6356673.0	69.80
HA6	377803.4	6356655.2	73.50
HA7	377823.5	6356643.8	75.25
HA8	377849.9	6356663.3	70.70
HA9	377860.1	6356649.0	72.10
HA10	377873.2	6356654.0	70.80
HA11	377875.5	6356610.3	77.75
TP101	378220.6	6356718.6	86.60
TP102	378057.1	6356573.7	68.10
TP103	377873.6	6356697.0	63.80
TP104	377961.7	6356866.8	58.40
TP105	377824.0	6356897.2	69.15
TP106	377648.1	6356947.1	68.65
TP107	377507.8	6356999.9	76.95
TP108	377507.3	6356859.7	70.70
TP109	377499.3	6356687.8	68.45
TP110	378069.5	6356377.4	96.82

Notes: Survey using GPS (RTK methods)
Above horizontal coordinates accuracy ±100mm only
Above vertical levels accuracy ±50mm only

Origin of Coordinates (MP STN120)
Easting 378056.840
Northing 6356424.726
RL 96.517

Ground level is an indication of the ground level in the immediate area of the well.

TEST PIT LOG
TP101
SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2012
SURFACE RL: 86.60 m AHD
COORDS: 378220.60 m E 6356718.60 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered	5		D-TP101 0.10m	86.5	0.10		SW	TOPSOIL, Silty SAND, fine to coarse grained, dark brown, with fine sub-rounded gravel	M		TOPSOIL
	5		0.20m				CL	Sandy CLAY, low plasticity, grey mottled orange-brown, fine to medium grained sand, trace of fine angular gravel (relict sandstone)	w~PL	H	RESIDUAL
	4		B								
	4		0.40m					Sandstone band from 0.4m to 0.45m			
	10				0.5						
	10			86.0							
	20				0.70			SANDSTONE, fine grained, grey	DW	L	BEDROCK
					0.85			TEST PIT TP101 TERMINATED AT 0.85 m Bucket refusal			
					1.0						
				85.5							
					1.5						
				85.0							
					2.0						
				84.5							

LOGGED: BG | CHECKED: MA | DATE: 28/10/2019

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GEOTECHNICAL • ENVIRONMENTAL

TEST PIT PHOTOGRAPH
TP101

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

TEST PIT LOG
TP102

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2019
SURFACE RL: 68.10 m AHD
COORDS: 378057.10 m E 6356573.70 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered	1		D-TP102 0.10m	68.0	0.10		SM	TOPSOIL, Silty SAND, fine grained, brown	M		TOPSOIL
	2						SM	Silty SAND, fine to medium grained, pale brown, low plasticity silt, trace of fine to medium sub-rounded gravel		L	SLOPEWASH
	1		0.30m								
	2		B 0.40m								
	2				0.5						
	3									MD	
	4			67.5							
	4										
	8										
	11				1.0						
	12										
	8			67.0							
	11				1.20		CL	Sandy CLAY, low plasticity, orange and grey, fine to medium grained sand, trace of fine sub-rounded gravel	w>LL	VSt	RESIDUAL
	12										
	11	PP350kPa									
	11				1.5						
	15			66.5							
	15				1.70		CH	CLAY, high plasticity, grey mottled orange-brown	w>PL		
		PP350kPa									
					2.0						
				66.0							
								TEST PIT TP102 TERMINATED AT 2.20 m Limit of investigation			

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TEST PIT PHOTOGRAPH
TP102

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

TEST PIT LOG
TP103
SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2019
SURFACE RL: 63.80 m AHD
COORDS: 377873.60 m E 6356697.00 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered	11	PP340 - 390kPa	D-TP103 0.10m	63.5	0.10		SM	TOPSOIL, Silty SAND, fine to medium grained, brown, with fine to medium sub-angular gravel	D		TOPSOIL
	8		0.20m				CH	CLAY, high plasticity, pale grey	w>PL	VSt	RESIDUAL
	5		B		0.5						
	3		0.40m								
	4										
	4										
	4										
	7										
	10			63.0	0.80			Carbonaceous SILTSTONE, brown, Interbedded with SILTSTONE, grey	DW	VL - L	BEDROCK
	15				1.00						
	20							TEST PIT TP103 TERMINATED AT 1.00 m Bucket refusal			
				62.5	1.5						
				62.0	2.0						
				61.5							

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TEST PIT PHOTOGRAPH
TP103

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

TEST PIT LOG
TP104
SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2019
SURFACE RL: 58.40 m AHD
COORDS: 377961.70 m E 6356866.80 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered			D-TP104 0.10m				SM	TOPSOIL, Silty SAND, fine grained, brown, low plasticity silt	D		TOPSOIL
	5										
	10				0.30						
	8		0.40m	58.0			CH	CLAY, high plasticity, grey mottled orange-brown, with fine to medium grained sand	w~PL	H	RESIDUAL
	4		B 0.50m		0.5						
	5				0.60						
	5							SANDSTONE, medium grained, grey stained orange	DW	M	BEDROCK
					0.70						
	6							TEST PIT TP104 TERMINATED AT 0.70 m Bucket refusal			
	20			57.5	1.0						
				57.0	1.5						
				56.5	2.0						
				56.0							

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TEST PIT PHOTOGRAPH
TP104

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

H:\JOBFILES\Job14399- John Hunter Hospital\400 Fieldwork\[14399 TP Photos.xlsm]TP109

TEST PIT LOG
TP105
SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2019
SURFACE RL: 69.15 m AHD
COORDS: 377824.00 m E 6356897.20 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered			TP105 0.10m	69.0	0.20		SM	TOPSOIL, Silty SAND, fine grained, brown	M		TOPSOIL
	3										
	2						CH	CLAY, high plasticity, grey	w>PL	St - VSt	RESIDUAL
	2				0.40						
	3						CH	CLAY, high plasticity, grey stained orange	MW	VH	Extremely Weathered Siltstone Structure
	3	PP200kPa			0.5						
			0.60m		0.60						
	3			68.5			CL	Sandy CLAY, low plasticity, grey stained orange	XW	VL	
	9		B								
	15		0.90m		0.90						
	12							SHALE, grey	MW	L	BEDROCK
	20				1.0						
				68.0							
					1.40			TEST PIT TP105 TERMINATED AT 1.40 m Bucket refusal			
					1.5						
				67.5							
					2.0						
				67.0							

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GEOTECHNICAL • ENVIRONMENTAL

TEST PIT PHOTOGRAPH
TP105

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

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GEOTECHNICAL • ENVIRONMENTAL

TEST PIT LOG
TP106
SHEET 1 OF 1

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2019
SURFACE RL: 68.85 m AHD
COORDS: 377684.10 m E 6356947.10 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered			D-TP106 0.10m				ML	TOPSOIL, Sandy SILT, low plasticity, brown	M		TOPSOIL
	5		0.20m		0.20						
	1						CH	CLAY, high plasticity, pale brown mottled grey and orange, trace of fine to medium grained sand	w>PL	St	RESIDUAL
	2		B	68.5							
	2	PP140 - 160kPa	0.50m		0.5						
	1										
	2									VSt	
	2										
	2			68.0							
	2	PP300 - 340kPa						As above, grey			
	3				1.0						
	3										
	8				1.20			SILTSTONE, grey	SW	M - H	BEDROCK
	20			67.5					XW - HW	VL - L	Dipping across hole
					1.5						
								TEST PIT TP106 TERMINATED AT 1.60 m Bucket refusal			
				67.0							
					2.0						
				66.5							

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GEOTECHNICAL • ENVIRONMENTAL

TEST PIT PHOTOGRAPH
TP106

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

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TEST PIT LOG
TP107

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2019
SURFACE RL: 76.95 m AHD
COORDS: 377507.80 m E 6356999.90 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered			D-TP107 0.10m	76.95	0.00		ML	TOPSOIL, Sandy SILT, medium plasticity, brown, fine grained sand	w>PL		TOPSOIL
	3										
	2										
	3		0.40m		0.40						
	3		B	76.5	0.5		CH	CLAY, high plasticity, grey mottled orange-brown, with fine to medium grained sand	w>PL	St - VSt	RESIDUAL
	4	PP200kPa	0.60m								
	4										
	4										
	8										
	20			76.0	1.0					VSt	
		PP240 - 30kPa									Extremely Weathered Siltstone structure from 1.1m
				75.5	1.50			SILTSTONE/SHALE, grey	SW	M - H	BEDROCK
								TEST PIT TP107 TERMINATED AT 1.60 m Bucket refusal			
				75.0	2.0						
				74.5							

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RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

TEST PIT PHOTOGRAPH
TP107

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

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TEST PIT LOG
TP108

SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2019
SURFACE RL: 70.70 m AHD
COORDS: 377507.30 m E 6356859.70 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered	8		D-TP108 0.10m		0.05		ML	TOPSOIL, Sandy SILT, low plasticity, brown, fine grained sand	D		TOPSOIL
	11			70.5			CH	CLAY, high plasticity, mottled grey and brown-orange	w>PL	VSt - H	RESIDUAL
	6	PP400 - 410kPa	0.30m								
	3										
	3		B		0.5						
	3	PP550 - 600kPa	0.60m							H	
	4			70.0							
	5										
	4										
	10				0.90			Sandy SILTSTONE, grey stained orange	HW	VL - L	BEDROCK
	25				1.0						
					1.10			TEST PIT TP108 TERMINATED AT 1.10 m Bucket refusal			
				69.5							
					1.5						
				69.0							
					2.0						
				68.5							

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RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

TEST PIT PHOTOGRAPH
TP108

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

H:\JOBFILES\Job14399- John Hunter Hospital\400 Fieldwork\[14399 TP Photos.xlsm]TP109

TEST PIT LOG
TP109
SHEET 1 OF 1

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE: 08/10/2019
SURFACE RL: 68.45 m AHD
COORDS: 377499.30 m E 6356687.80 m N MGA94 56
EXCAVATION METHOD: 3.5t Ex. with 350mm Toothed Bucket

Test Pit Information						Field Material Information					
WATER	DYNAMIC PENETROMETER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
Not Encountered	7		D-TP109 0.10m				ML	TOPSOIL, Sandy SILT, low plasticity, brown, fine grained sand	w<PL		TOPSOIL
	14										
	14										
	5		0.40m		0.40						
	3	PP400 - 600kPa		68.0			CH	CLAY, high plasticity, dark grey-brown, with fine to medium angular gravel (siltstone and charcoal), trace of fine to coarse grained sand	w>PL	VSt / H	COLLUVIUM
	2		B		0.5						
	4				0.60		CH	COAL, high plasticity, pale grey, trace of fine to medium angular gravel 9relict siltstone)	w>PL	VSt / H	RESIDUAL
	10		0.70m								
	12	PP480 - 550kPa									
	13			67.5	1.0						
	25				1.10			SILTSTONE, dark grey	SW	M	BEDROCK Fossiferous
					1.20			Carbonaceous CLAYSTONE/COAL, dark brown/black	XW - HW	VL - L	
				67.0	1.5						
				66.5	2.00			Tuffaceous CLAYSTONE, grey	MW	L	
								TEST PIT TP109 TERMINATED AT 2.10 m Limit of investigation			
				66.0							

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GEOTECHNICAL • ENVIRONMENTAL

TEST PIT PHOTOGRAPH
TP109

PROJECT: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health And Innovation Precinct

GEOTECHNICAL BOREHOLE LOG

BH101

SHEET 1 OF 6

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 03/10/2019
DATE COMPLETED: 03/10/2019
SURFACE RL: 70.95 m AHD
COORDS: 377909.90 m E 6356635.80 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered during augering)		BH101a 0.10m				CI	TOPSOIL, Silty CLAY, medium plasticity, brown	M		TOPSOIL
					0.20		CI-CH	CLAY, medium to high plasticity, grey mottled orange, trace of fine ironstone gravel	w>PL	VSt	RESIDUAL
		0.50m PP330 - 390kPa SPT 3, 3, 4 N=7 0.95m	0.50m BH101b 0.70m D 0.95m	70.5 70.0	0.5 1.0			Becoming pale grey mottled orange at 0.5m		VSt - H	
		1.50m PP>600kPa SPT 8, 17, 23 N=40 1.95m	1.50m D 1.95m	69.5 69.0	1.30 1.5 1.80 2.0		CH	Tuffaceous CLAY, high plasticity, pale grey, with very low strength siltstone layers	w<PL	H	
				68.5	2.5		CH	Tuffaceous CLAY, high plasticity, pale grey, with very low to low strength siltstone layers (Extremely Weathered Tuffaceous Siltstone)			EXTREMELY WEATHERED MATERIAL
		3.00m PP>600kPa SPT 13, 20/80mm N=R 3.23m	3.00m D 3.23m	68.0	2.70 3.0			Tuffaceous SANDSTONE, fine grained, pale grey	HW	VL	BEDROCK
				67.5 67.0 66.5 66.0	3.5 4.0 4.5			CONTINUED AS CORED BOREHOLE			

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CORED BOREHOLE LOG
BH101

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 03/10/2019
DATE COMPLETED: 03/10/2019
SURFACE RL: 70.95 m AHD
COORDS: 377909.90 m E 6356635.80 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				70.5	0.5					
				70.0	1.0					
				69.5	1.5					
				69.0	2.0					
				68.5	2.5					
				68.0	3.0					
					3.23		START CORING AT 3.23m			
NMLC	0% LOSS	100	85	67.5	3.45		Tuffaceous SANDSTONE, fine grained, pale grey	HW		JT 70° PR S DZ 4 mm
					3.5		SANDSTONE, fine to medium grained, pale grey, with iron oxide staining			DZ 2 mm BP 6° Fe Clay PR S
				67.0	4.0					DZ 5 mm JT 27° Fe PR S DZ 8 mm
				66.5	4.5					BP 6° Fe PR S BP 10° Fe PR S BP 10° Fe PR S
				66.0						BP 5° Fe Clay VNR PR S BP 5° Fe PR S

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CORED BOREHOLE LOG
BH101

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 03/10/2019
DATE COMPLETED: 03/10/2019
SURFACE RL: 70.95 m AHD
COORDS: 377909.90 m E 6356635.80 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	100	85	65.5	5.06		SILTSTONE, grey, with iron oxide staining	HW			CS 45 mm
							Becoming grey at 5.21m				BP 15° Fe Clay PR S 2 mm
					5.33						BP 15° Fe PR S
							Interbedded SILTSTONE/SANDSTONE, grey, fine grained sandstone				BP 16° Fe PR S
				65.0	5.5						
					6.0						BP 15° Clay PR S 2 mm
											BP 12° Fe PR S 5 mm
					6.23						CS 10°
							SANDSTONE, fine to medium grained, pale grey, with iron oxide staining				BP 13° Fe PR S
		100	90	64.5	6.5						JT 70 - 90° Fe Clay 4 mm
							High strength siltstone layer from 6.58m to 6.62m				CS 12 mm
				64.0	7.0						JT 70° Fe Clay PR S 3 mm
				63.5	7.5						JT 60 - 85° Fe PR S
											JT 60 - 85° Fe PR S
					7.62		SANDSTONE, fine grained, pale grey, with occasional iron oxide, interbedded with siltstone	MW			BP 5° Fe PR S
				63.0	8.0						BP 5° Fe PR S
							Fine to coarse grained from 8.0m to 8.43m				
				62.5	8.5						
	5% LOSS				8.84						
		96	92		8.88		CORE LOSS 0.04m (8.84-8.88)				
				62.0	9.0		SANDSTONE, fine grained, pale grey, with occasional iron oxide, interbedded with siltstone	MW			
				61.5	9.5						
	10% LOSS	95	87	61.0							

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CORED BOREHOLE LOG
BH101

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 03/10/2019
DATE COMPLETED: 03/10/2019
SURFACE RL: 70.95 m AHD
COORDS: 377909.90 m E 6356635.80 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	10% LOSS	95	87	60.5	10.14			MW			
					10.5		SANDSTONE, fine to medium grained, pale grey				
					10.64						
							COAL, black	SW			BP 2° PR S
					10.85						FZ 30 mm
					10.96		CORE LOSS 0.11m (10.85-10.96)				
				60.0	11.0		COAL, black	SW			JT 80° PR S
											CS 5° 14 mm
				59.5	11.5						CS 5° 25 mm
					11.60		SILTSTONE, grey, with carbonaceous layers	MW			
											BP 8° PR S
				59.0	11.92		SANDSTONE, fine grained, grey, with dark grey laminae	SW			
					12.0						
				58.5	12.5						
				58.0	13.0						DB 0°
											BP 11° X PR S
											BP 7° Clay VNR PR S
											BP 7° Clay VNR PR S
											CS 2 mm
											CS 2 mm
	5% LOSS	100	94	57.5	13.5						CS 2 mm
					13.60		SILTSTONE, grey	MW			CS 2 mm
											CS 2 mm
											CS 40 mm
				57.0	14.0						
					14.05		SANDSTONE, fine grained, pale grey	FR			
				56.5	14.5						
											BP 18° Fe UN S
				56.0							

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CORED BOREHOLE LOG
BH101

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 03/10/2019
DATE COMPLETED: 03/10/2019
SURFACE RL: 70.95 m AHD
COORDS: 377909.90 m E 6356635.80 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	5% LOSS	100	100	55.5	15.12		SANDSTONE, fine grained, pale grey	FR			
					15.5		Pebbly SANDSTONE, fine to coarse grained, grey, fine to medium sub-rounded gravel sized clasts				BP 17° PR S
				55.0	16.0						
				54.5	16.5						
				54.0	17.0						
								SW			
				53.5	17.5						
		100	100	53.0	18.0						
				52.5	18.5						
				52.0	19.00		CONGLOMERATE, grey, fine to medium sub-rounded sized clasts				
				51.5	19.5						
					19.75		Pebbly SANDSTONE, fine to coarse grained, grey, fine to medium sub-rounded gravel sized clasts				
				51.0	19.93		SANDSTONE, fine grained, grey				

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CORED BOREHOLE LOG
BH101

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 03/10/2019
DATE COMPLETED: 03/10/2019
SURFACE RL: 70.95 m AHD
COORDS: 377909.90 m E 6356635.80 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	5% LOSS	100	100		20.00		Pebbly SANDSTONE, fine to coarse grained, grey, fine to medium sub-rounded gravel sized clasts	SW			BP 5° Fe PR S
							CORED BOREHOLE BH101 TERMINATED AT 20.20 m				
				50.5	20.5						
				50.0	21.0						
				49.5	21.5						
				49.0	22.0						
				48.5	22.5						
				48.0	23.0						
				47.5	23.5						
				47.0	24.0						
				46.5	24.5						
				46.0							

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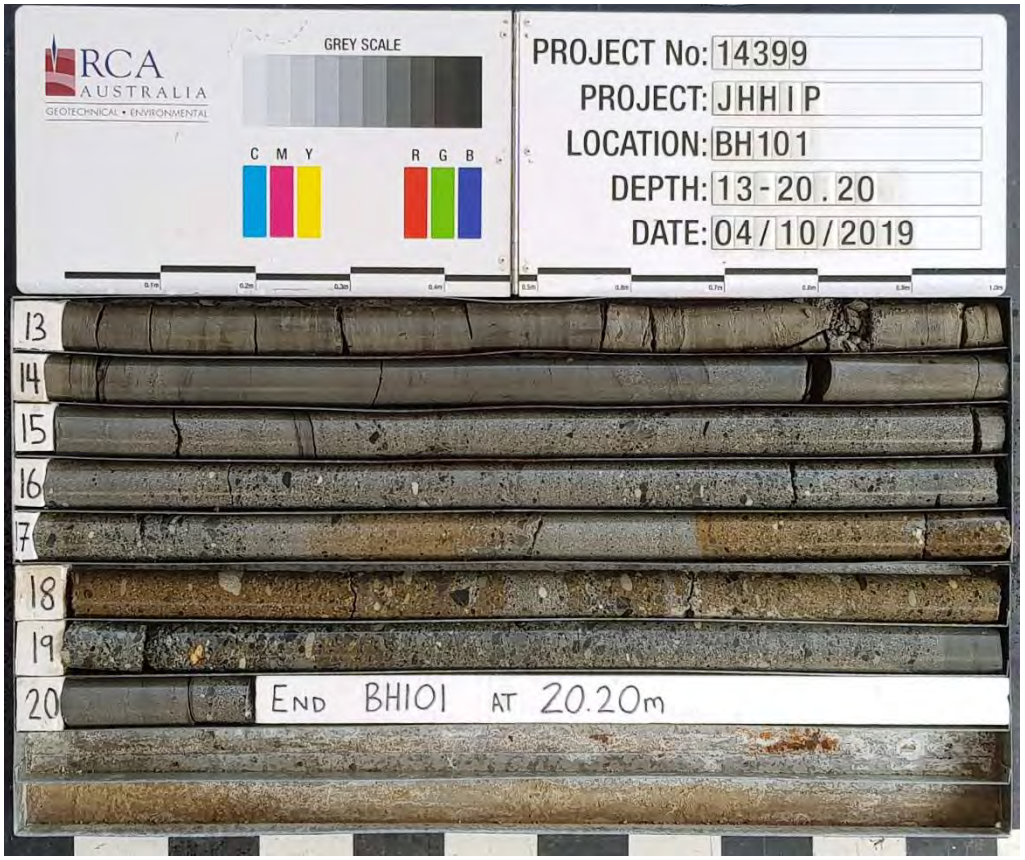
PHOTOGRAPH 1 OF 2 – BH101 3.23m to 13.0m

Client:	Health Infrastructure	**RCA Australia**
Project:	John Hunter Health and Innovation Precinct	
Location:	John Hunter Hospital	**RCA ref:** 14399



PHOTOGRAPH 2 OF 2 – BH101 13.0m to 20.20m

Client:	Health Infrastructure	**RCA Australia**
Project:	John Hunter Health and Innovation Precinct	
Location:	John Hunter Hospital	**RCA ref:** 14399

GEOTECHNICAL BOREHOLE LOG

BH102

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 23/09/2019
DATE COMPLETED: 24/09/2019
SURFACE RL: 73.85 m AHD
COORDS: 377892.80 m E 6356624.60 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered during augering)		D-BH102a QA1 0.10m	73.85	0.00		SM	FILL, Silty SAND, fine to medium grained, brown, trace of rootlets	M		FILL
					0.20		SM	FILL, Silty SAND, fine to medium grained, brown, trace of clay			
		0.50m	0.50m	73.5	0.5						
		PP250 - 390kPa SPT 2, 7, 9 N=16 PP>600kPa	D-BH102b (0.7-0.75m) 0.75m D		0.70		CI-CH	CLAY, high plasticity, brown mottled orange	w~PL	H	RESIDUAL
		0.95m	0.95m	73.0	1.0			Becoming dark grey mottled orange, with sand at 0.8m	w<PL		
		1.45m	1.45m D 1.50m	72.5	1.40			SILTSTONE, pale grey and orange	HW	VL	BEDROCK
		1.53m SPT 22/80mm HB N=R			1.5			CONTINUED AS CORED BOREHOLE			
				72.0	2.0						
				71.5	2.5						
				71.0	3.0						
				70.5	3.5						
				70.0	4.0						
				69.5	4.5						
				69.0							

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CORED BOREHOLE LOG
BH102

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 23/09/2019
DATE COMPLETED: 24/09/2019
SURFACE RL: 73.85 m AHD
COORDS: 377892.80 m E 6356624.60 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				73.5	0.5						
				73.0	1.0						
				72.5	1.50		START CORING AT 1.50m				
NMLC	0% Water LOSS	100	36		1.59		SILTSTONE, pale grey	HW			CS 30 mm
							Tuffaceous CONGLOMERATE, pale grey and orange				CS 30 mm CS 30 mm
				72.0	1.89						CS 10 mm
					2.0		Tuffaceous SILTSTONE, pale grey and orange				CS 50 mm JT 80° Fe PR RF
				71.5	2.5						BP 5° Fe PR RF
				71.0	3.0		Becoming pale grey-brown and orange at 3.00m				JT 60° PR S JT 75° PR S
		77	65	70.5	3.5						
					3.60		COAL, black, interbedded with pale brown clay				
	30% Water LOSS				3.68		CORE LOSS 0.58m (3.68-4.26)				
				70.0	4.0						
					4.26		Tuffaceous CLAY, high plasticity, pale grey, W>PL, very stiff	HW			PP=340kPa
				69.5	4.35		CORE LOSS 0.18m (4.35-4.53)				
					4.53						
		72	0		4.55		Tuffaceous CLAY, high plasticity, pale grey, W>PL, very stiff	HW			PP=120pKa
					4.70		COAL, black, weathered to soil properties				
				69.0			Tuffaceous SILTSTONE, pale grey				PP>600kPa

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CORED BOREHOLE LOG
BH102

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 23/09/2019
DATE COMPLETED: 24/09/2019
SURFACE RL: 73.85 m AHD
COORDS: 377892.80 m E 6356624.60 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information | Field Material Description

METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	30% LOSS	100	19	68.5	5.01		Tuffaceous SILTSTONE, pale brown	RS			
					5.05		COAL, black, weathered to soil properties				
					5.27		CLAY, high plasticity, brown and black				
					5.34		COAL, black, weathered to soil properties				
					5.47		Tuffaceous CLAY, high plasticity, pale grey				
					5.53		COAL, black, weathered to soil properties				
					5.65		COAL, black	HW			
					5.81						CS 10 mm brown
				68.0	5.85		COAL, black, weathered to soil properties	RS			
					6.0		Tuffaceous SILTSTONE, pale grey				
		100	97		6.10		SILTSTONE, grey with pale grey, laminae	MW			
				67.5	6.5						BP 5° Fe PR S and organics
				67.0	7.0			HW			
					7.10		COAL, black, weathered to soil properties	RS			
					7.28						FZ 20 mm
				66.5	7.37		SILTSTONE, grey-brown, with carbonaceous layers	MW			
					7.5		CORE LOSS 0.32m (7.37-7.69)				
	40-50% LOSS	77	47		7.69		SILTSTONE, grey Becoming grey and orange-brown at 7.73m	HW			FZ CS 10 mm
				66.0	7.90		Tuffaceous SILTSTONE, pale grey, with iron oxide stained healed defects	MW			
					8.0						JT 70° PR S
					8.24		SANDSTONE, fine grained, pale grey				
				65.5	8.40		SANDSTONE, fine to medium grained, pale grey, with occasional iron staining	SW			
		100	99		8.5						
				65.0	9.0		Becoming pale grey and orange brown at 9.0m				
				64.5	9.5		Becoming pale grey with occasional iron staining at 9.32m				
					9.77						BP 0° Fe PR S
				64.0			Tuffaceous SILTSTONE, pale grey, with iron stained defects				

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CORED BOREHOLE LOG
BH102

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 23/09/2019
DATE COMPLETED: 24/09/2019
SURFACE RL: 73.85 m AHD
COORDS: 377892.80 m E 6356624.60 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	90-90% LOSS	90	90	63.5	10.04		CORE LOSS 0.18m (10.04-10.22)	SW			BP 0° Fe PR S
					10.22		Tuffaceous SILTSTONE, pale grey, with iron stained defects				JT 90° Fe PR RF
					10.5						
					10.55		SANDSTONE, fine grained, pale grey with iron stained defects				BP 0° Fe PR RF JT 82° Fe PR RF
					10.73		SILTSTONE, pale grey				
				63.0	10.81		SANDSTONE, fine grained, pale grey				BP 3° Fe PR S
					11.0						
					11.06		SANDSTONE, fine grained, pale grey, with iron oxides staining, interbedded with siltstone				
				62.5							BP 13° Fe PR S
					11.5						
											BP 5° Fe PR S JT 85° Fe PR S
				62.0							JT 85° Fe PR RF
					12.0						JT 70 - 90° Fe Clay PR S up to 10mm thick JT 90° Fe Clay PR S up to 10mm thick
	10% LOSS	100	70	61.5							CS 45 mm Clay 10 mm JT 75° Fe PR S BP 5° Fe PR S
					12.5						
				61.0							JT 90° Fe PR ST S
					13.0						BP 13° Fe PR S CS 4° 8 mm BP 8° Fe PR S BP 8° Fe PR S BP 12° Fe Clay VNR PR S
				60.5							
					13.5						
				60.0	13.92		SANDSTONE, fine grained, pale grey, with iron oxide staining				
	10-20% LOSS	100	100		14.0						
				59.5							
					14.5						
		95	84	59.0							

LOGGED: RC | CHECKED: MA | DATE: 28/10/2019

CORED BOREHOLE LOG
BH102

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 23/09/2019
DATE COMPLETED: 24/09/2019
SURFACE RL: 73.85 m AHD
COORDS: 377892.80 m E 6356624.60 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	10-20% LOSS	95	84	58.5	15.12			SW			CS 30 mm BP 15° Fe PR S
					15.22		SILTSTONE, dark grey, with coal layers				
				58.0	15.5		COAL, black				CS 6 mm JT 90° PR S DZ 30 mm
					15.93						
					16.0		CORE LOSS 0.14m (15.93-16.07)				
					16.07		COAL, black	SW			JT 90° PR S BP 0° PR S
					16.20		SILTSTONE, grey and dark grey, with coal layers				
				57.5	16.35		SANDSTONE, fine grained, grey				BP 0° PR S
					16.5						
				57.0	17.0						
				56.5	17.5						BP 13° X PR S
				56.0	18.0						
					18.05		SANDSTONE, fine grained, grey, interbedded with siltstone				
				55.5	18.5						
					18.48		SANDSTONE, fine grained, grey	FR			
	10% LOSS	100	100	55.0	19.0						
				54.5	19.46						
					19.5		Pebbly SANDSTONE, fine to coarse grained, grey, fine to medium sub-rounded clasts				
				54.0							

LOGGED: RC | CHECKED: MA | DATE: 28/10/2019

CORED BOREHOLE LOG
BH102

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 23/09/2019
DATE COMPLETED: 24/09/2019
SURFACE RL: 73.85 m AHD
COORDS: 377892.80 m E 6356624.60 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	10-20% LOSS	100	100	53.5	20.5		Pebbly SANDSTONE, fine to coarse grained, grey, fine to medium sub-rounded clasts	FR			
				53.0	20.93						
					21.0		CORED BOREHOLE BH102 TERMINATED AT 20.93 m				
				52.5	21.5						
				52.0	22.0						
				51.5	22.5						
				51.0	23.0						
				50.5	23.5						
				50.0	24.0						
				49.5	24.5						
				49.0							

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PHOTOGRAPH 1 of 2 – BH102 1.5m to 11.0m

Client:	Health Infrastructure	**RCA Australia**
Project:	John Hunter Health and Innovation Precinct	
Location:	John Hunter Hospital	**RCA ref:** 14399

PHOTOGRAPH 2 of 2 – BH102 11.0m to 20.93m

Client:	Health Infrastructure	**RCA Australia**
Project:	John Hunter Health and Innovation Precinct	
Location:	John Hunter Hospital	**RCA ref:** 14399

GEOTECHNICAL BOREHOLE LOG

BH103

SHEET 1 OF 6

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 25/09/2019
DATE COMPLETED: 26/09/2019
SURFACE RL: 79.15 m AHD
COORDS: 377885.10 m E 6356597.70 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered during augering)		D-BH103a 0.10m D 0.20m D-BH103b 0.40m D-BH103c 0.50m D 0.61m	79.0	0.10			TOPSOIL, Silty SAND, fine to medium grained, brown	M		TOPSOIL
							SM	Silty SAND, fine to medium grained, orange-brown			SLOPEWASH
		0.50m SPT 10/110mm HB N=R 0.61m		78.5	0.40 0.5			SANDSTONE, fine to medium grained, pale grey and orange	MW - HW	VL L	BEDROCK
				78.0	1.0						
				77.5	1.5				MW	M	
				77.0	2.0						TC Bit refusal at 2.25m
				76.5	2.5			CONTINUED AS CORED BOREHOLE			
				76.0	3.0						
				75.5	3.5						
				75.0	4.0						
				74.5	4.5						

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CORED BOREHOLE LOG
BH103

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 25/09/2019
DATE COMPLETED: 26/09/2019
SURFACE RL: 79.15 m AHD
COORDS: 377885.10 m E 6356597.70 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				79.0	0.5						
				78.5	1.0						
				78.0	1.5						
				77.5	2.0						
				77.0	2.25		START CORING AT 2.25m				
NMLC	0% LOSS	100	100	76.5	2.5		SANDSTONE, fine to coarse grained, grey and orange, trace of fine to medium sub-rounded gravel sized clasts Becoming fine to medium grained at 2.35m	MW			JT 70 - 85° Fe PR RF Rootlets
					3.0		Becoming fine to coarse grained at 2.66m				
				76.0	3.5		Becoming fine to medium grained at 2.9m				
	0% LOSS	100	98	75.5	4.0						
				75.0	4.5						JT 40° Fe PR RF
				74.5							

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CORED BOREHOLE LOG
BH103

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 25/09/2019
DATE COMPLETED: 26/09/2019
SURFACE RL: 79.15 m AHD
COORDS: 377885.10 m E 6356597.70 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information | Field Material Description

METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	100	98	74.0	5.00		Pebbly SANDSTONE, fine to coarse grained, grey and orange, fine to medium sub-rounded gravel sized clasts	MW			DZ 20° 5 mm BP 10° Fe PR S CS 55 mm
				73.5	5.5						
					5.74		CORE LOSS 0.31m (5.74-6.05)				
					6.0						
					6.05		Pebbly SANDSTONE, fine to coarse grained, grey and orange, fine to medium sub-rounded gravel sized clasts	MW			BP 10° Fe PR VR JT 80° Clay VNR PR S
				73.0	6.5						BP 10° Fe PR RF
	5% LOSS	92	83	72.5	6.64		SANDSTONE, fine grained, grey and orange	HW			JT 70° Fe PR RF
					7.0						
				72.0							
					7.5						
				71.5			Carbonaceous clay 10mm thick at 7.71m				CS 75 mm
					7.78		SILTSTONE, grey, with iron oxide staining				BP 5° X PR S JT 88° Fe PR S
					8.0						BP 3° X PR S
	51% LOSS	100	92	71.0							
					8.5						
				70.5							JT 80° Fe PR RF Partially healed JT 80° Fe PR RF
					8.86						JT 80° Fe PR RF
					8.94		CORE LOSS 0.08m (8.86-8.94)				
					9.0		Tuffaceous CLAYSTONE Interbedded with SANDSTONE, fine grained, grey	HW MW			
	5% LOSS	88	84	70.0							
					9.5						
				69.5							
					9.87						

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CORED BOREHOLE LOG
BH103

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 25/09/2019
DATE COMPLETED: 26/09/2019
SURFACE RL: 79.15 m AHD
COORDS: 377885.10 m E 6356597.70 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information | Field Material Description

METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	100% LOSS	88	84	69.0	10.05		Carbonaceous SILTSTONE, dark grey-black, Interbedded with COAL				
					10.30		CORE LOSS 0.25m (10.05-10.30)				
							Carbonaceous SILTSTONE, dark grey-black, Interbedded with COAL	HW			JT 90° PR RF BP 3° PR S
				68.5	10.5						CS 35 mm
											JT 87° PR RF
					11.0						CS 16 mm
				68.0							JT 90° PR S
					11.5						CS 50 mm
				67.5							JT 90° PR S
					12.0						FZ 35 mm
				67.0							CS 90 mm
	100% LOSS	100	77		12.5						
				66.5							FZ 35 mm
					13.0						JT 73° PR S
				66.0							CS 12 mm CS 20 mm JT 85° PR S
					13.38						CS 10 mm DZ 40 mm
					13.5		CORE LOSS 0.15m (13.38-13.53)				
					13.53		COAL, black	HW			FZ 175 mm
				65.5							CS 25 mm
					13.76		SILTSTONE, grey, with carbonaceous laminae				
					14.0						BP 10° X PR S
				65.0							CS 150 mm
					14.5						
	100% LOSS	89	58								
				64.5	14.68		CORE LOSS 0.20m (14.68-14.88)				
	100% LOSS	84	57		14.88		COAL, black	HW			FZ 240 mm

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CORED BOREHOLE LOG
BH103

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 25/09/2019
DATE COMPLETED: 26/09/2019
SURFACE RL: 79.15 m AHD
COORDS: 377885.10 m E 6356597.70 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	100% LOSS	84	57	64.0	15.12		COAL, black	HW			
					15.5		Carbonaceous SILTSTONE, grey and black, Interbedded with COAL				JT 85° Fe PR S CS 280 mm
				63.5	15.70		SANDSTONE, fine to medium grained, grey and orange	MW			
					16.0			SW			CS 3 mm CS 20 mm
	100% LOSS	100	93	63.0							
					16.5						
				62.5							
					17.0						
				62.0							
					17.48		SILTSTONE Interbedded with SANDSTONE, fine grained, grey and orange	MW			
	100% LOSS	100	100	61.5							
					18.0						
				61.0							
	100% LOSS	100	0		18.5						
				60.5							
	100% LOSS	100	100		19.0						JT 70° Fe PR RF
				60.0							
					19.5						JT 85 - 90° Fe PR RF
				59.5			Two claystone layers 3mm and 9mm thick at 19.92m				JT 77° Fe PR RF JT 88° Fe PR S

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CORED BOREHOLE LOG
BH103

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 25/09/2019
DATE COMPLETED: 26/09/2019
SURFACE RL: 79.15 m AHD
COORDS: 377885.10 m E 6356597.70 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
	▼	100	100					MW			
				59.0			CORED BOREHOLE BH103 TERMINATED AT 20.11 m				
					20.5						
				58.5							
					21.0						
				58.0							
					21.5						
				57.5							
					22.0						
				57.0							
					22.5						
				56.5							
					23.0						
				56.0							
					23.5						
				55.5							
					24.0						
				55.0							
					24.5						
				54.5							

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PHOTOGRAPH 1 of 2 – BH103 2.25m to 12.0m

Client:	Health Infrastructure	**RCA Australia**
Project:	John Hunter Health and Innovation Precinct	
Location:	John Hunter Hospital	**RCA ref:** 14399

PHOTOGRAPH 2 of 2 – BH103 12.0m to 20.11m

Client:	Health Infrastructure	**RCA Australia**
Project:	John Hunter Health and Innovation Precinct	
Location:	John Hunter Hospital	**RCA ref:** 14399

GEOTECHNICAL BOREHOLE LOG

BH104

SHEET 1 OF 6

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 30/09/2019
DATE COMPLETED: 01/10/2020
SURFACE RL: 68.70 m AHD
COORDS: 377855.30 m E 6356674.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Information				
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG / CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered during augering)		D-BH104a QA2 0.10m	68.5	0.30		Silty SAND, fine to medium grained, brown, trace of fine to medium gravel	M		SLOPEWASH
		0.50m PP340 - 400kPa	0.30m D-BH104b 0.50m		0.5		CLAY, high plasticity, pale grey mottled orange	w>PL	St - VSt	RESIDUAL
		SPT 2, 3, 5 N=8	D	68.0					VSt - H	
		0.95m	0.95m		1.0					
				67.5	1.40					
		1.50m	1.50m		1.5		Tuffaceous SILTSTONE, pale grey with iron staining	HW	VL	BEDROCK
		SPT 10, 29, 30/110mm HB N=R 1.91m	D 1.91m	67.0						
					2.0		CONTINUED AS CORED BOREHOLE			
				66.5						
					2.5					
				66.0						
					3.0					
				65.5						
					3.5					
				65.0						
					4.0					
				64.5						
					4.5					
				64.0						

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CORED BOREHOLE LOG
BH104

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 30/09/2019
DATE COMPLETED: 01/10/2020
SURFACE RL: 68.70 m AHD
COORDS: 377855.30 m E 6356674.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	100	69	68.5	0.5		START CORING AT 1.91m				
				68.0	1.0						
				67.5	1.5						
				67.0	1.91						
				66.5	2.0		Tuffaceous CLAYSTONE, pale grey, with iron staining, interbedded with fine grained sandstone	HW			JT 63° Siltstone PR S 5 mm BP 10° Clay PR S BP 5° Clay & Fe PR S 1 mm BP 5° Fe PR S
					2.5						BP 14° Fe PR S BP 15° Fe PR S
				66.0	3.0		Fine to coarse grained sandstone from 2.72m to 2.74m				JT 85° Fe PR RF CS 40 mm
				65.5	3.5		Fine to coarse grained sandstone from 3.10m to 3.13m				CS 17° Fe PR S CS 5 mm
	0% LOSS	100	8	65.0	4.0						BP 3° Fe PR S JT 67° Fe PR S JT 75° Fe PR S BP 0° Fe PR S BP 15° Fe PR S DZ 10 mm JT 75° VNR PR S and rootlets
				64.5	4.5						BP 18° Clay & Fe VNR PR S BP 5° Clay & Fe VNR PR S and rootlets
	0% LOSS	100	83	64.0							JT 60° Clay VNR PR S CS 40 mm BP 7° Fe PR S JT 75° Clay PR S 2 mm BP 3° Fe PR S

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CORED BOREHOLE LOG
BH104

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 30/09/2019
DATE COMPLETED: 01/10/2020
SURFACE RL: 68.70 m AHD
COORDS: 377855.30 m E 6356674.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	100	83	63.5	5.24		Tuffaceous CLAYSTONE, pale grey, with iron staining, interbedded with fine grained sandstone Numerous iron oxide annealed edfecs from 5.04m to 5.18m	HW			CS 5° 15 mm
							SANDSTONE, fine grained, pale grey with iron oxide staining	MW			JT 24° Clay VNR PR S
				63.0	5.5						JT 77 - 90° Clay PR S 0-5mm Fe JT 65° Clay PR S 10 mm
					6.0						
					6.06		Tuffaceous SANDSTONE, fine grained, pale grey				JT 85° Clay PR S 3 mm
				62.5							JT 85° Clay & Fe PR S CS 1 mm CS 15 mm CS 110 mm
	0% LOSS	72	54		6.5						
				62.0							CS 17 mm
					7.0						JT 75° PR S
					7.08						
					7.12		COAL, BLACK	SW			
				61.5			CORE LOSS 0.45m (7.12-7.57)				
					7.5						
					7.57		COAL, black	SW			FZ 50 mm FZ 10 mm
				61.0							BP 0° PR S DZ 45 mm
					8.0						
					8.17						JT 90° X PR S
				60.5			CORE LOSS 0.17m (8.17-8.34)				
					8.34						
							SILTSTONE, grey, interbedded with fine grained sandstone	SW			BP 18° X PR S
					8.5						
				60.0							
					9.0						
	0% LOSS	91	77	59.5							CS 70° 4 mm BP 7° X PR S
					9.5						
				59.0							BP 10° Fe PR S

LOGGED: RC | CHECKED: MA | DATE: 28/10/2019

CORED BOREHOLE LOG
BH104

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 30/09/2019
DATE COMPLETED: 01/10/2020
SURFACE RL: 68.70 m AHD
COORDS: 377855.30 m E 6356674.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	100	100	58.5	10.12		SANDSTONE, fine to medium grained, grey	SW			BP 5° Clay & Fe PR RF 22 mm
				58.0	10.5						BP 5° Fe PR S
				57.5	11.0						
				57.0	11.5						
				56.5	11.78		Pebbly SANDSTONE, fine to coarse grained, grey, sub-rounded, fine to medium gravel sized clasts				
					12.0						
					12.05		SANDSTONE, fine to medium grained, grey				
					12.20		Pebbly SANDSTONE, fine to coarse grained, grey, sub-rounded, fine to medium gravel sized clasts				
				56.0	12.5						
					12.80		SANDSTONE, fine grained, grey, with dark grey laminae				BP 3° Fe PR S
					12.90			FR			BP 3° Fe PR RF
					13.0		SANDSTONE, fine to medium grained, grey				BP 3° Fe PR RF
				55.5	13.15		Pebbly SANDSTONE, fine to coarse grained, grey, sub-rounded, fine to medium gravel sized clasts				
	0% LOSS	100	97	55.0	13.5						
				54.5	14.0						
				54.0	14.5						
					14.85		CONGLOMERATE, grey, typically fine to medium sub-rounded gravel sized clasts				BP 0° X PR RF

LOGGED: RC | CHECKED: MA | DATE: 28/10/2019

CORED BOREHOLE LOG
BH104

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 30/09/2019
DATE COMPLETED: 01/10/2020
SURFACE RL: 68.70 m AHD
COORDS: 377855.30 m E 6356674.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	100	97	53.5	15.5		CONGLOMERATE, grey, typically fine to medium sub-rounded gravel sized clasts	FR			
					15.53		SANDSTONE, fine to coarse grained, grey				
				53.0	15.70		Pebbly SANDSTONE, fine to coarse grained, brown, sub-rounded, fine to medium gravel sized clasts				
					15.83		CONGLOMERATE, grey, typically fine to medium sub-rounded gravel sized clasts				
	0% LOSS	100	95	52.5	16.0						
				52.0	16.5						
					16.78		Pebbly SANDSTONE, fine to coarse grained, grey, fine to medium sub-rounded gravel sized clasts				
				51.5	17.0						
					17.10		CONGLOMERATE, grey, typically fine to medium sub-rounded gravel sized clasts				
							Becoming with some iron oxide staining at 17.35m	SW			
				51.0	17.5						
											BP 3° Fe PR VR
					18.0						BP 3° Fe PR VR
					18.10						BP 5° Fe PR RF
				50.5			SANDSTONE, fine grained, grey	FR			
					18.5		With fine to medium gravel sized clasts from 18.6m to 18.7m				
				50.0							
					18.78		CONGLOMERATE, grey, typically fine to medium sub-rounded gravel sized clasts	SW			
	0% LOSS	100	99		19.0						
				49.5			Becoming with fine gravel sized clasts at 19.2m				JT 50° X PR S
					19.32		SANDSTONE, fine grained, grey				
											BP 8° Fe PR S
					19.5			FR			BP 8° Fe PR S
				49.0							
					19.82			SW			

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CORED BOREHOLE LOG
BH104

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 30/09/2019
DATE COMPLETED: 01/10/2020
SURFACE RL: 68.70 m AHD
COORDS: 377855.30 m E 6356674.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	0% LOSS	100	99	48.5	20.5		CONGLOMERATE, grey, with iron oxide staining, typically fine to medium sub-rounded gravel sized clasts	SW			
					20.57		CORED BOREHOLE BH104 TERMINATED AT 20.57 m				

RL (m AHD): 48.0, 47.5, 47.0, 46.5, 46.0, 45.5, 45.0, 44.5, 44.0
DEPTH (m): 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5

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PHOTOGRAPH 1 of 2 – BH104 1.91m to 11.0m

Client:	Health Infrastructure	**RCA Australia**
Project:	John Hunter Health and Innovation Precinct	
Location:	John Hunter Hospital	**RCA ref:** 14399

PHOTOGRAPH 2 of 2 – BH104 11.0m to 20.57m

Client:	Health Infrastructure	**RCA Australia**
Project:	John Hunter Health and Innovation Precinct	
Location:	John Hunter Hospital	**RCA ref:** 14399

GEOTECHNICAL BOREHOLE LOG

BH105

SHEET 1 OF 6

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 26/09/2019
DATE COMPLETED: 30/09/2019
SURFACE RL: 72.75 m AHD
COORDS: 377835.70 m E 6356654.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered during augering)		D-BH105a 0.10m	72.5	0.5		SM	FILL, Gravelly Silty SAND, fine to medium grained, brown, fine to medium gravel, trace of organics	M		FILL
		0.50m PP150 - 250kPa SPT 2, 2, 4 N=6	0.50m D-BH105b 0.70m D-BH105c 0.90m D 0.95m					Becoming with a trace of clay at 0.5m			
		0.95m		72.0	0.70 1.0		CI-CH	CLAY, medium to high plasticity, pale grey mottled orange	w>PL	VSt - H	RESIDUAL
				71.5	1.10 1.5		CH	Tuffaceous CLAY, high plasticity, grey and orange		VSt	
		1.50m PP290 - 320kPa SPT 3, 4, 8 N=12	1.50m D	71.0	2.0						
		1.95m	1.95m	70.5	2.5						
		3.00m PP550 - >600kPa SPT 4, 11, 13 N=24	3.00m D	70.0	3.0			Becoming high plasticity, pale grey	w~PL	H	
		3.45m	3.45m	69.5	3.40 3.5		CI-CH	CLAY, medium to high plasticity, brown, with carbonaceous lenses	w<PL		
				69.0	4.0						
		4.50m SPT 13, 19, 26 N=45	4.50m D	68.5	4.30 4.5		CH	Extremely Weathered Tuffaceous Siltstone, properties of Tuffaceous CLAY, high plasticity, pale grey, with low strength tuffaceous siltstone layers			EXTREMELY WEATHERED MATERIAL
		4.95m	4.95m	68.0							

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GEOTECHNICAL BOREHOLE LOG

BH105

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 26/09/2019
DATE COMPLETED: 30/09/2019
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COORDS: 377835.70 m E 6356654.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Information					
METHOD	WATER	FIELD TEST	SAMPLE	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	DESCRIPTION (SOIL NAME;plasticity/grain size, particle shape, colour, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	MOISTURE/ WEATHERING	CONSISTENCY/ RELATIVE DENSITY/ STRENGTH	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	(Not Encountered during augering)	6.00m SPT 30/150mm HB N=R 6.15m	6.00m D 6.15m	67.5 67.0	5.5 6.0		CH	Extremely Weathered Tuffaceous Siltstone, properties of Tuffaceous CLAY, high plasticity, pale grey, with low strength tuffaceous siltstone layers	w<PL	H	EXTREMELY WEATHERED MATERIAL
				66.5 66.0 65.5 65.0 64.5 64.0 63.5 63.0	6.5 7.0 7.5 8.0 8.5 9.0 9.5			CONTINUED AS CORED BOREHOLE			

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CORED BOREHOLE LOG
BH105

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 26/09/2019
DATE COMPLETED: 30/09/2019
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COORDS: 377835.70 m E 6356654.30 m N MGA94 56
DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
				67.5	5.5					
				67.0	6.0		START CORING AT 6.15m			
	0% LOSS	100	0	66.5	6.15		SANDSTONE, fine to medium grained, pale grey, pale grey with occasional iron staining	MW		BP 11° Clay & Fe PR S 2 mm
				66.0	6.5					
				65.5	7.0		Becoming pale grey and orange			BP 3° PR S
HQ	40% LOSS				7.41		SILTSTONE, pale grey			BP 5° Fe PR S
					7.5					BP 6° Fe PR S
					7.55		SANDSTONE, fine grained, pale grey with occasional iron staining			BP 2°
					7.64					BP 0 - 5° Fe PR S
	100% LOSS	100	74	65.0	8.0		SILTSTONE, pale grey with occasional iron staining 50mm igneous intrusion at 7.71m			Fe IR RF 50 mm Igneous intrusions
										JT 75° Fe PR S partially healed
				64.5	8.5					BP 8° Fe PR S
		100	76							BP 2° Fe PR S
										JT 90° Fe U RF
										BP 0° Fe PR S
										DB 0°
										BP 6° Fe PR S
NMLC	0% LOSS	100	89	64.0	9.0					BP 9° Fe PR S
										JT 87° Fe PR RF
										BP 30° Fe PR S
	100% LOSS	100	66	63.5	9.5					BP 0° Fe PR S
										BP 0° Fe PR S
										JT 77° Fe PR RF
										JT 20° PR RF
				63.0						BP 23° Fe PR S
										BP 15 - 23° Fe PR S
										BP 7° Fe PR S
										JT 87° Fe PR RF
										BP 30° Fe PR S

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CORED BOREHOLE LOG
BH105

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
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LOCATION: John Hunter Hospital

DATE COMMENCED: 26/09/2019
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SURFACE RL: 72.75 m AHD
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DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description				
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	100% LOSS	100	66	62.5	10.00		Tuffaceous CLAYSTONE, pale grey, with occasional iron oxide staining, interbedded with fine grained sandstone Abundant iron stained annealed defects from 10.09m to 10.21m	MW			BP 3° Fe PR S BP 12° Clay & Fe PR S 3 mm Fe Igneous intrusion, 3-60mm 20° 10 mm Igneas intrusion JT 8° Fe PR S BP 40° Fe PR S BP 4° Fe PR S BP 3° Fe PR S JT 83° Fe PR IR healed JT Fe PR IR healed, 2-5mm JT 70° Fe PR S
	30-40% LOSS	100	69	61.0							JT 70° Fe PR S JT 30° Fe PR RF JT 90° Fe PR RF BP 10° Fe PR S JT 45° Fe VNR PR
	30-40% LOSS	100	71	59.5	12.47		SANDSTONE, fine grained, grey Becoming fine to medium grained, pale grey and orange at 12.8m Becoming fine to coarse grained, yellow-brown at 13.0m	HW			BP 0° Fe PR S IS Siltstone PR S 2 mm JT 0° Fe IR BP 10° Fe PR S JT 80° Fe PR VR CS 6 mm
				59.0	13.34		COAL, black Layer of grey siltstone from 14.11m to 14.17m Layer of grey, with dark grey laminae siltstone from 14.37m to 14.42m	SW			CS 4 mm CS 1 mm CS 3-5mm CS 2 mm CS 2 mm CS 13 mm DZ 60 mm
				58.0	14.53		SILTSTONE, grey, with dark grey, laminae, interbedded with fine grained sandstone	MW			BP 0° PR S DZ 140 mm JT 80° Clay VNR PR S

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CORED BOREHOLE LOG
BH105

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
CLIENT: Health Infrastructure
PROJECT: John Hunter Health and Innovation Precinct
LOCATION: John Hunter Hospital

DATE COMMENCED: 26/09/2019
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DRILL MODEL: Hanjin D&B 8d

Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	30-40% LOSS	100	100	57.5	15.5		SILTSTONE, grey, with dark grey, laminae, interbedded with fine grained sandstone	MW			
				57.0	16.0						
					16.10		SANDSTONE, fine grained, grey	SW			
				56.5	16.5						
				56.0	17.0		Interbedded with dark grey laminae siltstone from 16.89m to 16.96m Interbedded with fine to medium grained, dark grey laminae siltstone at 17.07m				
				55.5	17.5						
					17.72						
				55.0	18.0		Pebbly SANDSTONE, fine to coarse grained, brown, fine to medium sub-rounded gravel sized clasts interbedded with conglomerate				BPx3 5° Fe PR RF
					18.22						BP 14° Fe PR S
				54.5	18.34		Pebbly SANDSTONE, fine to coarse grained, grey fine to medium sub-rounded gravel sized clasts interbedded with conglomerate				BP 27° Fe PR S
	30-40% LOSS	100	100		18.5		Pebbly SANDSTONE, fine to coarse grained, brown, fine to medium sub-rounded gravel sized clasts interbedded with conglomerate				BP 3° Fe PR S
				54.0	19.0						
				53.5	19.5						
				53.0							

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CORED BOREHOLE LOG
BH105

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PROJECT No: 14399
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Borehole Information						Field Material Description					
METHOD	WATER	CORE RECOVERY	RQD	RL (m AHD)	DEPTH (m)	GRAPHIC LOG	DESCRIPTION (SOIL NAME; plasticity/grain size, colour, particle shape, secondary components, minor constituents) (ROCK NAME; grain size, colour, minor constituents)	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL -0.03, VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	AVERAGE DEFECT SPACING (mm) (10, 30, 100, 300, 1000, 3000)	DEFECT DESCRIPTION AND ADDITIONAL OBSERVATIONS (defect type, inclination, infilling, planarity, roughness, thickness)
NMLC	30-40% LOSS	100	100	52.5	20.5		Pebbly SANDSTONE, fine to coarse grained, brown, fine to medium sub-rounded gravel sized clasts interbedded with conglomerate	SW			BP 10° PR RF
				52.0	20.83						
					21.0		CORED BOREHOLE BH105 TERMINATED AT 20.83 m				
				51.5	21.5						
				51.0	22.0						
				50.5	22.5						
				50.0	23.0						
				49.5	23.5						
				49.0	24.0						
				48.5	24.5						
				48.0							

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