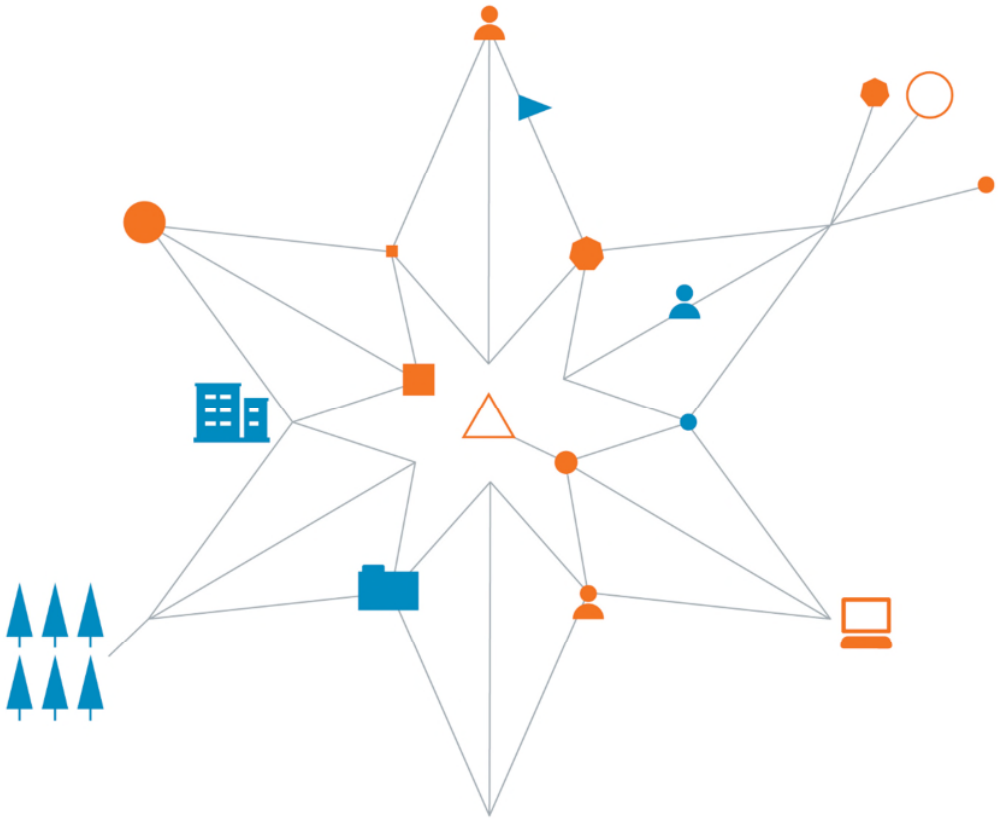
Taylor Thomson Whitting (NSW) Pty Ltd
Proposal for Wyong Hospital Expansion
Geotechnical and Pavement Investigation
754-NTLGE222494-AB.Rev1

19 November 2018



We're always pushing boundaries except when it comes to safety

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Wyong Hospital Expansion - Geotechnical and Pavement Design Report

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Quality information

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Table of contents

Tables

Figures

Appendices

1. Introduction

Taylor Thomson Whitting (NSW) Pty Ltd (TTW) commissioned Coffey Services Australia Pty Ltd (Coffey) to carry out a geotechnical investigation for the proposed multi storey hospital building and pavement investigation for access road. The site is located to west of the existing Wyong Hospital building and is access via Louisiana Road.

This report addresses the scope of work outlined in our proposal referenced as 754-NTLGE222494-AA, dated 13 September 2018.

Based on preliminary architectural drawings by HDR, the proposed development comprises of development of six levels hospital building.

Proposed Level 1 will require approximately 4.5m of excavation below existing ground level towards the north eastern boundary of the site area to RL 18.180m AHD. Fill up to approximately 2m deep will be required towards the opposite end of the site, that is the south western boundary. Vehicular access with to Level 1 will be via new proposed link road. Three pedestrian link bridges will be part of the proposed building and connect the new building with existing Hospital building the east.

Vehicular access to the proposed development at the time of the investigation is via existing haul (construction) road connected from Louisiana Road to the west.

Prior to this report Coffey was given following documents:

- Transport and Accessibility Impact Assessment prepared by TTW for Wyong Hospital Redevelopment, references as 181457 TAAA and dated 25 October 2018.
- Preliminary Architectural Drawings prepared by HDR, project titled as “Wyong Hospital Redevelopment Pacific Highway Kanwal, NSW, 2259”, referenced as project number 10116275 and dated as 10/10/2018, marked as work in progress. Below is list of the drawing received:
  - 55372-HDR-AR-DWG-1120100 to 700
  - 55372-HDR-AR-DWG-150100 to 500
  - 55372-HDR-AR-DWG-160000 to 400
- Proposed building site existing survey plan prepared Threhy Ingold Neate Land Development, drawing titles as “Work as Executed South Carpark (as surveyed 13.09.18), Lot 1, DP 1147734 Wyong”, referenced as project number 22604 and dated 19.09.18.
- Planning Secretary’s environmental assessment requirements (SEARs) for Wyong Hospital Expansion, 664 Pacific Highway, Hamlyn Terrace, referenced as SSD 9536 and dated 6/9/2018.

This report presents the results of the site geotechnical investigation carried out to assess the geotechnical conditions of the subsurface materials at the proposed development site. This will be used to provide geotechnical design parameters and recommendations on the foundation type and other geotechnical advice relevant to construction of the proposed hospital building and pavement.

2. Objectives and Scope

This report addresses to geotechnical aspects and pavement design of site area. Environmental assessment and waste classification are reported separately.

The objectives of the investigation have been to:

- assess the ground conditions within the 10 m below ground level (bgl) to assess suitability of the founding material for the proposed building.

- Comment on founding conditions and provide geotechnical parameters for footing design including allowable bearing capacities for footings in accordance with AS2870-2011.
- Provide geotechnical design parameters for piled / high level footings.
- Assess / comment on groundwater and how it may affect the proposed development.
- Comment on excavatability of the natural material within footprint of the proposed structure and pavement.
- Provide pavement design for the roadways and parking areas with comments on construction methods, material specification and drainage. Provide an estimate of the subgrade Young's Modulus for short term and long-term loading.
- Advise general earthworks requirements and the subgrade preparation and compaction requirements Provide the thickness of pavement appropriate for the traffic intensity and wheel loads. Advise the type of material and placement specification for pavement materials.

To achieve the objectives above, Coffey has completed the following scope of work:

- Preparation of site specific safety and planning documentation
- Liaison with DBYD and arranging for an underground service locator to confirm the proposed test locations were clear of buried services
- Drilling of four boreholes to 10m depth
- Excavation of seven test pits for the proposed pavement up to 2.0 m below ground level
- Laboratory testing
- Analysis and report preparation

3. Fieldwork

Coffey undertook a combined fieldwork set out for geotechnical investigation and environmental sampling. Fieldwork was carried out between 3 October to 5 October 2018. For geotechnical pavement design parameters Coffey completed the following:

- Setting out borehole and test pit location based on dial before you dig plans, service location survey and site access.
- Drilling of four boreholes BH01 to BH04, using a tracked DB515 drill rig.
- BH01, BH02, BH03 and BH04 were augured down to 7.0m, 5.5m, 5.6m, and 3.6m below ground level, respectively with SPT's completed at 1.5m intervals in soils. Drilling continued as rotary core drilling for pile design in BH01 and BH03 to medium to high strength rock to depth of 12.05m and 10.84m below ground level, respectively.
- Seven test pits were drilled, using a mini excavator with a 300mm auger mount. Holes were named TP01 to TP07 and were terminated at 2.0m, 0.6m, 2.0m, 1.0m, 2.0m, 0.9m, and 1.2m below ground surface, respectively. Early refusal depth in the test pits was within fill material.
- Laboratory testing was carried out on samples retrieved during drilling and following tests were done:
  - 5 nos. four-day soaked California Bearing Ratio (CBR).
  - 3 nos. shrink/swell.
  - 2 nos. Atterberg limit.
  - 4 soil gradation tests

- 4 aggressivity series tests
- 12 Point Load index tests at 2m centres.

Field work was carried out in the full-time presence of Coffey geotechnical engineers who produced field logs and nominated sampling of the boreholes.

Site location and the locations of the boreholes are shown in Figure 1, Appendix A along with geotechnical sections. The engineering logs and core photos for the boreholes are presented in Appendix B, together with explanatory Sheets defining the terms and symbols used. Results from laboratory testing are included in Appendix C.

4. Site Conditions

4.1. Surface Conditions

The site is a rectangular shaped land with an approximate area of 8,685 \m^2 and is located across Henry Moore Drive, to west of the Wyong Hospital existing building.

At the time of the investigation, the site comprised of a three level carpark area. The carpark was in construction stage presumably ready of for asphalt. The proposed link road comprised of unpaved construction road with patches of visible coarse gravel and uneven surface.

The site is located within the Central Coast Council (CCC) area, adjacent to Pacific Highway carriageway. Proposed development site access is via Louisiana Road reserve to the west. The site is bounded by the following properties, public roads and infrastructure:

- Hakea Grove Aged Care centre to the west
- Under construction car park to the north
- Trees and vegetation to the south; and
- Henry Moore Drive (hospital internal road) to the east of the site boundary.

The site topography during the investigation slopes was generally gently sloping and has an angle of less than 5° towards the south west to west.

4.2. Ground Model

With reference to the 1:100,000 scale Gosford-Lake Macquarie Geology series sheet 9131 & part sheet 9231, the site is underlain along the boundary of Tuggerah Formation of the Narrabeen Group and Holocene deposits of Quaternary age. The Tuggerah Formation is described as grey to green-grey laminate, red brown claystone and siltstone, interbedded with fine to medium grained green-grey sandstone. Quaternary age Holocene deposits are described as gravel and sand.

Site investigation confirms the above-mentioned geology. The site is overlayed by fill material to a depth of between 0.6m and 2.6m below ground surface. This is underlain by residual soils grading into extremely weathered material comprising clay materials to a maximum depth of 7.0m.

The borehole location plan is provided in Drawing 1. All borehole logs from the site investigation are provided in Appendix A. The interpreted geotechnical units encountered within boreholes and test pits are shown in the following Table 1 to Table 4.

Table 1: Summary of generalised ground model within borehole locations

Unit	Material / Origin	Description
1a	Fill	Sandy GRAVEL: fine grained, grey, fine to coarse grained sand. Sandy CLAY: low to medium plasticity, brown, grey and orange, fine grained sand. Gravelly SAND: fine to coarse grained, pale orange, fine grained sub-rounded gravel.
2a	Residual Soil	Sandy CLAY: low to medium plasticity, orange, pale grey, brown and red, fine grained sand. Clayey SAND: fine grained, orange and brown, with fine gravel. CLAY: low to medium plasticity, pale grey and orange. Gravelly CLAY: low plasticity, pale grey, fine, sub-angular gravel
2b	Extremely weathered material to highly weathered material	Sandy CLAY: low plasticity, red and orange, fine grained sand. SANDSTONE: fine grained, red and pale grey and orange, very low strength
3a	Moderately to slightly weathered rock	SANDSTONE: fine grained, red, pale grey, grey and brown with mudstone/siltstone bands and black carbonaceous laminations, low to medium strength
3b	Slightly weathered to fresh rock	SANDSTONE: fine to medium grained, grey to brown, with black carbonaceous veneer, moderately to slightly weathered, medium to high strength

Table 2: Summary of distribution subsurface ground conditions

Borehole ID	Depth to base of inferred geotechnical unit (m)				
	Unit 1a	Unit 2a	Unit 2b	Unit 3a	Unit 3b
BH01	0.7	5.0	7.0	9.8	12.05
BH02	0.6	4.5	5.5	NC	NC
BH03	2.6	4.5	5.6	8.6	10.89
BH04	2.0	3.0	3.6	NC	NC
Notes NC – Not cored					

Table 3: Summary of generalised ground model within test pit locations

Unit	Material / Origin	Description
4a	Fill – Wearing Course	Asphalt, black
4b	Fill – Existing Base Course	Sandy GRAVEL: medium to coarse grained, grey and dark grey, fine to coarse sand
4c	Fill – Existing Sub-Base	Sandy GRAVEL: fine to medium grained, brown, fine to coarse sand. Gravelly SAND: fine to coarse grained, grey, dark grey, fine to coarse grained, angular to sub-angular gravel.
4d	Fill	Gravelly SAND: fine to coarse grained, dark grey, pale brown, fine to coarse grained, angular to sub-angular gravel, with cobbles, trace of brick and fabric. Gravelly CLAY: low plasticity, mottled orange and pale grey, fine, angular to sub-angular gravel, with fine to coarse sand, traces of brick and sandstone cobbles. Clayey SAND: fine to coarse grained, red and grey, with traces of fine, angular gravel, tree bark and tree branches. Sandy CLAY: low plasticity, orange, with fine to medium grained sand.
5a	Residual Soil	Sandy CLAY: medium plasticity, mottled orange and pale grey, fine grained sand. CLAY: medium plasticity, mottled pale grey and red.

Table 4: Summary of distribution subsurface ground conditions

Test Hole ID	Test pit coordinates		Depth to base of inferred geotechnical unit (m)				
	Easting (m)	Northing (m)	Unit 4a	Unit 4b	Unit 4c	Unit 4d	Unit 5a
TP01	357899.00	6318873.00	NE	0.1	0.4	1.4	>2.0
TP02	357927.00	6318873.00	0.1	NE	0.2	0.6	-
TP03	358005.00	6318858.00	NE	NE	0.1	1.6	>2.0
TP04	353027.00	6318898.00	NE	NE	NE	1.0	-
TP05	358083.00	6318844.00	NE	NE	0.1	0.6	>1.6
TP06	358116.00	6318838.00	NE	0.1	NE	0.9	-
TP07	358168.00	6318832.00	NE	0.1	NE	1.2	-

Notes
NE - Not encountered

4.3. Groundwater

Groundwater was not encountered in any of the borehole and test pits completed during investigation. Groundwater measurement was not possible in BH01 and BH03 due to water used for core drilling in boreholes BH01 and BH03.

5. Laboratory Testing

Samples obtained during the investigation were returned to Coffey's Newcastle laboratory for temporary storage and NATA accredited testing. Laboratory testing carried out is outlined in Section 2 Fieldwork.

The test results are presented in Appendix B and summarised in the following tables.

Table 5: Shrink swell test results

Hole ID	Depth (m)	Field Moisture Content (%)	Swell (%)	Saturated Moisture Content (%)	Shrinkage (%)	Iss (%)
BH02	2.0 – 2.3	18.7	2.6	20.7	1.8	1.7
BH04	2.0 – 2.3	15.5	4.0	19.6	1.3	1.8

Table 6: CBR and standard maximum dry density test results

Borehole	Depth (m)	Field Moisture Content (%)	Optimum Moisture Content (%)	SMDD (t/m3)	CBR (1)
TP01	0.5 – 0.7	8.4	11.0	1.99	11
TP02	0.3 – 0.6	12.6	11.3	2.00	4.5
TP03	0.4 – 0.6	14.1	11.9	1.93	9
TP05	0.4 – 0.6	10.5	11.4	1.92	3.0
TP07	0.5 – 0.7	17.5	17.1	1.74	5
Notes (1): 4-day soak and 4.5kg surcharge					

Table 7: Atterberg limits test results

Borehole	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
BH01	0.5 – 0.7	26	15	11
BH02	0.4 – 0.6	25	17	8
BH03	1.3 – 1.5	23	15	8
BH04	0.5 – 0.9	27	18	9

Table 8: PSD test results

Test pit ID	Depth (m)	Particle size distribution	
		Sieve size (mm)	% passing
BH01	0.5 – 0.7	13.2	100
		4.75	95
		2.36	91
		0.075	37
BH02	0.4 – 0.6	13.2	97
		4.75	89
		2.36	85
		0.075	35
BH03	1.3 – 1.5	13.2	97
		4.75	92
		2.36	90
		0.075	45
BH04	0.5 – 0.9	13.2	100
		4.75	95
		2.36	91
		0.075	36

Table 9: Soil aggressivity test results

BH ID	Depth (m)	pH	Sulfate (SO_4) (ppm)	Chloride (ppm)	Electrical Resistivity (ohm.m)	Exposure classification for concrete piles	Exposure classification for steel piles
BH01	0.7	8.5	130	46	52	Nonaggressive	Nonaggressive
BH02	1.0	8.2	52	63	95	Nonaggressive	Nonaggressive
BH03	0.9	7.1	180	280	41	Nonaggressive	Nonaggressive
BH04	1.0	7.3	120	57	57	Nonaggressive	Nonaggressive

6. Discussion

6.1. General

The proposed building development will cover all the site area. Based on preliminary architectural drawings and survey plan, referenced above in Section 1, the design reduced level for Level 1 is RL 18.180m AHD. This will require approximately 4.5m excavation towards north east and fill of approximately 2m deep towards the south west boundary of the site.

The existing site is underlain by fill material, on top residual soils and sandstone. In the absence of an engineer's certification, all fill on the site is considered to be 'uncontrolled' and not suitable for support of structures or pavement.

6.2. Earthworks

6.2.1. Site Preparation

General site preparation for the proposed development will require removal or relocation of services etc., and removal of minor vegetation i.e. grass growing on strips between existing car park levels, across the footprint of the development. Following this, all uncontrolled fill and any obvious deleterious material should be removed and suitably disposed of or used for landscaping purposes only.

Given the cohesive nature of the subgrade materials, the site may become un-trafficable when subject to excessive moisture where minimal cut is proposed. Measures to protect the subgrade from ponding water should be considered. Such measures may include maintenance of suitable cross-falls to reduce the potential for water to pond and the provision of a working platform comprising of suitable crushed rock or concrete. The required thickness will depend on the plant required onsite.

6.2.2. Fill Placement

General guideline for fill placement is provided below:

- Prior to placement of any fill, the proposed fill area should be stripped to remove all vegetation, topsoil, existing uncontrolled fill or other potentially deleterious material. Based on site observations allowance should be made to strip a minimum of 0.6m or to the base of Unit 1a.
- The area to receive fill should be proof rolled to identify any loose or yielding areas. Any yielding areas should be excavated and replaced with controlled fill.
- All fill beneath structures should be compacted in layers not exceeding 300mm loose thickness to a minimum density ratio of 98% Standard Compaction within ± 2% of Optimum Moisture Content (OMC).
- All fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion.
- If fill is to be placed on sloping subgrade steeper than 1H:8V, then it should be placed on level surfaces benched into the subgrade.

Earthworks should be planned, carried out and documented in accordance with the recommendations outlined in AS3798-2007 'Guidelines for Earthworks for Commercial and Residential Developments' and in accordance with CCC Guidelines where applicable. Level 1 earthworks observation and testing is recommended for any controlled fill required to support structures, pavement or infrastructure and for all hillside earthworks.

6.2.3. Groundwater

Groundwater was not encountered during the investigation within soil profile in boreholes BH01 to BH04. It should be noted the absence of groundwater does not preclude its possible impact during construction.

Groundwater inflow can be from seepage through voids and fissures within the soil and associated seasonal watercourses. Consideration needs to be given to water inflow during a wet season and from perched water table. It is likely that such groundwater inflow may impact excavations. Excavations below water table should be designed to cater for the groundwater inflow.

6.2.4. Excavation Stability

Temporary excavations above the water table up to 2m high into natural clay can be expected to stand for short periods with vertical cuts, however workers on foot should not approach any vertical cut higher than 1.4m.

Based on the preliminary drawings, excavation is required of approximately 4.5m below existing ground level of RL 22.68m AHD. Temporary shoring may be designed based on retaining wall parameters presented Table 7 (Section 5.45.4 below).

All other temporary excavations should be cut at 1:1 or flatter. Steeper cuttings may be permissible with specific geotechnical advice, otherwise shoring will be required to accommodate construction. Shoring should be designed specific to conditions of the excavation and in consideration to project needs.

6.2.5. Dilapidation Survey

For all excavations that are deeper than 1m at or near the site boundary, a dilapidation survey of the adjacent properties is recommended prior to excavation.

6.2.6. Excavatability

Excavation will be approximately 4.5m below ground level extending to RL 18.180m AHD and is therefore anticipated to be within the Unit 3a, sandstone rock with a low to medium strength (point loads Is50 less than 1MPa).

Based on our investigation, excavation within fill underlain by residual soils will be possible using conventional earthmoving equipment such as tracked loaders and hydraulic excavators. Based on the Chart by Pettifer & Frookes 1994), the rock within the proposed excavation depth is classified as easy ripping, and should be achievable with a D6 to D7 or equivalent dozer or a 30T excavator with a rock pick. Although not encountered in our boreholes, concretionary zones may be present within the sandstone that require heavy ripping and possible breakers to achieve excavation. Where zero lot line excavation is required, rock sawing or milling may be required to achieve the required line and grade.

6.2.7. Reuse of Material

Due to the proposed excavation onsite, a significant amount of material is expected to be generated.

Unit 1a comprises of material described as fill and may be used for engineering fill material, only after being checked and assessed for any deleterious or hazardous materials that may be embedded in it. The environmental site investigation did not find any deleterious material embedded within the Unit 1a, however it should be noted that testing was done only at four locations within the proposed building footprint.

Unit 2a and 2b typically comprises sandy clay with gravel, clay to sandy clay. Although the fines component of the material comprised low to medium plasticity clay, due to the proportion of sands and gravels the material has a high swell potential (Is value of 1.8). As such this material is likely to be suitable for reuse onsite as engineered fill (except for drainage zones at the back of retaining walls).

The excavations will also generate Unit 3a moderately weathered to slightly weathered, low to medium strength rock material. The material generated by excavation of sandstone rock can be re-used for engineered fill and drainage zones at the back of retaining walls.

It is not anticipated that general excavations will not generate any Unit 3b rock material.

6.3. Foundation

All footing elements should be placed beneath any uncontrolled fill.

The footings of a single structure should be founded within the same strata unless the structure can be designed with articulation to accommodate potential differential ground response to loading. Shallow and deep footings may be required for the proposed hospital building based on site topography and geology.

6.3.1. Shallow Footings

High level strip or pad footings founded in stiff or better residual soils (Unit 2a) may be proportioned on an allowable baring capacity of 100kPa. High level strip or pad footings founded in extremely weathered Unit 2b material may be proportioned based on an allowable bearing capacity of 250kPa.

High level footings founded in Unit 3a sandstone (Class IV or better) rock may be proportioned for an allowable ultimate bearing pressure of 500kPa (refer to Pells et al 1998).

6.3.2. Deep Footings

Deep pile footings may be required at places with deep fill/soil profile encountered within footprint of the proposed development, anticipated towards south western boundary of the site.

Piles socketed in a minimum of 0.3m into the geological Unit 3a (slightly weathered), may be designed for geotechnical strength parameters in accordance with the guidelines presented in Australian Standard AS2159-2009, Piling Design and Installation, as shown in Table 10.

Table 10: Preliminary ultimate capacities for deep footings

Unit	Material	Ultimate End Bearing Pressure (MPa)(1)	Ultimate Shaft Adhesion (kPa)
2a	Residual soil	N/A	45
2b	Extremely weathered rock	1	65
3a	Moderately weathered sandstone rock (Class IV)	2.5	200
3b	Slightly weathered sandstone rock (Class III)	3	500
Notes: (1) Ultimate values occur at large settlements (>5% of minimum footing dimensions).			

A geotechnical reduction factor ϕ_g of 0.48 should be applied to the above values for the geotechnical design. This reduction factor may be increased with more site investigation and site-specific pile load testing.

All footings should be free of loose or softened material and free of water prior to the placement of concrete. Concrete should be placed as soon as possible after the drilling/excavation to prevent softening of the footing base or pier walls. Footing drilling / excavation should be observed by a suitably experienced geotechnical consultant to assess that the recommended founding material has been reached and to confirm that conditions encountered are consistent with those described in this report.

6.3.3. Retaining Wall Design

The soil parameters shown in Table 11 below can be used in the short and long-term design of the retaining walls.

It is noted that retaining walls constructed as part of the building walls will need to be designed for at rest (k_0) earth pressures due to their fixity. This is also the case for walls within close proximity of structures sensitive to movements.

Engineered retaining walls may be designed using the guidelines presented below. The design must include an assessment of global stability of the walls and surrounding soils.

Drainage behind the wall should, as a minimum, comprise a geo-composite drain or geotextile wrapped gravel drain at the back of the wall that drains to a geotextile wrapped subsoil drain along the wall toe. The toe drain should discharge to the site storm water system to provide long term drainage behind retaining walls.

Table 11: Retaining wall parameters

Soil Type	Residual Soil (Unit 2a)	Extremely weathered rock (Unit 2b)	Compacted Granular Backfill behind the wall
Short term shear strength (Su kPa)	75	200	NA
Long term (drained) friction angle (ϕ' °)	26	28	33
Long term (drained) effective cohesion (c′ kPa)	5	7	0
Unit Weight (γ kN/m^3)	18	20	18
Coefficient of Lateral Earth Pressure at rest k_0	1.8	1.8	0.45
Coefficient of Active Earth pressure k_a	0.40	0.37	0.30
Clay coefficient of Active Earth pressure k_{ac}	1.25	1.2	N/A
Coefficient of Passive Earth pressure k_p	1.7	1.8	2.0

6.4. Pavement Design

Pavement design investigation was carried out for stretch of link road from Louisiana Road to proposed new building. Existing haulage road comprise of fill material of variable thickness within the footprint of the proposed road. The fill material was identified as Wearing Course, Base, Sub-Base and general fill. It is underlain by sandy clay or clay residual soils. Refer to Section 3.2 summary of soil units encountered during investigation.

The pavement design herein is based on the empirical methods provided in Austroads 2012 Guide to Pavement Technology Part 2: Pavement Structural Design and supplements to this guide published by Roads and Maritime Services NSW as well as reference to Central Coast Council document “Civil Works Specification Volume 1 - Design” September 2017. This document requests a design life of 40 years.

6.4.1. Design Traffic Loadings

Coffey was not provided with traffic loadings; however, pavement design was carried on the following assumed design loadings:

- Flexible pavement with a design ESA value of 1.0 x 10^4
- Flexible pavement with a design ESA value of 1.0 x 10^5
- Flexible pavement with a design ESA value of 5.0 x 10^5

6.4.2. Flexible Pavements

For urban roads it is preferential to adopt 95% confidence level design. This has been adopted for subgrade rutting with a 90% confidence level adopted for asphalt fatigue. The flexible pavement composition and minimum required thicknesses are presented in Table 12.

Table 12: Flexible pavement design components

Pavement components	Link Road (from Louisiana Road to proposed building)		
[1]Wearing Course (mm)	40	40	40
Base-course (mm)	150	150	150
Subbase (mm)	210	280	350
Total Thickness (mm)	400	470	540
Subgrade[2]	CBR min 3%	CBR min 3%	CBR min 3%
Traffic Load DESA	1.0 x 10^4	1.0 x 10^5	5.0 x 10^5

Note:

1 All Wearing Courses to be AC10 on a 10mm seal

2 The upper 150mm of subgrade in fill areas is to comprise select quality material in accordance with Central Coast Council Specification 2018

The summary of the pavement designs, together with pavement material and compaction requirements are presented in Appendix D.

Existing fill material has a high CBR although it is not considered suitable for road subgrade unless it can be demonstrated to be controlled fill via and engineer's certification. In these areas any uncontrolled fill should be removed and replaced to subgrade level with controlled fill per Section 6.2.

Allowance should made to replace the asphalt surfacing after 10 to 15 years of service due to oxidation and as such the proposed loading has been reduced by 25% when assessing asphalt fatigue. It is noted that Fairmount Avenue asphalt thickness is being governed by asphalt fatigue rather than subgrade rutting. Note that the 40mm thick asphalt will only be suitable away from intersections given the screwing action of tyres within intersections.

6.4.3. Drainage

Drainage at the site is provided by the granular subgrade fill material.

7. Closure

The extent of testing associated with this assessment is limited to discrete points of observation supplemented by bores to observe superficial soil types. Variation in ground conditions can occur between and away from observed points. If subsurface conditions encountered during construction differ from those given in this report further advice should be sought so that recommendations can be reviewed, and revised, if necessary.

Further advice on the uses and limitations of this report is presented in the attached document, *Important Information about your Coffey Report* which forms and integral part of this report

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

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

Data should not be separated from the report*

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

Geoenvironmental concerns are not at issue

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

Rely on Coffey for additional assistance

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

Responsibility

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

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Appendix A – Drawings

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	RB	JD	8/11/18

20 0 20 40 60 80

Scale (metres) 1:1500

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
AERIAL IMAGE ©: 2018 CNES/Airbus

drawn	RB / AW
approved	JD
date	8 / 11 / 18
scale	AS SHOWN
original size	A3

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A TETRA TECH COMPANY

client: COLLIERS INTERNATIONAL PTY LTD

project: WYONG HOSPITAL EXPANSION
PACIFIC HIGHWAY, HAMLYN TERRACE, NSW

title: INVESTIGATION LOCATION PLAN

project no: 754-NTLGE222494 | figure no: FIGURE 1 | rev: A

WEST

EAST

LEVEL 7 RL 44.450

LEVEL 6 RL 39.950

LEVEL 5 RL 35.700

LEVEL 4 RL 31.500

LEVEL 3 RL 27.300

LEVEL 2 RL 23.100

LEVEL 1 RL 18.900

4500 4250 4200 4200 4200 4200 4920

MRF 01

CON 01

AL 01

GLZ 01

MS1

MRF 01

MS1

MRF 01

BH01
(-0.2m)
18.60mAHD

N=R
N=R
N=25 VSt
N=R
N=R
MWtoSW L
LtoM
SWtoFR MtoH
EOH 12.05m

BH04
(0.1m)
21.10mAHD

N=25 St-VSt
N=R
EOH 3.60m

UNIT 1

UNIT 2a

UNIT 2b

UNIT 3a

UNIT 3b

RL (m)

22 20 18 16 14 12 10 8 6 4

0 10 20 30 40 50 60 70 80 90 100 110 120 130

DISTANCE (m)

SECTION A-A'

LEGEND

- FILL
- SANDY CLAY
- CLAYEY SAND
- SANDSTONE
- CLAY
- GRAVELLY CLAY
- EXISTING GROUND SURFACE
- INFERRED GEOLOGICAL BOUNDARY

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	RB	JD	8/11/18

5 0 5 10 15 20
Horizontal Scale (metres) 1:400

2.5 0 2.5 5 7.5 10
Vertical Scale (metres) 1:200

drawn	RB / AW
approved	JD
date	8 / 11 / 18
scale	AS SHOWN
original size	A3

coffey
A TETRA TECH COMPANY

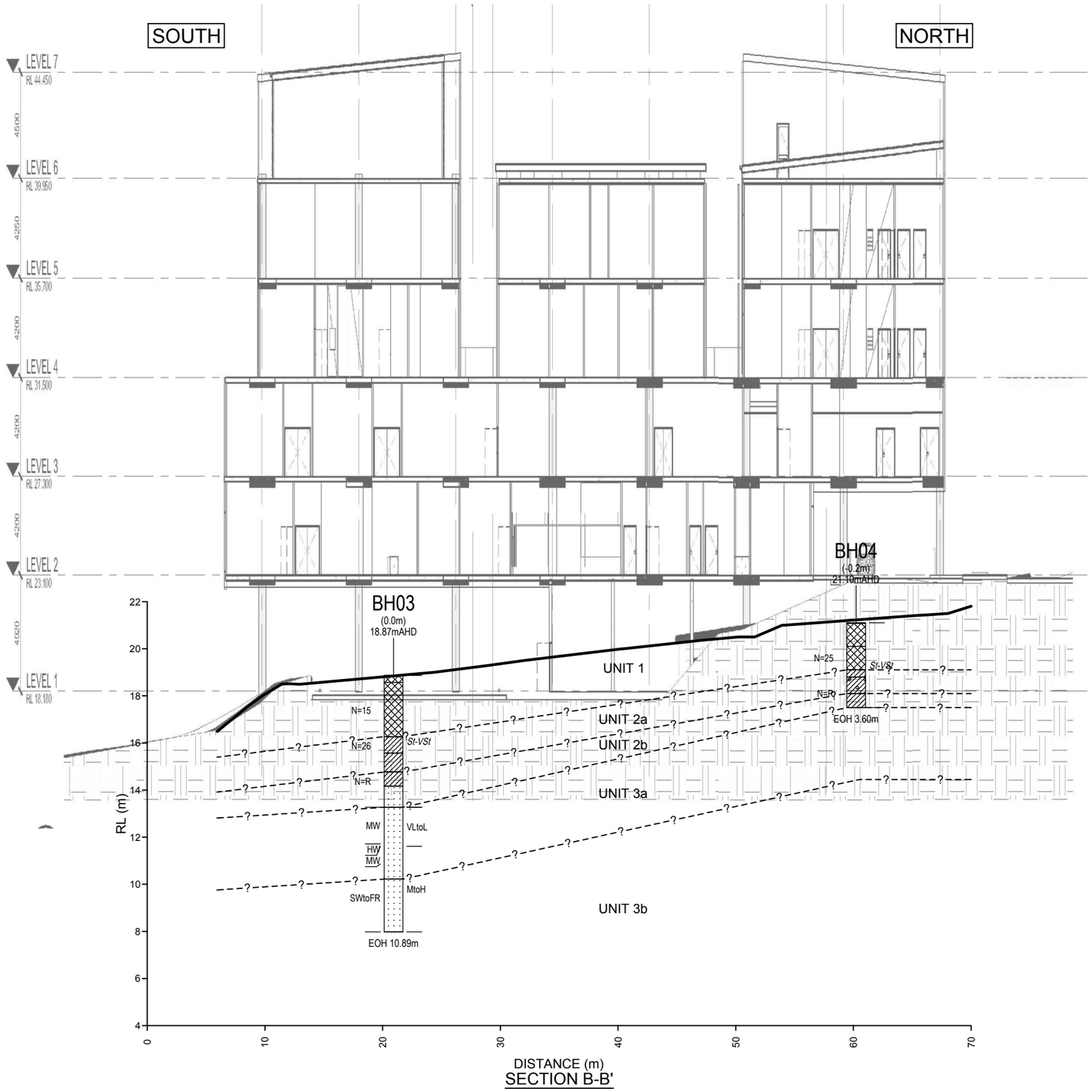
client: COLLIERS INTERNATIONAL PTY LTD

project: WYONG HOSPITAL EXPANSION
PACIFIC HIGHWAY, HAMLYN TERRACE, NSW

title: SECTION A-A'

project no: 754-NTLGE222494 | figure no: FIGURE 2 | rev: A

PLOT DATE: 8/11/2018 2:52:29 PM DWG FILE: F:\1. PROJECTS\4. SYD-GEOTECHNICS\OTHER OFFICES\NTL-GEN\TLGE222494\CAD\754-NTLGE222494.DWG



LEGEND

- FILL
- SANDY CLAY
- CLAYEY SAND
- SANDSTONE
- CLAY
- GRAVELLY CLAY
- EXISTING GROUND SURFACE
- INFERRED GEOLOGICAL BOUNDARY

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	RB	JD	8/11/18

Horizontal Scale (metres) 1:400

Vertical Scale (metres) 1:200

drawn	RB / AW
approved	JD
date	8 / 11 / 18
scale	AS SHOWN
original size	A3

coffey
A TETRA TECH COMPANY

client: COLLIERS INTERNATIONAL PTY LTD

project: WYONG HOSPITAL EXPANSION
PACIFIC HIGHWAY, HAMLYN TERRACE, NSW

title: SECTION B-B'

project no: 754-NTLGE222494 | figure no: FIGURE 3 | rev: A

PLOT DATE: 8/11/2018 2:52:13 PM DWG FILE: F:\1. PROJECTS\4. SYD-GEOTECHNICS\OTHER OFFICES\NTL-GEN\TLGE222494\CAD\754-NTLGE222494.DWG

Appendix B – Borehole Logs and Core Photos

Soil Description Explanation Sheet (1 of 2)

DEFINITION:
In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 µm to 2.36 mm
	medium	200 µm to 600 µm
	fine	75 µm to 200 µm

MOISTURE CONDITION

Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH s_u (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 – 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 – 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 – 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 – 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	–	Crumbles or powders when scraped by thumbnail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	Less than 15
Loose	15 – 35
Medium Dense	35 – 65
Dense	65 – 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.
Lenses	Discontinuous shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.
Pockets	Irregular inclusions of different material.		

GEOLOGICAL ORIGIN WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.

TRANSPORTED SOILS

Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Fill	Man-made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES USC (Excluding particles larger than 60 mm and basing fractions on estimated mass)						USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.36 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes		GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.		GP	GRAVEL
			GRAVELS WITH FINES Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)		GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)		GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.36 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes		SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).		SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm				
			DRY STRENGTH	**DILATANCY**	**TOUGHNESS**		
		SILTS & CLAYS Liquid limit less than 50	None to Low	Quick to slow	None	ML	SILT
			Medium to High	None	Medium	CL	CLAY
			Low to medium	Slow to very slow	Low	CL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium	MH	SILT
			High	None	High	CH	CLAY
			Medium to High	None	Low to medium	OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture.			PT	PEAT

● Low plasticity – Liquid Limit w_L less than 35%. ● Medium plasticity – w_L between 35% and 50%. ● High plasticity – w_L greater than 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM	TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.		SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length		TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter.	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.		TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.		INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Rock Substance	In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.
Defect	Discontinuity or break in the continuity of a substance or substances.
Mass	Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	**RS**	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	**XW**	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	**HW**	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	**MW**	The whole of the rock substance is discoloured, usually by iron staining or bleaching , to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	**SW**	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	**FR**	Rock substance unaffected by weathering.

Notes on Weathering:
AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction. DW may be used with the definition given in AS1726. Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.

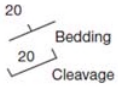
ROCK SUBSTANCE STRENGTH TERMS

Term	Abbre-viation	Point Load Index, $I_{s(50)}$ (MPa)	Field Guide
Very Low	**VL**	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

Notes on Rock Substance Strength:
In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.
The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.
The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fall across the planar anisotropy) is typically 10 to 25 times the point load index Is(50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.			

Notes on Defects:

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.
2. Partings and joints are not usually shown on the graphic log unless considered significant.
3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.

DEFECT SHAPE TERMS

Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes of orientation

Note: The assessment of defect shape is partly influenced by the scale of the observation.

ROUGHNESS TERMS

Slickensided	Grooved or striated surface, usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch. Few or no surface irregularities
Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Veneer	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein.

BLOCK SHAPE TERMS

Blocky	Approximately equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section

72710 / 07-06

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Engineering Log - Borehole

Borehole ID.	**BH01**
sheet:	1 of 3
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date started:	**03 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**03 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 358,121.00; N: 6,318,820.00 (MGA94) | surface elevation: 18.60 m (AHD) | angle from horizontal: 90°

drill model: DB515, Track mounted | drilling fluid: None | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T		Not Encountered	D	18			GP	**FILL: Sandy GRAVEL**: fine grained, grey, fine to coarse grained sand.	M	VSt		**FILL**
							CL-CI	**FILL: Sandy CLAY**: low to medium plasticity, brown, grey and orange, fine sand.	>Wp			
			SPT 10, 25/130mm, N=R	17	1.0		CL	**Sandy CLAY**: low plasticity, orange, fine sand.				**RESIDUAL SOIL**
							CL	**Sandy CLAY**: low plasticity, pale grey and orange, fine sand.	<Wp			
			SPT 16, 20, 25/110mm N=R	16	2.0							
					3.0		SW	**CLAYEY SAND**: fine grained, orange, with fine gravel.	M			
			SPT 12, 10, 15 N=25	15	4.0		CL-CI	**Sandy CLAY**: low to medium plasticity, orange and pale grey, with fine sand.	~Wp			
				14			CL	**Sandy CLAY**: low plasticity, red, with fine sand.	<Wp			**EXTREMELY WEATHERED MATERIAL**
N			SPT 4, 22, 25/90mm N=R	13	5.0							
					6.0			6.5 m: becoming firmer				
			SPT 25/130mm, , N=R	12	7.0			Borehole BH01 continued as cored hole				
				11								

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE222494-BH.GPJ <<DrawingFile>> 07/11/2018 17:25

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

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

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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	2 of 3
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date started:	**03 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**03 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 358,121.00; N: 6,318,820.00 (MGA94) | surface elevation: 18.60 m (AHD) | angle from horizontal: 90°

drill model: DB515, Track mounted | drilling fluid: None | hole diameter : 96 mm | vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		18	1.0								
		17	2.0								
		16	3.0								
		15	4.0								
		14	5.0								
		13	6.0								
		12	7.0		started coring at 7.00m						
HQ	Not Encountered	11			**SANDSTONE**: fine to medium grained, red and pale grey, with carbonaceous laminations.	MW to SW	X	a=0.18 d=0.25	100%		

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: CORED 754-NTLGE222494-BH.GPJ <<DrawingFile>> 07/11/2018 17:37

method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

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

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	3 of 3
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date started:	**03 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**03 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 358,121.00; N: 6,318,820.00 (MGA94) surface elevation: 18.60 m (AHD) angle from horizontal: 90°

drill model: DB515, Track mounted drilling fluid: None hole diameter : 96 mm vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	Not Encountered	10	9.0		**SANDSTONE**: fine to medium grained, red and pale grey, with carbonaceous laminations. *(continued)* 8.50 m: becoming pale grey only 8.70 m: 50mm carbonaceous laminations	MW to SW		a=0.17 d=0.14	100%		PT, 5°, PL, RO, SN
		9	10.0		**SANDSTONE**: fine to coarse grained, pale grey, with carbonaceous laminations.	SW to FR		a=0.77 d=0.19 a=2.63 d=3.05	96%		PT, 0°, PL, RO, CN PT, 0°, PL, RO, CN PT, 0°, IR, RO, CN PT, 0°, IR, RO, CN PT, 0°, PL, RO, CN
		8	11.0								
		7	12.0		11.60 m: 100mm carbonaceous laminations Borehole BH01 terminated at 12.05 m			a=3.31 d=3.35			PT, 0°, IR, RO, CN
		6	13.0								
		5	14.0								
		4	15.0								
		3									

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

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

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

Start depth

BH01 BOX 1 - 2

End depth

PROJECT: PROPOSED WYONG HOSPITAL NEW BUILDING, HAMLYN TERRACE
PROJECT NO: 754-NTLGE222494
BOREHOLE NO: BH01

drawn	RB	coffey A TETRA TECH COMPANY	client:	Collier International Pty Ltd
approved	JD		project:	Proposed Wyong Hospital New Building
date	7/11/2018		title:	CORE PHOTOGRAPH
scale	N/A		project no: 754-NTLGE222494	borehole no: BH01
original size	A4			

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Engineering Log - Borehole

Borehole ID.	**BH02**
sheet:	1 of 1
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date started:	**03 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**03 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 358,155.00; N: 6,318,772.00 (MGA94) | surface elevation: 16.52 m (AHD) | angle from horizontal: 90°

drill model: DB550, Track mounted | drilling fluid: Water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T — N		Not Encountered	D	16			GP / SP	**FILL: Sandy GRAVEL**: fine grained, brown, fine to coarse grained sand. **FILL: Gravelly SAND**: fine to coarse grained, pale orange, fine grained sub-rounded gravel.	M	St - VSt		**FILL**
							CL	**Sandy CLAY**: low plasticity, brown, fine grained sand.	>Wp			**RESIDUAL SOIL**
					1.0		SW	**CLAYEY SAND**: fine to coarse grained, brown.	M			
			SPT 1, 4, 8 N=12	15			CL-CI	**CLAY**: low to medium plasticity, pale grey and orange.	<Wp			
				14	2.0							
			SPT 6, 12, 15 N=27	13	3.0		CL	**Sandy CLAY**: low plasticity, red, fine grained sand.				
					4.0							
			SPT 6, 25/140mm, N=R	12	5.0			5.0 m: becoming harder with some orange				**EXTREMELY WEATHERED MATERIAL**
				11				Borehole BH02 terminated at 5.5 m				
				10	6.0							
				9	7.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

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

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Engineering Log - Borehole

Borehole ID.	**BH03**
sheet:	1 of 3
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date started:	**03 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**03 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 358,235.00; N: 6,318,759.00 (MGA94) | surface elevation: 18.87 m (AHD) | angle from horizontal: 90°

drill model: DB550, Track mounted | drilling fluid: None | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T, N		Not Observed	D	18	1.0		GP / SP / CL	**FILL: Sandy GRAVEL**: fine grained, grey, fine grained sand. **FILL: Gravelly SAND**: fine to coarse grained, pale orange, fine grained sand, sub-rounded gravel. **FILL: Sandy CLAY**: low plasticity, brown, fine grained sand.	M / >Wp	St - VSt		**FILL**
			D									
			SPT 5, 8, 7 N=15	17	2.0			1.5 m: becoming orange, pale grey and brown with some fine grained sub-rounded gravel				
				16	3.0		CL-CI	**Sandy CLAY**: low to medium plasticity, orange, red and brown, with fine to coarse sand.				**RESIDUAL SOIL**
			SPT 11, 11, 15 N=26	15	4.0		CL	**Sandy CLAY**: low plasticity, pale grey and orange, with fine sand.				
							CL	**Sandy CLAY**: low plasticity, red and pale grey, with fine sand. 4.5 m: becoming red only	<Wp			
			SPT 8, 25/130mm, N=R	14	5.0			**SANDSTONE**: fine grained, red and pale grey, very low strength.				**EXTREMELY WEATHERED MATERIAL**
				13	6.0			Borehole BH03 continued as cored hole				
				12	7.0							
				11								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- * bit shown by suffix
- e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

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

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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	2 of 3
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date started:	**03 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**03 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 358,235.00; N: 6,318,759.00 (MGA94) | surface elevation: 18.87 m (AHD) | angle from horizontal: 90°

drill model: DB550, Track mounted | drilling fluid: None | hole diameter : 96 mm | vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		18	1.0								
		17	2.0								
		16	3.0								
		15	4.0								
		14	5.0		started coring at 5.60m						
HQ	Not Observed	13	6.0		**SANDSTONE**: fine to medium grained, pale grey, grey and brown, with siltstone/mudstone bands. 5.70 m: 560mm mudstone, red-brown band	MW		a=0.13 d=0.08 a=0.12 d=0.10	100%		
		12	7.0		6.73 m: 70mm mudstone, red-brown band 6.97 m: 20mm siltstone, grey band	HW MW		d=0.05	90%		PT, 5°, PL, RO, SN PT, 5°, PL, RO, SN PT, 0°, PL, RO, CN
		11						a=1.15 d=0.74			PT, 0°, PL, RO, SN

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

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

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	3 of 3
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date started:	**03 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**03 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 358,235.00; N: 6,318,759.00 (MGA94) | surface elevation: 18.87 m (AHD) | angle from horizontal: 90°

drill model: DB550, Track mounted | drilling fluid: None | hole diameter : 96 mm | vane id.:

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

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	Not Observed	10	9.0		**SANDSTONE**: fine to medium grained, pale grey, grey and brown, with siltstone/mudstone bands. *(continued)*	SW to FR			90%		PT, 0°, IR, RO, SN
					8.50 m: 50mm siltstone band						
					SANDSTONE: fine grained, pale grey.			a=2.11 d=2.12			
		9	10.0					a=2.16 d=1.33	76%		PT, 0°, PL, RO, SN PT, 5°, PL, RO, SN
		8			Borehole BH03 terminated at 10.89 m			a=1.59 d=1.84			PT, 0°, PL, RO, SN
		7	11.0								
		6	12.0								
		5	13.0								
		4	14.0								
		3	15.0								

method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

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

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

Start depth

BH03 BOX 1 - 2

End depth

PROJECT: PROPOSED WYONG HOSPITAL NEW BUILDING, HAMLYN TERRACE
PROJECT NO: 754-NTLGE222494
BOREHOLE NO: BH03

drawn	RB	coffey A TETRA TECH COMPANY	client:	Collier International Pty Ltd
approved	JD		project:	Proposed Wyong Hospital New Building
date	7/11/2018		title:	CORE PHOTOGRAPH
scale	N/A		project no: 754-NTLGE222494	borehole no: BH03
original size	A4			

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Engineering Log - Borehole

Borehole ID.	**BH04**
sheet:	1 of 1
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date started:	**04 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**04 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 358,241.00; N: 6,318,808.00 (MGA94) | surface elevation: 21.10 m (AHD) | angle from horizontal: 90°

drill model: DB550, Track mounted | drilling fluid: None | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T, N		Not Encountered	D	21			GP / CL	**FILL: Sandy GRAVEL**: fine grained, grey, fine to coarse grained sand.	D / >Wp	St - VSt		**FILL**
			D					**FILL: Sandy CLAY**: low plasticity, brown, fine grained sand.				
				20	1.0		CL	**FILL: Sandy CLAY**: low plasticity, brown and pale orange, fine sand with fine grained, sub-rounded gravel.				
			SPT 8, 6, 19 N=25	19	2.0		CL	**Sandy CLAY**: low plasticity, orange, pale white and mottled brown.	<Wp			**RESIDUAL SOIL**
							GC	**Gravelly CLAY**: low plasticity, pale grey, fine sub-angular gravel.				HP >600 kPa
			SPT 14, 25/80mm, N=R	18	3.0		CL	**Sandy CLAY**: low plasticity, red, with fine sand.				**EXTREMELY WEATHERED MATERIAL**
								Borehole BH04 terminated at 3.6 m				
				17	4.0							
				16	5.0							
				15	6.0							
				14	7.0							

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remoulded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

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

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Engineering Log - Excavation

Excavation ID.	**TP01**
sheet:	1 of 1
project no.	**754-NTLGE222494**
client:	**Collier International Pty Ltd**
date excavated:	**05 Oct 2018**
principal:	**Health Infrastructure**
date completed:	**05 Oct 2018**
project:	**Wyong Hospital Expansion**
logged by:	**MJ**
location:	**Wyong Hospital, Hamlyn Terrace, NSW**
checked by:	**RB**

position: E: 357,899.00; N: 6,318,873.00 (MGA94) | surface elevation: 9.50 m (AHD) | pit orientation:

equipment type: Mini Excavator | excavation method: | excavation dimensions: 0.3 m long

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
E	N		Not Encountered		9.5			GP	**FILL: Sandy GRAVEL BASE**: medium to coarse grained, grey, fine to coarse sand.	M			**FILL**
				E				GP	**FILL: Sandy GRAVEL SUB-BASE**: fine to coarse grained, brown, fine to coarse sand.				
				B	9.0	0.5		SP	**FILL: Gravelly SAND**: fine to coarse grained, pale brown, with angular to sub-angular fine to coarse gravel, with cobbles, trace of brick and fabric.				
					8.5	1.0							
					8.0	1.5		Cl	**Sandy CLAY**: medium plasticity, mottled orange and pale grey, with fine sand.	<Wp	St	X	**RESIDUAL SOIL**
												X	HP 100 - 150 kPa
												X	HP 100 - 150 kPa
									Test pit TP01 terminated at 2.0 m Target depth				

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

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- U## undisturbed sample ##mm diameter
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remouded (uncorrected kPa)
- R refusal

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- W_P plastic limit
- W_L liquid limit

consistency / relative density

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

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Engineering Log - Excavation

		Excavation ID.	***TP02***
		sheet:	1 of 1
		project no.	***754-NTLGE222494***
client:	***Collier International Pty Ltd***	date excavated:	***05 Oct 2018***
principal:	***Health Infrastructure***	date completed:	***05 Oct 2018***
project:	***Wyong Hospital Expansion***	logged by:	***MJ***
location:	***Wyong Hospital, Hamlyn Terrace, NSW***	checked by:	***RB***

position: E: 357,927.00; N: 6,318,873.00 (MGA94) | surface elevation: 10.50 m (AHD) | pit orientation:

equipment type: Mini Excavator | excavation method: | excavation dimensions: 0.3 m long

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
E	N		Not Encountered		10.5				**FILL: ASPHALT**: black, 100mm.	M			**FILL**
				E				SP	**FILL: Gravelly SAND SUB-BASE**: fine to coarse grained, grey, fine angular to sub-angular gravel.				
								SP	**FILL: Gravelly SAND**: fine to coarse grained, brown, fine angular to sub-angular gravel.				
				B	10.0	0.5							
									Test pit TP02 terminated at 0.6 m Refusal				
					9.5	1.0							
					9.0	1.5							

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

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- U## undisturbed sample ##mm diameter
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remouded (uncorrected kPa)
- R refusal

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- W_P plastic limit
- W_L liquid limit

consistency / relative density

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

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Engineering Log - Excavation

Excavation ID.	***TP03***
sheet:	1 of 1
project no.	***754-NTLGE222494***
client: ***Collier International Pty Ltd***	date excavated: ***05 Oct 2018***
principal: ***Health Infrastructure***	date completed: ***05 Oct 2018***
project: ***Wyong Hospital Expansion***	logged by: ***MJ***
location: ***Wyong Hospital, Hamlyn Terrace, NSW***	checked by: ***RB***

position: E: 358,005.00; N: 6,318,858.00 (MGA94) | surface elevation: 11.50 m (AHD) | pit orientation:

equipment type: Mini Excavator | excavation method: | excavation dimensions: 0.3 m long

excavation information | **material substance**

method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
E	N		Not Encountered		11.5			SP	**FILL: Gravelly SAND SUB-BASE**: fine to coarse grained, dark grey, fine angular to sub-angular gravel.	M			**FILL**
				E				CL	**FILL: Gravelly CLAY**: low plasticity, mottled orange and pale grey, fine angular to sub-angular gravel, with some fine to coarse grained sand, traces of brick and sandstone cobbles.				
				B	11.0	0.5							
				E	10.5	1.0		SP	**FILL: CLAYEY SAND**: fine to coarse grained, grey, with traces of tree bark and sticks.				
					10.0	1.5		Cl	**Sandy CLAY**: medium plasticity, mottled orange and pale grey, fine grained sand.	<Wp	St		**RESIDUAL SOIL**
									Test pit TP03 terminated at 2.0 m Target depth			HP 150 - 200 kPa	

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

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- U## undisturbed sample ##mm diameter
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remouded (uncorrected kPa)
- R refusal

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- W_P plastic limit
- W_L liquid limit

consistency / relative density

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

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Engineering Log - Excavation

Excavation ID.	***TP04***
sheet:	1 of 1
project no.	***754-NTLGE222494***
client: ***Collier International Pty Ltd***	date excavated: ***05 Oct 2018***
principal: ***Health Infrastructure***	date completed: ***05 Oct 2018***
project: ***Wyong Hospital Expansion***	logged by: ***MJ***
location: ***Wyong Hospital, Hamlyn Terrace, NSW***	checked by: ***RB***

position: E: 353,027.00; N: 6,318,898.00 (MGA94) | surface elevation: 13.00 m (AHD) | pit orientation:

equipment type: Mini Excavator | excavation method: | excavation dimensions: 0.3 m long

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
E	N		Not Encountered		13.0			SP	**FILL: Gravelly SAND**: fine to coarse grained, dark grey, fine angular to sub-angular gravel.				**FILL**
				E				SP	**FILL: CLAYEY SAND**: fine to coarse grained, red, trace of angular to sub-angular gravel.				
					12.5	0.5							
				E	12.0	1.0			Test pit TP04 terminated at 1.0 m Refusal				
					11.5	1.5							

CDF_0_9_06_LIBRARY.GLB rev:AN Log COF EXCAVATION 754-NTLGE222494-TP.GPJ <<DrawingFile>> 02/11/2018 15:22

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

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- U## undisturbed sample ##mm diameter
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remouded (uncorrected kPa)
- R refusal

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- W_P plastic limit
- W_L liquid limit

consistency / relative density

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

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Engineering Log - Excavation

Excavation ID.	***TP05***
sheet:	1 of 1
project no.	***754-NTLGE222494***
client: ***Collier International Pty Ltd***	date excavated: ***05 Oct 2018***
principal: ***Health Infrastructure***	date completed: ***05 Oct 2018***
project: ***Wyong Hospital Expansion***	logged by: ***MJ***
location: ***Wyong Hospital, Hamlyn Terrace, NSW***	checked by: ***RB***

position: E: 358,083.00; N: 6,318,844.00 (MGA94) | surface elevation: 14.50 m (AHD) | pit orientation:

equipment type: Mini Excavator | excavation method: | excavation dimensions: 0.3 m long

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa)	structure and additional observations
E	N		Not Encountered		14.5			SP	**FILL: Gravelly SAND SUB-BASE**: fine to coarse grained, dark grey, fine to coarse angular to sub-angular gravel.				**FILL**
				E				SP	**FILL: CLAYEY SAND**: fine to coarse grained, red, with trace of angular to sub-angular gravel, brick and tree branches.				
				B	14.0	0.5							
								Cl	**CLAY**: medium plasticity, mottled orange and pale grey.		St - VSt		**RESIDUAL SOIL**
												100 200 300 400	HP 250 - 300 kPa
				B	13.5	1.0							
					13.0	1.5		Cl	**CLAY**: medium plasticity, mottled pale grey and red.				
									Test pit TP05 terminated at 1.6 m Refusal				

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

support
- N none
- S shoring

penetration (1 2 3)
- no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- U## undisturbed sample ##mm diameter
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remouded (uncorrected kPa)
- R refusal

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- W_P plastic limit
- W_L liquid limit

consistency / relative density

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

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Engineering Log - Excavation

		Excavation ID.	***TP06***
		sheet:	1 of 1
		project no.	***754-NTLGE222494***
client:	***Collier International Pty Ltd***	date excavated:	***05 Oct 2018***
principal:	***Health Infrastructure***	date completed:	***05 Oct 2018***
project:	***Wyong Hospital Expansion***	logged by:	***MJ***
location:	***Wyong Hospital, Hamlyn Terrace, NSW***	checked by:	***RB***

position: E: 358,116.00; N: 6,318,838.00 (MGA94) | surface elevation: 17.00 m (AHD) | pit orientation:

equipment type: Mini Excavator | excavation method: | excavation dimensions: 0.3 m long

excavation information | **material substance**

method	support	penetration (1 2 3)	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
E	N		Not Encountered		17.0			GP	**FILL: Sandy GRAVEL SUB-BASE**: fine to coarse grained, dark grey.				**FILL**
				E				SP	**FILL: CLAYEY SAND**: fine to coarse grained, red, with angular to sub-angular gravel, and red sandstone cobbles.				
				E	16.5	0.5							
					16.0	1.0			Test pit TP06 terminated at 0.9 m Refusal				
					15.5	1.5							

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

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- U## undisturbed sample ##mm diameter
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remouded (uncorrected kPa)
- R refusal

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- W_P plastic limit
- W_L liquid limit

consistency / relative density

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

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Engineering Log - Excavation

Excavation ID.	***TP07***
sheet:	1 of 1
project no.	***754-NTLGE222494***
client: ***Collier International Pty Ltd***	date excavated: ***05 Oct 2018***
principal: ***Health Infrastructure***	date completed: ***05 Oct 2018***
project: ***Wyong Hospital Expansion***	logged by: ***MJ***
location: ***Wyong Hospital, Hamlyn Terrace, NSW***	checked by: ***RB***

position: E: 358,168.00; N: 6,318,832.00 (MGA94) | surface elevation: 19.00 m (AHD) | pit orientation:

equipment type: Mini Excavator | excavation method: | excavation dimensions: 0.3 m long

excavation information | **material substance**

method	support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
E	N		Not Encountered		19.0			GP	**FILL: Sandy GRAVEL SUB-BASE**: fine to medium grained, grey, with fine to coarse grained sand.	M			**FILL**
				E				CL	**FILL: Sandy CLAY**: low plasticity, orange, with fine to medium grained sand.	<Wp			
				B	18.5	0.5							
				B	18.0	1.0			Test pit TP07 terminated at 1.2 m Refusal				
					17.5	1.5							

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

support
- N none
- S shoring

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- U## undisturbed sample ##mm diameter
- D disturbed sample
- B bulk disturbed sample
- E environmental sample
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear peak/remouded (uncorrected kPa)
- R refusal

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- W_P plastic limit
- W_L liquid limit

consistency / relative density

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

Appendix C – Laboratory Test Results

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30 years Testing For Life 1987–2017
Celebrating 30 years Testing and Protecting Human Health

Certificate of Analysis

Coffey Environments Pty Ltd Newcastle
Lot 101, 19 Warabrook Boulevard
Warabrook
NSW 2304

NATA Accredited
Accreditation Number 1261
Site Number 20794

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Merrick Jones**

Report **623123-S**
Project name WYONG DEVELOPMENT
Project ID 754-NTLGE 222494
Received Date Oct 18, 2018

Client Sample ID			**BH04_1.5-1.95**
Sample Matrix			**Soil**
Eurofins | mgt Sample No.			**B18-Oc21503**
Date Sampled			**Oct 04, 2018**
Test/Reference	LOR	Unit	
Chromium Suite			
pH-KCL	0.1	pH Units	4.7
Acid trail - Titratable Actual Acidity	2	mol H+/t	12
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3
Sulfur - KCl Extractable	0.02	% S	n/a
HCl Extractable Sulfur	0.02	% S	n/a
Net Acid soluble sulfur	0.02	% S	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a
Acid Neutralising Capacity - acidity (a-ANCbt)	2	mol H+/t	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a
ANC Fineness Factor		factor	1.5
CRS Suite - Net Acidity (Sulfur Units)	0.02	% S	< 0.02
CRS Suite - Net Acidity (Acidity Units)	10	mol H+/t	12
CRS Suite - Liming Rate[S01]	1	kg CaCO3/t	< 1
Extraneous Material			
<2mm Fraction	0.005	g	180
>2mm Fraction	0.005	g	< 0.005
Analysed Material	0.1	%	100
Extraneous Material	0.1	%	< 0.1
% Moisture	1	%	13

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chromium Reducible Sulfur Suite			
Chromium Suite	Brisbane	Oct 18, 2018	6 Week
- Method: LTM-GEN-7070			
Extraneous Material	Brisbane	Oct 18, 2018	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Oct 18, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

ABN– 50 005 085 521
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Melbourne
2-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Perth
2/91 Leach Highway
Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name:	Coffey Environments P/L N'castle	**Order No.:**		**Received:**	Oct 18, 2018 9:00 AM
Address:	Lot 101, 19 Warabrook Boulevard Warabrook NSW 2304	**Report #:**	623123	**Due:**	Oct 25, 2018
		Phone:	02 4016 2300	**Priority:**	5 Day
		Fax:	02 4016 2380	**Contact Name:**	Merrick Jones
Project Name:	WYONG DEVELOPMENT				
Project ID:	754-NTLGE 222494				

Eurofins | mgt Analytical Services Manager : Andrew Black

Sample Detail						Chromium Reducible Sulfur Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 23736							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH04_1.5-1.95	Oct 04, 2018		Soil	B18-Oc21503	X	X
Test Counts						1	1

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
LCS - % Recovery							
Chromium Suite							
Chromium Reducible Sulfur	%	95			70-130	Pass	
Acid Neutralising Capacity (ANCbt)	%	101			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Chromium Suite				Result 1	Result 2	RPD			
pH-KCL	B18-Oc21503	CP	pH Units	4.7	4.7	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B18-Oc21503	CP	mol H+/t	12	12	3.6	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B18-Oc21503	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B18-Oc21503	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B18-Oc21503	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Sulfur - KCl Extractable	B18-Oc21503	CP	% S	n/a	n/a	n/a	30%	Pass	
HCl Extractable Sulfur	B18-Oc21503	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B18-Oc21503	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B18-Oc21503	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B18-Oc21503	CP	% S	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B18-Oc21503	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B18-Oc21503	CP	% S	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B18-Oc21503	CP	factor	1.5	1.5	<1	30%	Pass	
CRS Suite - Net Acidity (Sulfur Units)	B18-Oc21503	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
CRS Suite - Net Acidity (Acidity Units)	B18-Oc21503	CP	mol H+/t	12	12	n/a	30%	Pass	
CRS Suite - Liming Rate	B18-Oc21503	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B18-Oc17936	NCP	%	14	14	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	No
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised By

Andrew Black	Analytical Services Manager
Myles Clark	Senior Analyst-SPOCAS (QLD)

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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NATA # 1261 Site # 20794

Perth
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Kewdale WA 6105
Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name: Coffey Environments P/L N'castle
Address: Lot 101, 19 Warabrook Boulevard
Warabrook
NSW 2304

Project Name: WYANB DEVELOPMENT
Project ID: 754-NTC6E222494

Order No.:
Report #: 621182
Phone: 02 4016 2300
Fax: 02 4016 2380

Received: Oct 5, 2018 9:11 AM
Due: Oct 12, 2018
Priority: 5 Day
Contact Name: Merrick Jones

Eurofins | mgt Analytical Services Manager : Andrew Black

Sample Detail						Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794							
Perth Laboratory - NATA Site # 23736							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH01 0.7-1.0M	Oct 03, 2018		Soil	M18-Oc07315	X	X
2	BH02 1.0	Oct 03, 2018		Soil	M18-Oc07316	X	X
3	BH03 0.9-1.1M	Oct 03, 2018		Soil	M18-Oc07317	X	X
4	BH04 1.0	Oct 04, 2018		Soil	M18-Oc07318	X	X
Test Counts						4	4

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30 years Testing For Life 1987–2017
Celebrating 30 years Testing and Protecting Human Health

Certificate of Analysis

Coffey Environments Pty Ltd Newcastle
Lot 101, 19 Warabrook Boulevard
Warabrook
NSW 2304

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Attention: **Merrick Jones**

Report **621182-S**
Project name WYANB DEVELOPMENT
Project ID 754-NTC6E222494
Received Date Oct 05, 2018

Client Sample ID			**BH01 0.7-1.0M**	**BH02 1.0**	**BH03 0.9-1.1M**	**BH04 1.0**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**M18-Oc07315**	**M18-Oc07316**	**M18-Oc07317**	**M18-Oc07318**
Date Sampled			**Oct 03, 2018**	**Oct 03, 2018**	**Oct 03, 2018**	**Oct 04, 2018**
Test/Reference	LOR	Unit				
Chloride	5	mg/kg	46	63	280	57
Conductivity (1:5 aqueous extract at 25°C as rec.)	10	uS/cm	190	110	250	180
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	8.5	8.2	7.1	7.3
Resistivity*	0.5	ohm.m	52	95	41	57
Sulphate (as SO4)	30	mg/kg	130	52	180	120
% Moisture	1	%	12	7.2	9.3	9.4

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chloride	Melbourne	Oct 08, 2018	28 Day
- Method: LTM-INO-4090 Chloride by Discrete Analyser			
Conductivity (1:5 aqueous extract at 25°C as rec.)	Melbourne	Oct 08, 2018	7 Day
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25°C as rec.)	Melbourne	Oct 08, 2018	7 Day
- Method: LTM-GEN-7090 pH in soil by ISE			
Sulphate (as SO4)	Melbourne	Oct 08, 2018	28 Day
- Method: LTM-INO-4110 Sulfate by Discrete Analyser			
% Moisture	Melbourne	Oct 05, 2018	14 Day
- Method: LTM-GEN-7080 Moisture			

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Site # 23736

Company Name: Coffey Environments P/L N'castle
Address: Lot 101, 19 Warabrook Boulevard
Warabrook
NSW 2304

Project Name: WYANB DEVELOPMENT
Project ID: 754-NTC6E222494

Order No.:
Report #: 621182
Phone: 02 4016 2300
Fax: 02 4016 2380

Received: Oct 5, 2018 9:11 AM
Due: Oct 12, 2018
Priority: 5 Day
Contact Name: Merrick Jones

Eurofins | mgt Analytical Services Manager : Andrew Black

Sample Detail						Aggressivity Soil Set	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794							
Perth Laboratory - NATA Site # 23736							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH01 0.7-1.0M	Oct 03, 2018		Soil	M18-Oc07315	X	X
2	BH02 1.0	Oct 03, 2018		Soil	M18-Oc07316	X	X
3	BH03 0.9-1.1M	Oct 03, 2018		Soil	M18-Oc07317	X	X
4	BH04 1.0	Oct 04, 2018		Soil	M18-Oc07318	X	X
Test Counts						4	4

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	Quality Systems Manual ver 5.1 US Department of Defense
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 50-150%-Phenols & PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.1 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
Chloride			mg/kg	< 5			5	Pass	
Sulphate (as SO4)			mg/kg	< 30			30	Pass	
LCS - % Recovery									
Chloride			%	99			70-130	Pass	
Sulphate (as SO4)			%	93			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Chloride	M18-Oc09693	NCP	%	91			70-130	Pass	
Sulphate (as SO4)	M18-Oc09693	NCP	%	109			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Chloride	M18-Oc04816	NCP	mg/kg	46	41	13	30%	Pass	
Conductivity (1:5 aqueous extract at 25°C as rec.)	M18-Oc07491	NCP	uS/cm	86	120	29	30%	Pass	
pH (1:5 Aqueous extract at 25°C as rec.)	M18-Oc07490	NCP	pH Units	6.5	6.6	pass	30%	Pass	
Resistivity*	M18-Oc07491	NCP	ohm.m	120	87	29	30%	Pass	
Sulphate (as SO4)	M18-Oc04816	NCP	mg/kg	< 30	< 30	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	M18-Oc07318	CP	%	9.4	9.3	1.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Andrew Black	Analytical Services Manager
Julie Kay	Senior Analyst-Inorganic (VIC)

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Phone : +61 8 9251 9600
NATA # 1261
Site # 23736

Company Name:	Coffey Environments P/L N'castle	**Order No.:**		**Received:**	Oct 18, 2018 9:00 AM
Address:	Lot 101, 19 Warabrook Boulevard Warabrook NSW 2304	**Report #:**	623123	**Due:**	Oct 25, 2018
		Phone:	02 4016 2300	**Priority:**	5 Day
		Fax:	02 4016 2380	**Contact Name:**	Merrick Jones
Project Name:	WYONG DEVELOPMENT				
Project ID:	754-NTLGE 222494				

Eurofins | mgt Analytical Services Manager : Andrew Black

Sample Detail						Chromium Reducible Sulfur Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 23736							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH04_1.5-1.95	Oct 04, 2018		Soil	B18-Oc21503	X	X
Test Counts						1	1

Newcastle Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
19 Warabrook Boulevard
Warabrook NSW 2304

Phone: +61 2 4016 2300
Fax: +61 2 4016 2380

A TETRA TECH COMPANY

California Bearing Ratio Test Report

Report No: CBR:NEWC18S-08692
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

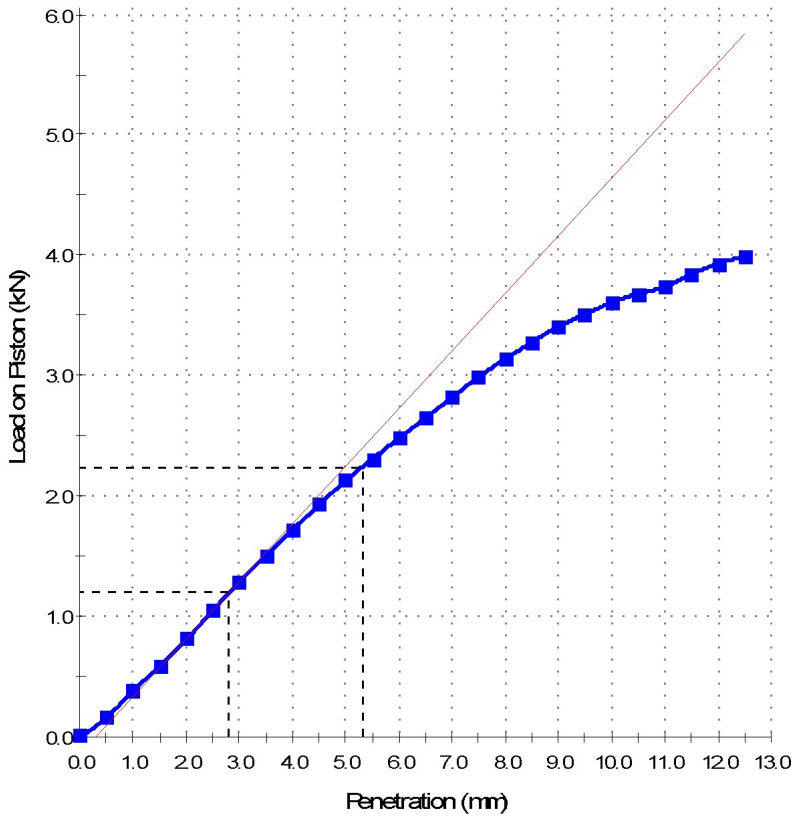
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08692	**Sampling Method:**	Submitted by client
Date Sampled:	5/10/2018	**Material:**	Existing Ground
Date Submitted:	8/10/2018	**Source:**	On-Site
Date Tested:	15/10/2018	**Specification:**	No Specification
Project Location:	Wyong, NSW		
Sample Location:	TP01 - 0.5 - 0.7m		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR At 5.0mm (%):	**11**
Maximum Dry Density (t/m³):	1.99
Optimum Moisture Content (%):	11.0
Dry Density before Soaking (t/m³):	1.99
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	11.2
Moisture Ratio before Soaking (%):	101
Dry Density after Soaking (t/m³):	1.99
Density Ratio after Soaking (%):	100
Swell (%):	0.0
Moisture Content of Top 30mm (%):	13.7
Moisture Content of Remaining Depth (%):	12.4
Compactive Effort:	Standard
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Oversize Material:	Excluded
Oversize Material (%):	12.2
—Moisture Content—	
Field Moisture Content (%):	8.4
Curing Time (Hrs):	23.6
Plasticity Level Method:	Visual

Comments

Newcastle Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
19 Warabrook Boulevard
Warabrook NSW 2304

Phone: +61 2 4016 2300
Fax: +61 2 4016 2380

California Bearing Ratio Test Report

Report No: CBR:NEWC18S-08693
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

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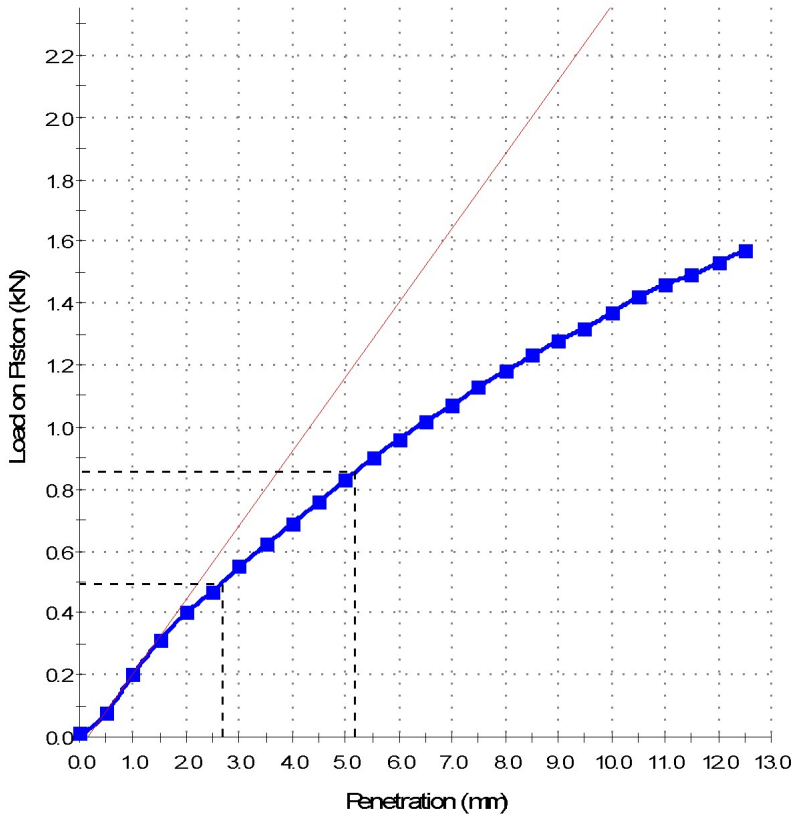
Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08693	**Sampling Method:**	Submitted by client
Date Sampled:	5/10/2018	**Material:**	Existing Ground
Date Submitted:	8/10/2018	**Source:**	On-Site
Date Tested:	15/10/2018	**Specification:**	No Specification
Project Location:	Wyong, NSW		
Sample Location:	TP02 - 0.3 - 0.6m		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR At 5.0mm (%):	**4.5**
Maximum Dry Density (t/m³):	2.01
Optimum Moisture Content (%):	11.3
Dry Density before Soaking (t/m³):	2.02
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	10.9
Moisture Ratio before Soaking (%):	96
Dry Density after Soaking (t/m³):	2.00
Density Ratio after Soaking (%):	99
Swell (%):	1.0
Moisture Content of Top 30mm (%):	16.8
Moisture Content of Remaining Depth (%):	15.3
Compactive Effort:	Standard
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Oversize Material (%):	0.0
—Moisture Content—	
Field Moisture Content (%):	12.6
Curing Time (Hrs):	24.0
Plasticity Level Method:	Visual

Comments

Newcastle Laboratory

Coffey Services Australia Pty Ltd
ABN 55 139 460 521
19 Warabrook Boulevard
Warabrook NSW 2304

Phone: +61 2 4016 2300
Fax: +61 2 4016 2380

A TETRA TECH COMPANY

California Bearing Ratio Test Report

Report No: CBR:NEWC18S-08694
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

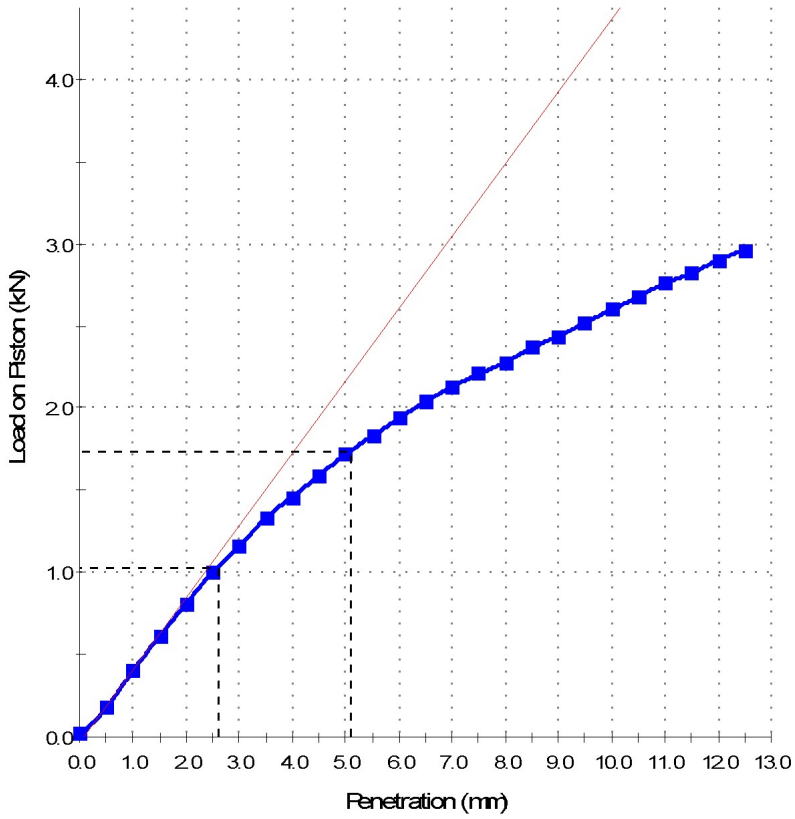
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08694	**Sampling Method:**	Submitted by client
Date Sampled:	5/10/2018	**Material:**	Existing Ground
Date Submitted:	8/10/2018	**Source:**	On-Site
Date Tested:	15/10/2018	**Specification:**	No Specification
Project Location:	Wyong, NSW		
Sample Location:	TP03 - 0.4 - 0.6m		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR At 5.0mm (%):	**9**
Maximum Dry Density (t/m³):	1.95
Optimum Moisture Content (%):	11.9
Dry Density before Soaking (t/m³):	1.94
Density Ratio before Soaking (%):	99
Moisture Content before Soaking (%):	12.4
Moisture Ratio before Soaking (%):	104
Dry Density after Soaking (t/m³):	1.93
Density Ratio after Soaking (%):	99
Swell (%):	0.5
Moisture Content of Top 30mm (%):	13.5
Moisture Content of Remaining Depth (%):	12.9
Compactive Effort:	Standard
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Oversize Material:	Excluded
Oversize Material (%):	8.6
—Moisture Content—	
Field Moisture Content (%):	14.1
Curing Time (Hrs):	24.5
Plasticity Level Method:	Visual

Comments

Newcastle Laboratory

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A TETRA TECH COMPANY

California Bearing Ratio Test Report

Report No: CBR:NEWC18S-08695
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

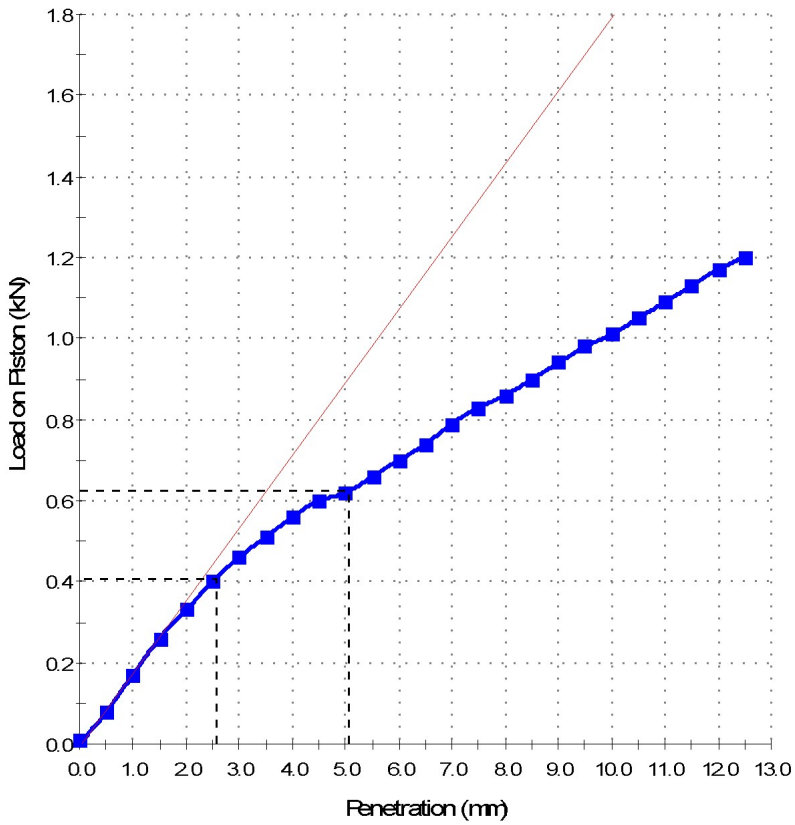
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08695	**Sampling Method:**	Submitted by client
Date Sampled:	5/10/2018	**Material:**	Existing Ground
Date Submitted:	8/10/2018	**Source:**	On-Site
Date Tested:	15/10/2018	**Specification:**	No Specification
Project Location:	Wyong, NSW		
Sample Location:	TP05 - 0.4 - 0.6m		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR At 5.0mm (%):	**3.0**
Maximum Dry Density (t/m³):	1.95
Optimum Moisture Content (%):	11.4
Dry Density before Soaking (t/m³):	1.94
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	11.7
Moisture Ratio before Soaking (%):	102
Dry Density after Soaking (t/m³):	1.92
Density Ratio after Soaking (%):	98
Swell (%):	1.5
Moisture Content of Top 30mm (%):	18.2
Moisture Content of Remaining Depth (%):	14.6
Compactive Effort:	Standard
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Oversize Material (%):	0.0
—Moisture Content—	
Field Moisture Content (%):	10.5
Curing Time (Hrs):	23.0
Plasticity Level Method:	Visual

Comments

Newcastle Laboratory

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A TETRA TECH COMPANY

California Bearing Ratio Test Report

Report No: CBR:NEWC18S-08696
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

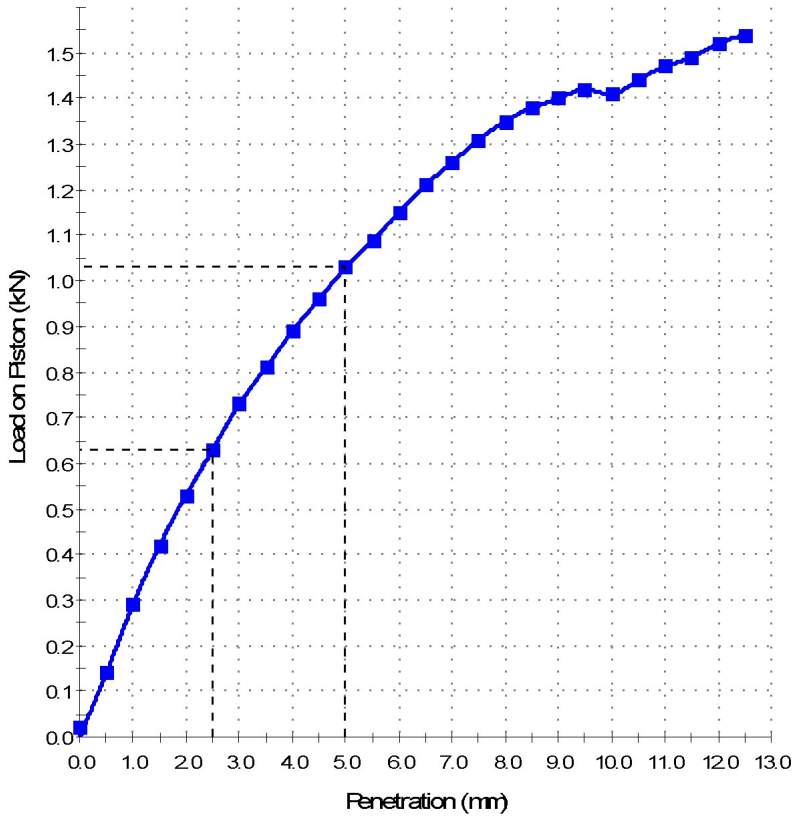
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08696	**Sampling Method:**	Submitted by client
Date Sampled:	5/10/2018	**Material:**	Existing Ground
Date Submitted:	8/10/2018	**Source:**	On-Site
Date Tested:	15/10/2018	**Specification:**	No Specification
Project Location:	Wyong, NSW		
Sample Location:	TP07 - 0.5 - 0.7m		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR At 5.0mm (%):	**5**
Maximum Dry Density (t/m³):	1.77
Optimum Moisture Content (%):	17.1
Dry Density before Soaking (t/m³):	1.76
Density Ratio before Soaking (%):	100
Moisture Content before Soaking (%):	17.3
Moisture Ratio before Soaking (%):	101
Dry Density after Soaking (t/m³):	1.74
Density Ratio after Soaking (%):	99
Swell (%):	1.0
Moisture Content of Top 30mm (%):	23.5
Moisture Content of Remaining Depth (%):	20.1
Compactive Effort:	Standard
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Oversize Material (%):	0.0
—Moisture Content—	
Field Moisture Content (%):	17.5
Curing Time (Hrs):	24.3
Plasticity Level Method:	Visual

Comments

Newcastle Laboratory

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A TETRA TECH COMPANY

Material Test Report

Report No: NEWC18S-08687-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

NATA WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08687
Client Sample:	-
Date Sampled:	04/10/2018
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Wyong, NSW
Sample Location:	BH02 - 0.4 - 0.6m

Other Test Results

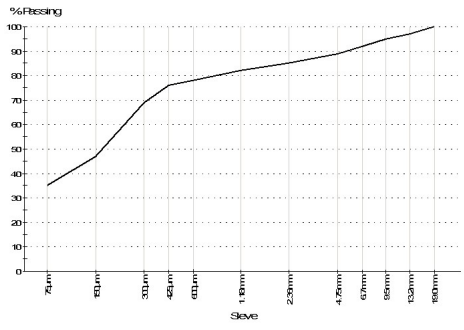
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.0	
Mould Length (mm)		125	
Liquid Limit (%)	AS 1289.3.1.1	25	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	17	
Plasticity Index (%)	AS 1289.3.3.1	8	
Date Tested		11/10/2018	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	15/10/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	97	
9.5mm	95	
6.7mm	92	
4.75mm	89	
2.36mm	85	
1.18mm	82	
600µm	78	
425µm	76	
300µm	69	
150µm	47	
75µm	35	

Chart



Comments

N/A

Newcastle Laboratory

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Warabrook NSW 2304

Phone: +61 2 4016 2300
Fax: +61 2 4016 2380

A TETRA TECH COMPANY

Material Test Report

Report No: NEWC18S-08688-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

NATA WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08688
Client Sample:	-
Date Sampled:	04/10/2018
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Wyong, NSW
Sample Location:	BH03 - 1.3 - 1.5m

Other Test Results

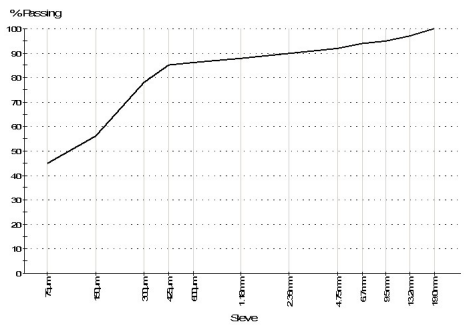
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.0	
Mould Length (mm)		124.9	
Liquid Limit (%)	AS 1289.3.1.1	23	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	8	
Date Tested		11/10/2018	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	15/10/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
13.2mm	97	
9.5mm	95	
6.7mm	94	
4.75mm	92	
2.36mm	90	
1.18mm	88	
600µm	86	
425µm	85	
300µm	78	
150µm	56	
75µm	45	

Chart



Comments

N/A

Newcastle Laboratory

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A TETRA TECH COMPANY

Material Test Report

Report No: NEWC18S-08689-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

NATA WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08689
Client Sample:	-
Date Sampled:	04/10/2018
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Wyong, NSW
Sample Location:	BH04 - 0.5 - 0.9m

Other Test Results

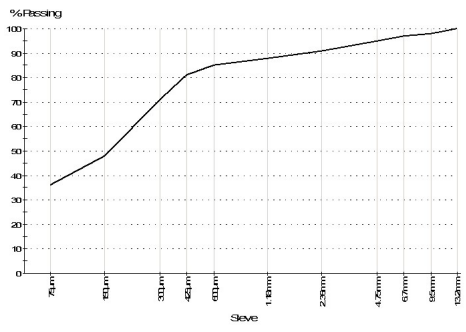
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.5	
Mould Length (mm)		124.9	
Liquid Limit (%)	AS 1289.3.1.1	27	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	18	
Plasticity Index (%)	AS 1289.3.3.1	9	
Date Tested		11/10/2018	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	15/10/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
13.2mm	100	
9.5mm	98	
6.7mm	97	
4.75mm	95	
2.36mm	91	
1.18mm	88	
600µm	85	
425µm	81	
300µm	71	
150µm	48	
75µm	36	

Chart



Comments

N/A

Newcastle Laboratory

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A TETRA TECH COMPANY

Material Test Report

Report No: NEWC18S-08686-1
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

NATA WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 19/10/2018

Sample Details

Sample ID:	NEWC18S-08686
Client Sample:	-
Date Sampled:	04/10/2018
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Wyong, NSW
Sample Location:	BH01 - 0.5 - 0.7m

Other Test Results

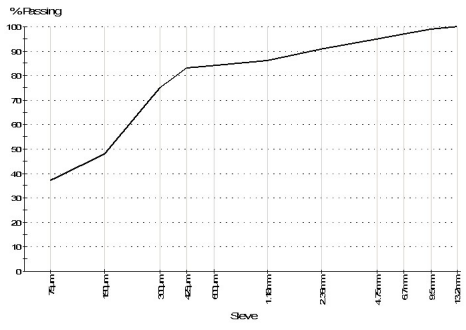
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.0	
Mould Length (mm)		125.5	
Liquid Limit (%)	AS 1289.3.1.1	26	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	11	
Date Tested		11/10/2018	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying by:	Oven
Date Tested:	15/10/2018
Note:	Sample Washed

Sieve Size	% Passing	Limits
13.2mm	100	
9.5mm	99	
6.7mm	97	
4.75mm	95	
2.36mm	91	
1.18mm	86	
600µm	84	
425µm	83	
300µm	75	
150µm	48	
75µm	37	

Chart



Comments

N/A

Newcastle Laboratory

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A TETRA TECH COMPANY

Report No: SSI:NEWC18S-08690
Issue No: 1

Shrink Swell Index Report

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 17/10/2018

Sample Details

Sample ID:	NEWC18S-08690	**Sampling Method:**	Submitted by client
Date Sampled:	4/10/2018	**Material:**	Existing Ground
Date Submitted:	4/10/2018	**Source:**	On-Site
Date Tested:	11/10/2018		
Project Location:	Wyong, NSW		
Sample Location:	BH02 - 2.0 - 2.3m		
Borehole Number:	-		
Borehole Depth (m):	-		

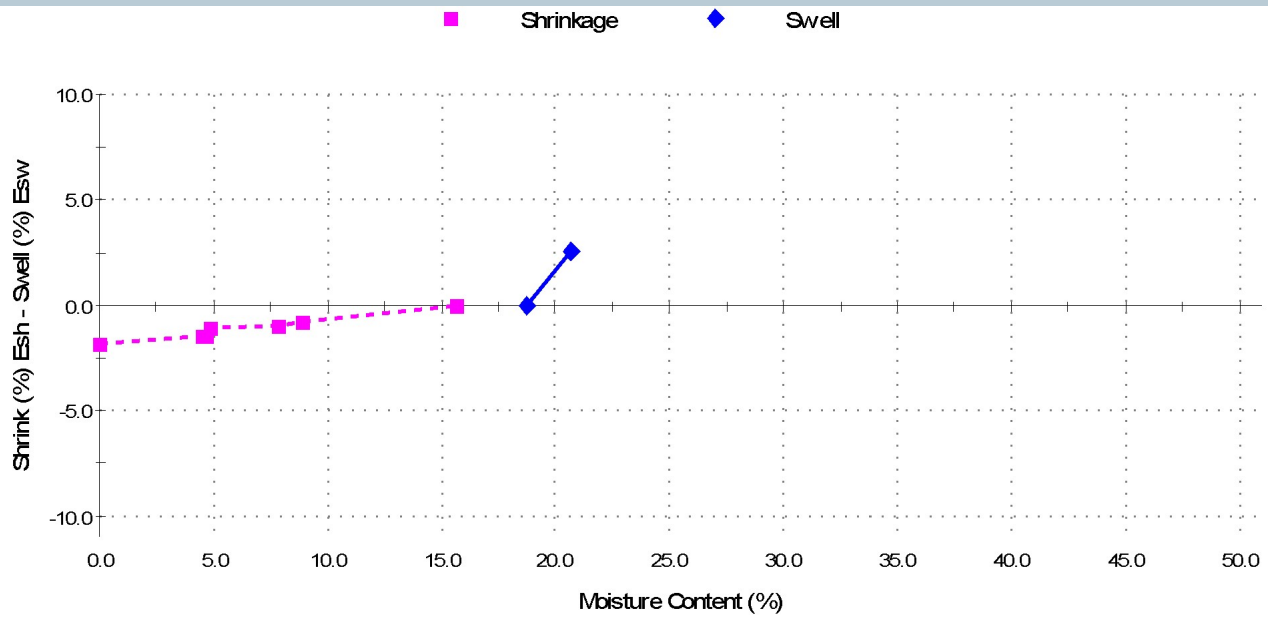
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	2.6
Moisture Content before (%):	18.7
Moisture Content after (%):	20.7
Est. Unc. Comp. Strength before (kPa):	260
Est. Unc. Comp. Strength after (kPa):	220

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	1.8
Shrinkage Moisture Content (%):	15.6
Est. inert material (%):	0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 1.7

Comments

Clay medium to high plasticity, brown.

Newcastle Laboratory

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A TETRA TECH COMPANY

Shrink Swell Index Report

Report No: SSI:NEWC18S-08691
Issue No: 1

Client:	Coffey Services Australia Pty Ltd (Newcastle) 19 Warabrook Boulevard Newcastle NSW 2304
Principal:	
Project No.:	754-NEWC00600AA
Project Name:	754-NTLGE222494 - 754-WYONG HOSPITAL EXPANSION
Lot No.:	- **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Greg Eveleigh (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 18/10/2018

Sample Details

Sample ID:	NEWC18S-08691	**Sampling Method:**	Submitted by client
Date Sampled:	4/10/2018	**Material:**	Existing Ground
Date Submitted:	4/10/2018	**Source:**	On-Site
Date Tested:	15/10/2018		
Project Location:	Wyong, NSW		
Sample Location:	BH04 - 2.0 - 2.3m		
Borehole Number:	-		
Borehole Depth (m):	-		

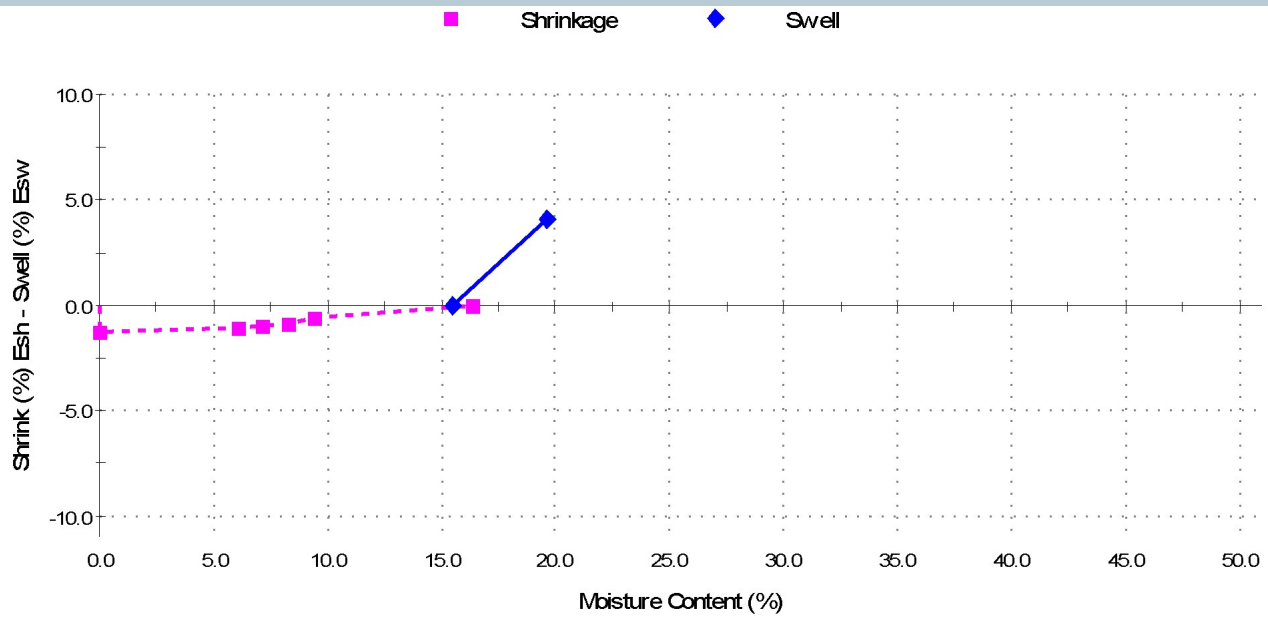
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	4.0
Moisture Content before (%):	15.5
Moisture Content after (%):	19.6
Est. Unc. Comp. Strength before (kPa):	260
Est. Unc. Comp. Strength after (kPa):	220

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	1.3
Shrinkage Moisture Content (%):	16.4
Est. inert material (%):	0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 1.8

Comments

Clay, medium plasticity,Pale brown.
Sample was Remoulded.

Appendix D – Flexible Pavement Design

Coffey Services Australia Pty Ltd ABN 55 139 460 521
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pavement thickness design summary

client :	**Colliers International Pty Ltd**	job no :	**754-NTLGE222494**
principal :		laboratory :	**NEWCASTLE**
project:	**New Link Road**	report date :	**7/11/2018**
location :	**Wyon Hospital, Hamlyn Terrace**	designed by :	**RB**
council :	**Central Coast Council**	checked by :	**NS**

road name or type:		Flexible Pavement	Flexible Pavement	Flexible Pavement	
chainage interval:	(m)				
design traffic loading:	(ESA)	1×10^4	1×10^5	5×10^5	
wearing course thickness:	(mm)	40	40	40	
basecourse thickness:	(mm)	150	150	150	
sub-base thickness:	(mm)	210	280	350	
select thickness:	(mm)	-	-	-	
total thickness:	(mm)	400	470	540	
CBR used for design:	(%)	3	3	3	

design traffic loading:

Design traffic loading is the number of equivalent standard axles (ESA) in the design lane during the design period. For definitions, refer Appendix 1.1 'Pavement Design' AUSTROADS. Refer covering letter/report.

material quality:

wearing course:	*AC10 on a 10mm seal*
basecourse:	*Conforming to Council requirements*
sub-base:	*Conforming to Council requirements*
select:	*CBR > 15%, PI < 15*

Note: Recommended materials types may vary from those of job specification or statutory authority. Refer covering letter/report.

compaction requirements:

wearing course :		*Conforming to council requirements*
basecourse :	upper:	*98% Modified*
	lower:	
sub-base :		*95% Modified*
select :		*80% Density Index, 100% Standard*
subgrade :		*80% Density Index, 100% Standard*
fill below:		*70% Density Index, 95% Standard*

Modified: Minimum required dry density ratio, AS1289 5.4.1-2007, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent and the maximum dry density obtained using AS1289 5.2.1-2003 or equivalent.

Standard: As above, but maximum dry density obtained using AS1289 5.1.1-2003 or equivalent.

Density Index: Minimum required Density Index AS1289 5.6.1-1998, calculated using field dry density determined by AS1289 5.3.1-2004 or equivalent and laboratory values of maximum and minimum density obtained by AS1289 5.5.1-1998 or equivalent.

Note : Recommendations for compaction may vary from those of job specification or statutory authority. Refer covering letter/report.

Drainage:

The design assumes the provision of adequate surface and subsurface drainage of the pavement and adjacent areas. Refer covering letter/report.

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