Construction Sciences

Geotechnical Investigation Report

MACKAY BASE HOSPITAL – BLOCK P EXPANSION

Prepared for Conrad Gargett

11 November 2022

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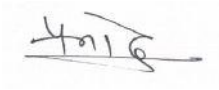

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Contents

Appendices

Figures

Tables

1. Introduction

At the request of Conrad Gargett (CG), Construction Sciences Pty Ltd (CS) was commissioned to undertake geotechnical investigation for the proposed Block P Expansion at the Mackay Base Hospital. The area of investigation and the location of boreholes have been shown on the Site Investigation Location Plan included in Appendix A.

This report presents a geotechnical summary of the site to include the following:

- Subsurface conditions encountered.
- In-situ and laboratory testing results.
- Site Classification to AS2870.
- Recommendations for suitable foundation types.
- Geotechnical design parameters of strata for building foundations.
- Comment on short-term and long-term settlements of foundation.
- Earthquake site factor in accordance with AS1170.4.
- Discussion on areas of foundation risk including presence of uncontrolled fill, compressible layers, potential for liquefaction, presence of aggressive soils.
- Recommendations for earthworks and suitability of onsite material to be used as fill.
- Groundwater levels.
- Suitable temporary and permanent batter slopes.
- Recommendation related to founding slabs on ground and external pavements.
- Geotechnical parameters for retaining wall design.
- General recommendations for construction and maintenance of the site during construction and in service.

2. Site Conditions

The site is located at 475 Bridge Road, Mackay QLD. Access was granted via Bridge Road, on the western side of the contractor's access road opposite the existing helipad. The site is an existing courtyard between three surrounding hospital blocks, with grass and shrubbery on the boundaries of the lot. The site was generally flat, and an uncontrolled fill profile was observed within the surficial metre of boreholes conducted. Boreholes were conducted in areas identified as free of underground services.

Refer to Figure 2.1 for typical site conditions encountered during the investigation.

Figure 2.1 East Facing toward BH01 Location.

3. Investigation Work

3.1 Fieldwork

The fieldwork was completed between 15th and 22nd August 2022 and comprised the drilling and sampling of 5 No. boreholes (designated BH01 to BH05) by means of a truck mounted Hydrapower Scout drilling rig using a combination of continuous solid flight augers of nominal 100mm and 250mm diameter, and wash bore drilling techniques. The boreholes were extended to a target depth of 15.0m.

The Site Investigation Location Plan in Appendix A shows the indicative location of each borehole and CBR sample undertaken for this investigation.

The subsurface profile was logged in general accordance with AS1726 *"Geotechnical Site Investigations"*. Strata identification was based on inspection of materials recovered from the auger and from the core samples. In-situ testing comprised Standard Penetration Tests (SPT) undertaken to determine the penetration resistance and allowable bearing pressure available in the soil strata intersected. The results of SPTs completed at generally 1.5m intervals and detailed boreholes descriptions are provided on the borehole logs included in Appendix B.

Disturbed and undisturbed samples were recovered during the field work and returned to our NATA accredited Rockhampton laboratory.

3.2 Laboratory Testing

Selected samples recovered from the test sites were tested to determine the following:

- Particle Size Distribution
- Atterberg Limits
- Moisture Content
- Shrink/Swell
- 4-day Soaked CBR – Single Point
- Aggressivity of Soil
- Moisture-Density Relationship
- pH Screening Test
- Chromium Suite Analysis

3.3 Subsurface Strata

The boreholes drilled at the site intersected variable soil stratigraphy. The investigation showed that generally the surface is underlain by uncontrolled fill, atop alluvial Sands and Clays.

For details of the strata encountered at each test location, the logs are provided in Appendix B. A summary of the encountered ground conditions is provided in Table 3.1 below.

Table 3.1 Summary of Subsurface Strata.

Location	FILL				ALLUVIUM											Termination Depth	Termination Condition
					CLAY					SAND				GRAVEL			
	CLAY	SAND	GRAVEL	COBBLES	F	F-St	St	VSt	H	L	L-MD	MD	D	L	MD		
BH01	0.8-1.5	0.0-0.3	0.3-0.8				1.5-4.1 10.25-11.5	11.5-14.5	14.5-14.95	4.1-7.0		7.0-7.45	7.45-10.1		10.1-10.25	14.95	Target Depth-Hard Clay
BH02	0.4-0.95	0.0-0.4			0.95-4.2			8.1-10.0 11.6-13.0	13.0-14.95	4.2-7.6		7.6-8.1	10.0-11.6			14.95	Target Depth-Hard Clay
BH03		0.0-1.7				4.7-5.0 6.3-7.8	1.7-4.1	10.3-13.0	13.0-14.95	4.1-4.7 5.0-6.3	7.8-9.0	9.0-10.15			10.15-10.3	14.95	Target Depth-Hard Clay
BH04		0.0-0.15		0.15-0.7	0.7-3.4 3.7-4.5	5.2-5.5	11.4-12.2 12.6-12.75	13.25-14.5	14.5-15.0	3.4-3.7 4.5-5.2 5.5-11.4 12.75-13.0 12.2-12.6				13.0-13.25		15	Target Depth-Hard Clay
BH05	0.65-1.3	0.0-0.2		0.2-0.65	9.7-11.5	2.3-2.8 3.4-3.7 4.6-5.6 6.0-6.8	11.5-13.0	13.0-14.5	14.5-14.95	1.3-2.3 2.8-3.4 3.7-4.6 5.6-6.0		6.8-9.7				14.95	Target Depth-Hard Clay

RELATIVE DENSITY			SOIL CONSISTENCY		
VL	-	Very Loose	VS	-	Very Soft
L	-	Loose	S	-	Soft
MD	-	Medium Dense	F	-	Firm
D	-	Dense	St	-	Stiff
VD	-	Very Dense	VSt	-	Very Stiff
			H	-	Hard

1) All depths, in meters (m), were measured from the existing surface level at the time of the investigation.
2) Strata labels also represent combination strata descriptions i.e. CLAY represents Sandy CLAY, Silty Sandy CLAY, etc.
3) Strata consistencies and strengths are generalised for the layer described. Detailed consistencies and strengths can be found in the investigation logs, provided in *Appendix B*.

Groundwater

Groundwater was first observed during drilling at the following locations and depths. However, the depth can fluctuate depending on weather.

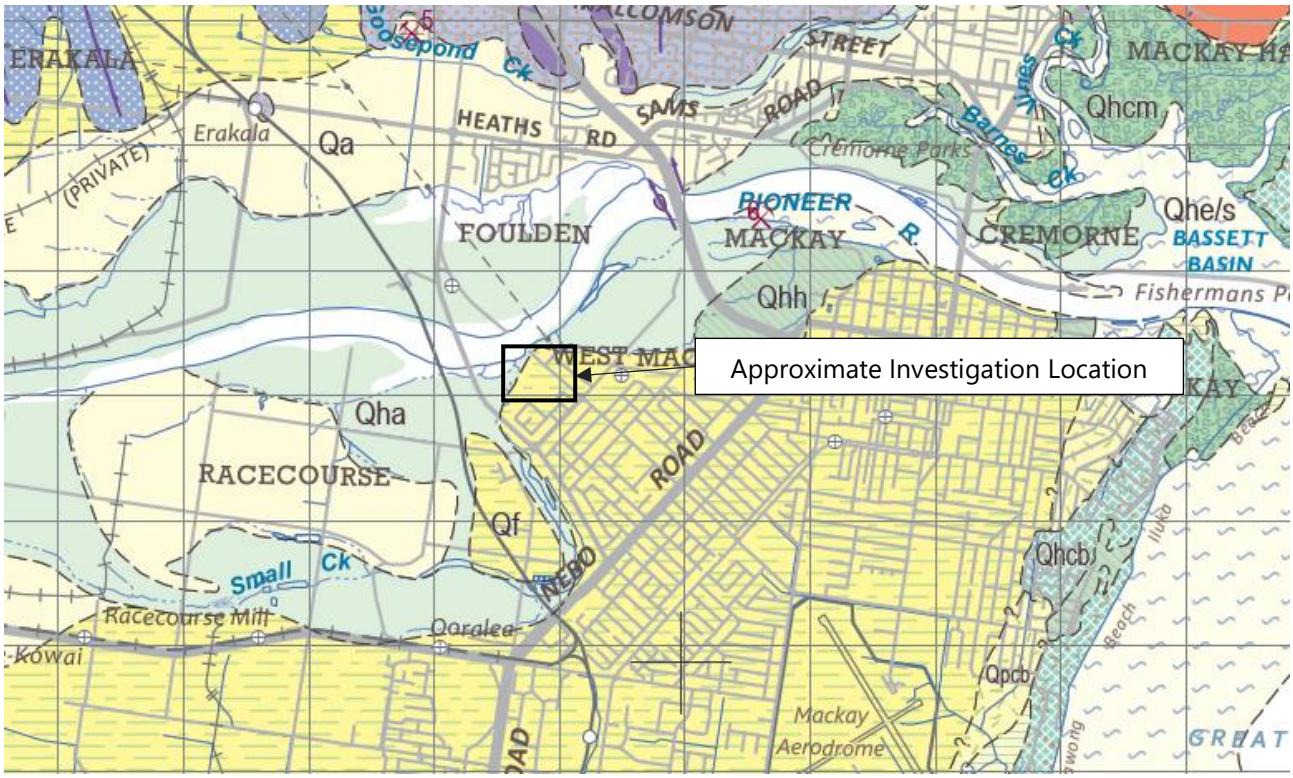
Table 3.2 Groundwater Locations & Depths.

Location	Depth Encountered (m)
BH01	7.7
BH02	7.9
BH03	5.4
BH04	8.8
BH05	7.7

3.4 Geology of the Area

According to the "Mackay Sheet 8755" of the 1: 100 000 geological series, produced by the Queensland Governments, Natural Resources Mines and Water, the site is located on areas of alluvial clay, silt, sand, and clayey to sandy gravel of the Quaternary Age.

Figure 4.1 Typical Regional Geology of Investigation Site.



Qha	*Sand, gravel, silt and clay; active stream channels and low terraces*
Qf	*Clay, silt, sand and clayey to sandy gravel; alluvial fans, sheetwash and floodout sheets*

*These extracts are from the "Mackay Sheet 8755" of the 1: 100 000 geological series, produced by the Queensland Governments, Natural Resources Mines and Water and are for information purposes only

3.5 Laboratory Test Results

The following tables detail the samples tested and results obtained. All NATA Accredited laboratory test results are in Appendix C.

Table 3.3 Particle Size Distribution, Atterberg Limit & Moisture Content Test Results.

Sample Location	Sample Depth (m)	Liquid Limit (%)	Linear Shrinkage (%)	Plasticity Index (%)	% Passing AS Sieve (mm)			Moisture Content (%)
					2.36	0.425	0.075	
BH01	2.50-2.95	28	6.0	9	100	100	58	20.2
BH01	12.00-12.45	57	15.5	33	100	97	90	26.2
BH02	5.50-5.95	N/A	N/A	N/A	100	98	31	9.9
BH03	2.20-2.50	28	6.5	9	99	98	48	19.2
BH04	4.00-4.45	29	3.0	7	98	97	59	15.7
BH05	10.00-10.45	28	8.0	11	100	83	43	22.3
BH05	14.50-14.95	56	16	32	100	98	94	23.7

Table 3.4 Shrink/Swell Test Results.

Sample Location	Sample Depth (m)	Shrink/Swell Index (%)
BH02	2.50-2.80	0.4
BH04	1.50-1.80	0.7

Table 3.5 California Bearing Ratio (CBR) – 4 Day Soaked Samples Results.

Sample Location	Sample Depth (m)	Maximum Dry Density (t/m^3)	Optimum Moisture Content (%)	CBR Value	Swell (%)
BH01	0.8-1.2	1.68	21.0	6	1.0
BH02	0.9-1.2	1.69	17.5	9	0.0
BH03	0.9-1.2	1.76	16.5	10	0.0

4. Geotechnical Assessment and Recommendations

4.1 Earthworks Materials Planning and Management

4.1.1 Site Preparation

All site preparation work should be carried out in accordance with AS3798-2007 *'Guidelines on Earthworks for Commercial and Residential Developments'*.

All soil containing grass and root material should be stripped from the building sites and access areas prior to construction. This material is not considered suitable for use as structural fill but may be stockpiled for possible future landscaping purposes, if required. Stripping depths will generally be in the order of around 0.3m. However, isolated areas may require a deeper stripping depth.

Where any existing fill is/was encountered, it is expected that this fill was not placed in accordance with recognised standards and as such must be deemed to *'uncontrolled'*. As such removal of this fill and recompaction of the fill to the standards discussed below is recommended.

Prior to the placement of any structural fill the site should be proof rolled using a minimum 10 tonne vibrating padfoot roller or similar. Should isolated soft/loose areas be encountered during this process, this material should be removed and replaced with select fill. It is likely that where soft to firm clays, loose to medium dense sands were encountered, that the removal of these materials will alleviate potential handling, settlement, or creep issues during and after construction.

Depressions formed by the removal of vegetation should have all disturbed soil cleaned out and be backfilled with compacted select fill material.

Construction Sciences Pty Ltd should be engaged to confirm the suitability of the stripping depth and confirm the adequacy of the newly exposed soil for fill placement.

4.1.2 Structural Fill Placement

Except for the topsoil and fill stratum, all materials encountered during the investigation are considered acceptable for use as structural fill provided that any pre-treatment (moisture conditioning, removal of oversize), is carried out prior to fill placement.

To minimise the potential for post compaction volume change due to moisture content variations, any structural clay bearing fill should be placed in loose layers not greater than 200mm thick at a moisture content in the range -2% to +3% of the standard optimum moisture content, and be compacted to a minimum dry density ratio of 95% standard compaction as per AS1289 5.1.1.

Measures should be adopted to ensure that this clay fill material is not allowed to dry out prior to the placement of succeeding layers of fill and final covering with building slabs and road pavements.

It is recommended that the placement of all structural fill be inspected, tested, and certified by Construction Sciences Pty Ltd to Level 1 requirements, during the earthworks operations to ensure that all fill is placed in a 'controlled manner', in accordance with AS3798-2007.

Where filling is to be carried out over sloping land (slope > 8H:1V), the surface of the natural material should be benched so that the fill can be 'keyed' into the slope, allowing for a good bonding interface between structural fill and the natural. The maximum height of the step must not exceed 0.5m, and the benching must be sloped to ensure free drainage.

4.1.3 Excavatability

No problems should be encountered in excavating the near surface material on site. Most soils encountered on site should be within the excavation limits of a small dozer (e.g. Cat D6 or similar) in bulk excavations or medium size backhoe (e.g. Case 580 or similar) in trench excavations.

Groundwater was encountered 5 to 7 m below the ground level during the investigation, however, any inflows during or shortly after high rainfall wet season periods may impact the water level. This should be readily handled by pumping from sumps within the excavations. If excavations experience groundwater inflow, they will be susceptible to moisture softening and possible retrogressive collapse. Therefore, the duration that excavations are left to remain open should be minimised as far as practicable.

Short term temporary batter slopes no steeper than 1.5H: 1V (H = horizontal, V = vertical) are suggested during the construction phase for excavations having depths of less than 2m at the site. If a perched groundwater or soft material is encountered the stable slope would be approximately half this value (3H:1V).

Care should also be taken to ensure that there is no surcharge from stockpiled materials and building or vehicular loads to at least the excavation depth beyond the crest of excavations.

4.2 Geotechnical Design Parameters

4.2.1 Retaining Wall Design Parameters

For any retaining structures, the characteristic earth pressure coefficients are provided in Table 4.1 below and may be adopted for the purpose of retaining wall design(s).

Table 4.1 Retaining Wall Design Parameters.

Materials		Friction Angle, ϕ' (°)	Cohesion, c' (kPa)	Unit Weight, γ (kN/m^3)	Earth Pressure Coefficient (Rankine)		At Rest (k_o)
					Active (k_a)	Passive (k_p)	
Cohesive Soil	Firm	24	2	17.0	0.422	2.371	0.593
	Stiff	26	3	18.0	0.390	2.561	0.562
	Very Stiff	28	4	19.0	0.361	2.770	0.531
	Hard	30	5	20.0	0.333	3.000	0.500
Granular Soil	Loose	32	NA	17.0	0.307	3.255	0.470
	Medium Dense	34	NA	19.0	0.283	3.537	0.441
	Dense	36	NA	20.0	0.260	3.852	0.412

Further to these parameters, in considerations for retaining structures it is important to enable good drainage behind the structure itself to prevent excessive hydrostatic pressure. It is recommended to utilise clean granular backfill behind the wall itself and drain-pipes at the base of the structure to release any water (or weep holes where required). The design should also allow for water pressure acting on the retaining structure to at-least half the wall height in order to ensure stability in extreme situations and fluctuations in the ground water pressure.

In addition, materials directly behind the structure should not be compacted heavily, otherwise adverse active pressure from increased earth pressures may affect the in-service use of the structure. Compaction by hand-held equipment is recommended when placing these layers.

Any retaining wall design for the building should take into consideration, the loads that may apply from adjacent sites (buildings, driveways, laneways, etc.)

4.3 Site Classification

The results of the investigations and testing show that in its undisturbed state, the site would be classified as **Class S - "Slightly Reactive"** in accordance with AS2870, with predicted ground surface movement of up to 20mm. However, due to the presence of fill material containing mostly CLAY of up to 1.7m in depth, the site must be classified as **Class P**.

4.4 Suitable Foundation Types

Ground encountered on site is primarily Fill up to 1.7 m followed by Alluvium of varying density/consistency. (firm to very stiff CLAY/Loose to dense SAND) to the bore hole termination depth of maximum 15 m bgl. This suggests that the ground is suitable for strip footing if the building is single storey. However, if multistorey building is required, driven pile foundation would be appropriate. Driven concrete or steel tube (CHS) pile may

be considered for design. Pile may refuse between 15 to 20 m bgl. Therefore, a suitable diameter pile (>450 mm) should be selected and designed by a competent geotechnical and structural engineer together.

Founding depth of strip footing will depend on footing loads and dimensions. Groundwater was encountered during the investigation and footing excavations are expected to be susceptible to collapse. Footing excavation should not be allowed to remain open for a significant period of time. A concrete blinding layer should be cast in excavation bases to prevent softening due to moisture ingress, unless footings are cast immediately after excavations are complete.

All foundation excavations should be inspected by an experienced geotechnical engineer prior to casting, to confirm adequate bearing capacity and final footing dimensions. All footing excavations should be clean, dry and free of loose/softened materials immediately prior to casting.

4.5 Pile Design Parameters

Design parameters for driven piles are provided in Table 4.2.

Table 4.2 Design Parameters for Driven Pile.

Foundation Material		Ultimate Base/End Bearing Capacity (f_{bu}) (kPa)	Ultimate Skin Friction (f_{su}) (kPa)
FILL		NR	NR
Cohesive Materials (CLAY, SILT, Silty CLAY, Clayey SILT)	Soft to Firm	NR	NR
	Stiff	450	40
	Very Stiff	900	60
	Hard	1800	100
Granular Materials (SAND/GRAVEL)	Loose	NR	NR
	Medium Dense	Ultimate base bearing, $f_{bu} = N_q\sigma'_v$, where N_q is the dimensionless bearing capacity factor, and σ'_v = Effective vertical stress.	Ultimate Skin friction, $f_{su} = \beta\sigma'_v$, where β is the dimensionless skin friction factor, and σ'_v = Effective vertical stress.
	Dense		
	Very Dense		

(1) NR = Not Recommended

(2) The top 1.5m of profile should be disregarded for pile capacity calculations.

(3) A geotechnical strength reduction factor (ϕ_g) should be applied to the ultimate design values in accordance with AS2159-2009 Table 4.3.2. Based on the available information a reduction factor (ϕ_g) equal to 0.6 has been recommended for driven pile. The value of (ϕ_g) can be increased to 0.75 if in-situ pile testing is carried out as per AS2159-2009.

(4) Nq = 20, 40, 50 for MD, D, VD Granular Materials respectively. β = 0.37, 0.46, 0.56 for MD, D, VD Granular Materials respectively.

(5) For granular materials, upper limit of f_{bu} (kPa) = 5000, 1000, 10000 for MD, D, VD Granular Materials respectively.

(6) For granular materials, upper limit of f_{su} (kPa) = 80, 95, 115 for MD, D, VD Granular Materials respectively.

4.6 Foundation Settlement

Once the foundation type and loads are determined, settlement can be estimated correctly. However, structure should be designed for a minimum tolerable differential settlement of 25 mm in 5 m length if founded on strip footing.

4.7 Earthquake Site Factor

In accordance with AS1170.4-2007, Hazard Factor (Z) for Mackay is 0.09.

Also, based on the type and depth of materials encountered, the Site Class is "Class C – Shallow soil site".

4.8 Liquefaction

In accordance with *NZS, MBIE guidelines Module 3: Identification, assessment and mitigation of liquefaction hazards*, materials encountered at the site is of Alluvium origin with fine contents (passing 0.075 mm sieve) generally >35% and plasticity index (PI) between 7 and 12%. This indicates that the ground is potentially susceptible to liquefaction. However, ground water is 5 to 7 m below ground level and Hazard factor (Z) is low (i.e. z = 0.09); potential for liquefaction may be considered negligible.

4.9 Pavement Subgrade

The results of laboratory testing on selected samples are included in Table 3.5 above. The results from central and eastern sections of the lot indicate medium subgrade strength of 6.0 to 10.0%. The western section on the lot was not assessed due to coarse rock fill obstructing the 250mm auger during attempted sampling.

Preparation of the site for pavement construction works should involve clearing and grubbing in conjunction with the stripping of topsoil, which should be removed and stockpiled separately with care taken to avoid contamination by other materials. The site should then undergo a general inspection and proof roll of the subgrade to identify any soft areas or unsuitable material. If encountered, soft areas shall be excavated to a depth such that the soft material is removed, and the excavated area shall be backfilled with approved material and compacted.

Effective erosion and sedimentation control measures should be installed maintained for the duration of the construction. Furthermore, adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding except where ponding forms part of a planned erosion and sedimentation control system.

To promote long term performance of the pavements, sub soil drainage and related features should also be considered to minimise moisture ingress and subsequent pavement failure.

4.10 Aggressivity

Soil aggressiveness has been assessed based on the Exposure Classification as detailed under Table 6.4.2(C) and Table 6.5.2(C) of AS2159-2009 for concrete and steel piles respectively. Based on the encountered soil/rock

profile and the laboratory test results summarised above, it is considered an Exposure classification of *Mild* to *Moderate* be appropriate for this site. The tables below show the field analysis undertaken for this project.

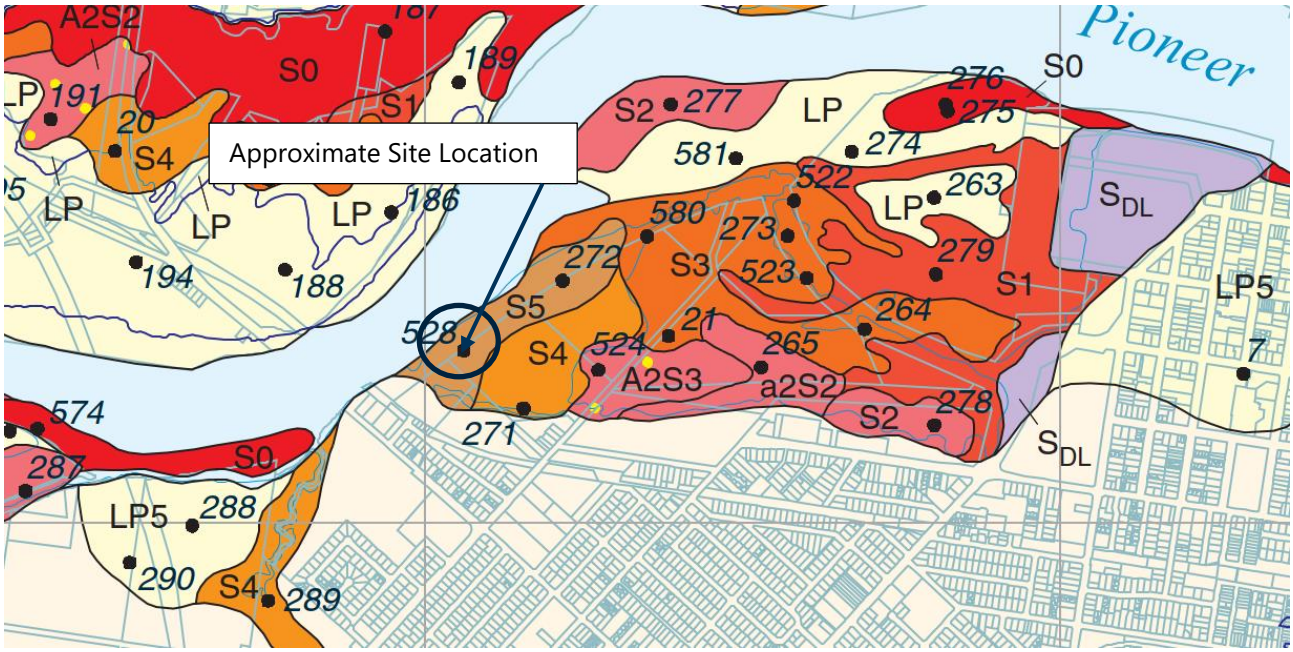
Table 4.3 Summary of Aggressivity Test Results.

Location	Sample Depth (m)	pH	Cl (mg/kg)	S (mg/kg)	SO_4 (ppm)	EC (dS/m)	Resistivity* (Ω.cm)	Temperature (°C)	Resistivity, $R_{15.5}$ (Ω.cm)
BH01	10.00-10.45	7.2	1	<1	<1000	0.04	2400	21	2700
BH02	11.50-11.95	7.6	<1	40	<1000	0.03	630	21	720
BH03	10.00-10.45	7.5	<1	<1	<1000	0.03	17000	21	1900
BH03	11.50-11.95	7.7	<1	<1	<1000	0.0222	730	21	400830
BH05	11.50-11.95	7.6	<1	<1	<1000	0.02	4200	21	4800

4.11 Acid Sulfate Soils Assessment

Preliminary assessment for the presence and extent of acid sulfate soils has been carried out based on the review of the State Planning Policy 2/02 Guideline, Acid Sulfate Soils, Version 2, August 2002 (SPP 2/02).

The site is shown as 'low to moderate' on the 1:50 000 Scale, Acid Sulfate Hazard Map for Mackay produced by the Queensland Government, Natural Resources Mines and Energy.



4.11.1 Qualitative pH Field and Fox Testing

Due to the identification of potential ASS, 19 samples from BH04 were collected at 0.25m intervals and submitted for qualitative pH field and pH Fox Testing to provide an indication of ASS.

pH Field testing results ranged from 7.15-7.74, indicating soils are predominantly neutral – mildly alkaline in nature. These values are not uncommon for undisturbed ASS, especially in marine environments as witnessed on this site.

pH Fox testing results ranged from 4.89 – 7.41, with the top 9 samples (BH04 0-0.25m through to BH04 2.00-2.25m) recording a difference >1 between pH field and pH Fox results. Reaction intensities were noted to be inconsistent and varied across all samples tested.

pH Field and Fox results are largely inconclusive due to their qualitative nature; however, the available results indicate small amounts of sulphides may be present in the top 2.25m of the BH04 profile. Quantitative Chromium Suite testing was subesquently recommended at a rate of 1 per 1m of soil depth profile to quantify the presence of ASS and inform any treatment requirements of the material moving forward.

Copies of the pH field and pH fox testing reports are detailed in Appendix C – Laboratory Tests.

4.11.2 Quantitative Chromium Suite Testing

Seven (7) samples were selected based on the qualitative testing results and submitted for quantitative Chromium Suite analysis (AS4969). No sample returned results above the net acidity action criteria of 0.03%S, with the highest net acidity level of 0.003%S recorded at BH04 3.5-4.0m. pH_{KCL} levels were noted to range from 6.2 – 6.7, indicating minimal acidity in soil. Results indicate the material is best classified as non-ASS. No liming treatment is required. A summary of Chromium Suite Testing results is presented below.

Table 4.4 Summary of Chromium Suite Test Results.

Sample Location	pH K_{CL}	Titratable Actual Acidity %S	S K_{CL} %S	S_{Cr}	Net Acidity %S	*Recommended Liming Rate kg/m^3
BH04 0.75-1.0m	6.4	<0.002	<0.007	<0.02	0	No Liming Required
BH04 1.75-2.0m	6.7	0	<0.007	<0.02	-0.231	No Liming Required
BH04 2.5-3.0m	6.4	<0.002	0.008	<0.02	0	No Liming Required
BH04 3.5-4.0m	6.2	0.003	<0.007	<0.02	0.0003	No Liming Required
BH04 4.5-5.0m	6.3	<0.002	<0.007	<0.02	0	No Liming Required
BH04 5.5-6.0m	6.3	0	0.015	<0.02	0	No Liming Required
BH04 6.5-7.0m	6.3	<0.002	0.011	<0.02	0	No Liming Required

Important Information about this Geotechnical Report

Scope of Work

The purpose of this report and any associated documentation is expressly stated in the document. This document does not form a complete assessment of the site, and no implicit determinations about Construction Sciences scope can be taken if not specifically referenced. Whilst this report is intended to reduce geotechnical risk, no level of detail or scope of work can entirely eliminate risk.

The nature of geotechnical data typically precludes auxiliary environmental assessment without undertaking specific methods in the investigation. Therefore, unless it is explicitly stated in the scope of work, this report does not provide any contamination or environmental assessment of the site or adjacent sites, nor can it be inferred or implied from any component of the document.

The scope of work, geotechnical information, and assessments made by Construction Sciences may be summarised in the report; however, all aspects of the document, including associated data and limitations should be reviewed in its entirety.

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Construction Sciences have undertaken investigations, performed consulting services, and prepared this report based on the Client's specific requirements, data that was available or was collected, and previous

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Construction Sciences findings and assessment represent its reasonable judgment, diligence, skill, with sound professional standards, within the time and budget constraints of its commission. No warranty, expressed or implied, is made as to the professional advice included in this report.

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Variability in conditions and limitations of data

Subsurface conditions are complex and can be highly variable; they cannot be accurately defined by discrete investigations. Geotechnical data is based on investigation locations which are explicitly representative of the specific sample or test points. Interpretation of conditions between such points cannot be assumed to represent actual subsurface information and there are unknowns or variations in ground conditions between test locations that cannot be inferred or predicted.

The precision and reliability of interpretive assessment between discrete points is dependent on the uniformity of the subsurface strata, as well as the frequency, detail, and method of sampling or testing.

Subsurface conditions are formed by various natural and anthropogenic processes and therefore are subject to change over time. This is particularly relevant with changes to the site ownership or usage, site boundary or layout, and design or planning modifications. Aspects of the site may also not be able to be determined due to physical or project related constraints and any information provided by Construction Sciences cannot apply following modification to the site, regulations, standards, or the development itself.

It is important to appreciate that no level of detail in investigation, or diligence in assessment, can eliminate uncertainty related to subsurface conditions and thus, geotechnical risk. Construction Sciences cannot and does not provide unqualified warranties nor does it assume any liability for site conditions not observed or accessible during the investigations.

Verification of opinions and recommendations

Geotechnical information, by nature, represents an opinion and is based extensively on judgment of both data and interpretive assessments or observation. This report and its associated documentation are provided explicitly based on Construction Sciences opinion of the site at the time of inspection, and cannot be extended beyond this.

Any recommendations or design are provided as preliminary until verified on site during project implementation or construction. Inspection and verification on site shall be conducted by a suitably qualified geotechnical consultant or engineer, and where subsurface conditions or interpretations differ from those provided in this document or otherwise anticipated, Construction Sciences must be notified and be provided with an opportunity to review the recommendations.

Client and copyright

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Appendix A
Site Investigation Location Plan

LEGEND

- Top Bank
- Bottom Bank
- Change of Grade
- Concrete Edge
- Road Centreline
- Kerb Lip/Bitumen Edge
- Kerb
- Track Centre
- Track Edge
- Road Marking
- Traffic Guidance Sign
- Street Sign
- Guide Post
- Paving Edge
- Rock Edge
- Railway Line
- Wall
- Building Edge
- Eave
- Fence
- Drainage Line
- E — Overhead Electrical
- Power Pole
- Light Pole
- Electrical Stay Wire
- UE — Underground Electrical
- E — Electrical Pit
- e — Electrical Pillar
- e — Electrical Tag
- S — Sewer Line
- MH — Sewer Manhole
- MH — Sewer Manhole (Square)
- ST — Septic Tank
- Sewer Trap
- SW — Stormwater Line
- Grated Stormwater Pit
- SW — Stormwater Manhole
- SW — Stormwater Manhole (Square)
- Kerb Adaptor
- W — W — Water Pipe
- FH — Fire Hydrant
- SV — Sluice Valve
- W — Water Tag
- Water Tap
- Water Meter
- B — Bore
- IV — Irrigation Valve
- T — Telstra Cable
- T — Telstra Pit
- t — Telstra Pillar
- Telstra Junction Box
- Telstra Marker Post
- P — Phone Box
- Telstra Tag

Scale 1:1000 - Lengths are in Metres

10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140

0 50mm 100mm 150mm SCALE BAR

This plan is prepared for Mackay hospital and Health Services from field survey and from provided site records for the purpose of a site services plan and should not be used for any other purpose.

The title boundaries as shown hereon have been derived from the DCDB

Services shown hereon have been derived from a combination of site survey and compiled from provided site records.

The Position of underground services on this drawing are indicated by a single line. Care should be exercised as services may occupy a considerably wider corridor than that indicated on this drawing. Users should be aware during excavation or construction that services may exist for which there is no record.

Prior to any demolition, excavation or construction on the site, the relevant authority should be contacted for possible location of further underground services and detailed location of all services.

PRELIMINARY

Mackay Hospital

IMPORTANT NOTES:
(These notes are an integral part of this plan)
This plan has been prepared for Mackay Hospital and Health Services for the purposes of Site Services Plan.
It is not to be used by any other person or corporation or for any other purposes and is subject to the following limitations:
See note on face of plan

Data Sources

Cadastral Boundaries	DCDB
Contours / Topographic	-
Aerial Images	-
Flood Level	-
Engineering Design	-
Architectural Design	-
Landscape Design	-

Issue	Revisions	Date	Drawn
C	Revise Services	22.03.2019	BSC
B	Revise Services	21.03.2019	BSC
A	Original	19.03.2019	BSC

Locality:	Mackay
Local Authority:	Mackay RC
Projection:	Grid
Horizontal Meridian:	MGA94 RTK GPS
Vertical Level Datum:	*
Level Origin:	*
Scale:	1:1000 @ A1
Surveyed:	Various
Designed:	*
Drawn:	BSC 19.03.2019
Checked:	BSC 19.03.2019
Plot Date:	22 Mar, 2019
Computer File Ref:	400359 SP-01 Rev C.dwg

Site Services Plan
Mackay Hospital
Bridge Road, Mackay

veris

BRISBANE (07) 3666 4700
WHITSUNDAYS (07) 4945 1702
MACKAY (07) 4951 2911
CAIRNS (07) 4051 6722

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Drawing No: 400359 SP-01
Issue: C

Appendix B
Borehole Logs

Explanatory Notes

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. Material descriptions are deduced from field observation or engineering examination, and may be appended or confirmed by in situ or laboratory testing. The information is dependent on the scope of investigation, the extent of sampling and testing, and the inherent variability of the conditions encountered.

Subsurface investigation may be conducted by one or a combination of the following methods.

Method	
Test Pitting: excavation/trench	
BH	Backhoe bucket
EX	Excavator bucket
R	Ripper
H	Hydraulic Hammer
X	Existing excavation
N	Natural exposure
Manual drilling: hand operated tools	
HA	Hand Auger
Continuous sample drilling	
PT	Push tube
PS	Percussion sampling
SON	Sonic drilling
Hammer drilling	
AH	Air hammer
AT	Air track
Spiral flight auger drilling	
AS	Auger screwing
AD/V	Continuous flight auger: V-bit
AD/T	Continuous spiral flight auger: TC-Bit
HFA	Continuous hollow flight auger
Rotary non-core drilling	
WB	Washbore drilling
RR	Rock roller
Rotary core drilling	
PQ	85mm core (wire line core barrel)
HQ	63.5mm core (wire line core barrel)
NMLC	51.94mm core (conventional core barrel)
NQ	47.6mm core (wire line core barrel)
DT	Diatube (concrete coring)

Sampling is conducted to facilitate further assessment of selected materials encountered.

Sampling method	
Soil sampling	
B	Bulk disturbed sample
D	Disturbed sample
C	Core sample
ES	Environmental soil sample
SPT	Standard Penetration Test sample
U	Thin wall tube ‘undisturbed’ sample
Water sampling	
WS	Environmental water sample

Field testing may be conducted as a means of assessment of the in situ conditions of materials.

Field testing	
SPT	Standard Penetration Test
HP/PP	Hand/Pocket Penetrometer
Dynamic Penetrometers (blows per noted increment)	
DCP	Dynamic Cone Penetrometer
PSP	Perth Sand Penetrometer
MC	Moisture Content
VS	Vane Shear
PBT	Plate Bearing Test
IMP	Borehole Impression Test
PID	Photo Ionization Detector

If encountered, refusal (R), virtual refusal (VR) or hammer bouncing (HB) of penetrometers may be noted.

The quality of the rock can be assessed by the degree of natural defects/fractures and the following.

Rock quality description	
TCR	Total Core Recovery (%) (length of core recovered divided by the length of core run)
RQD	Rock Quality Designation (%) (sum of axial lengths of core greater than 100mm long divided by the length of core run)

Notes on groundwater conditions encountered may include.

Groundwater	
Not Encountered	Excavation is dry in the short term
Not Observed	Water level observation not possible
Seepage	Water seeping into hole
Inflow	Water flowing/flooding into hole

Perched groundwater may result in a misleading indication of the depth to the true water table. Groundwater levels are also likely to fluctuate with variations in climatic and site conditions.

Notes on the stability of excavations may include.

Excavation conditions	
Stable	No obvious/gross short term instability noted
Spalling	Material falling into excavation (minor/major)
Unstable	Collapse of the majority, or one or more face of the excavation

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Explanatory Notes: General Soil Description

The methods of description and classification of soils used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. In practice, a material is described as a soil if it can be remoulded by hand in its field condition or in water. The dominant component is shown in upper case, with secondary components in lower case. In general descriptions cover: soil type, plasticity or particle size/shape, colour, strength or density, moisture and inclusions.

In general, soil types are classified according to the dominant particle on the basis of the following particle sizes.

Soil Classification		Particle Size (mm)
CLAY		< 0.002
SILT		0.002 0.075
SAND	fine	0.075 to 0.21
	medium	0.21 to 0.6
	coarse	0.6 to 2.36
GRAVEL	fine	2.36 to 6.7
	medium	6.7 to 19
	coarse	19 to 63
COBBLES		63 to 200
BOULDERS		> 200

Soil types may be qualified by the presence of minor components on the basis of field examination methods and/or the soil grading.

Terminology	In coarse grained soils		In fine soils
	% fines	% coarse	% coarse
Trace	≤5	≤15	≤15
With	>5, ≤12	>15, ≤30	>15, ≤30

The strength of cohesive soils is classified by engineering assessment or field/lab testing as follows.

Strength	Symbol	Undrained shear strength
Very Soft	VS	≤12kPa
Soft	S	12kPa to ≤25kPa
Firm	F	25kPa to ≤50kPa
Stiff	St	50kPa to ≤100kPa
Very Stiff	VSt	100kPa to ≤200kPa
Hard	H	>200kPa

Cohesionless soils are classified on the basis of relative density as follows.

Relative Density	Symbol	Density Index
Very Loose	VL	<15%
Loose	L	15% to ≤35%
Medium Dense	MD	35% to ≤65%
Dense	D	65% to ≤85%
Very Dense	VD	>85%

The plasticity of cohesive soils is defined by the Liquid Limit (LL) as follows.

Plasticity	Silt LL	Clay LL
Low plasticity	≤ 35%	≤ 35%
Medium plasticity	N/A	> 35% ≤ 50%
High plasticity	> 50%	> 50%

The moisture condition of soil (*w*) is described by appearance and feel and may be described in relation to the Plastic Limit (PL), Liquid Limit (LL) or Optimum Moisture Content (OMC).

Moisture condition and description	
Dry	Cohesive soils: hard, friable, dry of plastic limit. Granular soils: cohesionless and free-running
Moist	Cool feel and darkened colour: Cohesive soils can be moulded. Granular soils tend to cohere
Wet	Cool feel and darkened colour: Cohesive soils usually weakened and free water forms when handling. Granular soils tend to cohere

The structure of the soil may be described as follows.

Zoning	Description
Layer	Continuous across exposure or sample
Lens	Discontinuous layer (lenticular shape)
Pocket	Irregular inclusion of different material

The structure of soil layers may include: defects such as softened zones, fissures, cracks, joints and root-holes; and coarse grained soils may be described as strongly or weakly cemented.

The soil origin may also be noted if possible to deduce.

Soil origin and description	
Fill	Anthropogenic deposits or disturbed material
Topsoil	Zone of soil affected by roots and root fibres
Peat	Significantly organic soils
Colluvial	Transported down slopes by gravity/water
Aeolian	Transported and deposited by wind
Alluvial	Deposited by rivers
Estuarine	Deposited in coastal estuaries
Lacustrine	Deposited in freshwater lakes
Marine	Deposits in marine environments
Residual soil	Soil formed by in situ weathering of rock, with no structure/fabric of parent rock evident
Extremely weathered material	Formed by in situ weathering of geological formations, with the structure/fabric of parent rock intact but with soil strength properties

The origin of the soil generally cannot be deduced solely on the appearance of the material and the inference may be supplemented by further geological evidence or other field observation. Where there is doubt, the terms ‘possibly’ or ‘probably’ may be used

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Explanatory Notes: General Rock Description

The methods of description and classification of rocks used in this report are based on Australian Standard AS1726-2017 Geotechnical Site Investigations. In practice, if a material cannot be remoulded by hand in its field condition or in water, it is described as a rock. In general, descriptions cover: rock type, grain size, structure, colour, degree of weathering, strength, minor components or inclusions, and where applicable, the defect types, shape, roughness and coating/infill.

Rock types are generally described according to the predominant grain or crystal size, and in groups for each rock type as follows.

Rock type	Groups
Sedimentary	Deposited, carbonate (porous or non), volcanic ejection
Igneous	Felsic (much quartz, pale), Intermediate, or mafic (little quartz, dark)
Metamorphic	Foliated or non-foliated
Duricrust	Cementing minerology (iron oxides or hydroxides, silica, calcium carbonate, gypsum)

Reference should be made to AS1726 for details of the rock types and methods of classification.

The classification of rock weathering is described based on definitions in AS1726 and summarised as follows.

Term and symbol		Definition
Residual Soil	RS	Soil developed on rock with the mass structure and substance of the parent rock no longer evident
Extremely weathered	XW	Weathered to such an extent that the rock has 'soil-like' properties. Mass structure and substance still evident
Distinctly weathered	DW	The strength is usually changed and may be highly discoloured. Porosity may be increased by leaching, or decreased due to deposition in pores. May be distinguished into MW (Moderately Weathered) and HW (Highly Weathered).
Slightly weathered	SW	Slightly discoloured; little or no change of strength from fresh rock
Fresh Rock	FR	The rock shows no sign of decomposition or staining

The rock material strength can be defined based on the point load index as follows.

Term and symbol		Point Load Index I_s50 (MPa)
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1.0
High	H	1.0 to 3
Very High	VH	3 to 10
Extremely High	EH	> 10

It is important to note that the rock material strength as above is distinct from the rock mass strength which can be significantly weaker due to the effect of defects.

A preliminary assessment of rock strength may be made using the field guide detailed in AS1726, and this is conducted in the absence of point load testing.

The defect spacing measured normal to defects of the same set or bedding, is described as follows.

Definition	Defect Spacing (mm)
Thinly laminated	< 6
Laminated	6 to 20
Very thinly bedded	20 to 60
Thinly bedded	60 to 200
Medium bedded	200 to 600
Thickly bedded	600 to 2000
Very thickly bedded	> 2000

Terms for describing rock and defects are as follows.

Defect Terms			
Joint	JT	Sheared zone	SZ
Bedding Parting	BP	Seam	SM
Foliation	FL	Vein	VN
Cleavage	CL	Drill Lift	DL
Crushed Seam	CS	Handling Break	HB
Fracture Zone	FZ	Drilling Break	DB

The shape and roughness of defects in the rock mass are described using the following terms.

Planarity		Roughness	
Planar	PR	Very Rough	VR
Curved	CU	Rough	RF
Undulose	UN	Smooth	S
Irregular	IR	Slickensided	SL
Stepped	ST	Polished	POL
Discontinuous	DIS		

The coating or infill associated with defects in the rock mass are described as follows.

Infill and Coating		
Clean	CN	
Stained	SN	
Carbonaceous	X	
Minerals	MU	Unidentified mineral
	MS	Secondary mineral
	KT	Chlorite
	CA	Calcite
	Fe	Iron Oxide
	Qz	Quartz
Veneer	VNR	Thin or patchy coating
Coating	CT	Infill up to 1mm

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Graphic Symbols Index


CLAY


Silty CLAY


Sandy CLAY


Gravelly CLAY


Silty Gravelly CLAY


Silty Sandy CLAY


Sandy Gravelly CLAY


SILT


Clayey SILT


Sandy SILT


Gravelly SILT


Clayey Sandy SILT


Clayey Gravelly SILT


Sandy Gravelly SILT


SAND


Clayey SAND


Silty SAND


Gravelly SAND


Clayey Silty SAND


Clayey Gravelly SAND


Silty Gravelly SAND


GRAVEL


Clayey GRAVEL


Silty GRAVEL


Sandy GRAVEL


Clayey Silty GRAVEL


Clayey Sandy GRAVEL


Silty Sandy GRAVEL


COBBLES & BOULDERS


PEAT, highly organic soil


TOPSOIL


FILL


FILL: Asphalt or Bituminous Seal


FILL: Ballast


FILL: Concrete


FILL: Roadbase


Sedimentary rock: fine, mostly clay (CLAYSTONE)


Sedimentary rock: fine, mostly silt (SILTSTONE)


Sedimentary rock: fine, silt and clay (MUDSTONE, SHALE, LAMINITE)


Sedimentary rock: medium (SANDSTONE, GREYWACKE)

Sedimentary rock: fine to coarse, angular (BRECCIA)

Sedimentary rock: coarse, rounded (CONGLOMERATE)

Sedimentary rock: Organic (COAL)

Sedimentary rock: Carbonate (LIMESTONE, DOLOMITE)

Sedimentary rock: Volcanic (TUFF, VOLCANIC BRECCIA, AGGLOMERATE)

Igneous rock: Felsic, fine (RHYOLITE)

Igneous rock: Felsic, coarse (GRANITE)

Igneous rock: Mafic, fine to medium (BASALT, DOLERITE)

Igneous rock: Mafic, coarse (GABBRO)

Metamorphic rock: Foliated, fine to medium (SLATE, PHYLLITE, SHIST)

Metamorphic rock: Foliated, coarse (GNEISS)

Metamorphic rock: Non-foliated (QUARTZITE, HORNFELS, MARBLE)

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BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH01

Job No: 2128E.P.1330 **Sheet:** 1 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS
Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS
Date Started: 15/8/22 **Date Completed:** 16/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Depth (m)	Material Description: Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T		HWT		D 0.00 - 0.30 m			SM	FILL: Silty SAND: fine to coarse, dark brown, low to medium plastic silt	M	L	FILL
								0.30m			
							GC	FILL: Sandy Clayey GRAVEL: fine to coarse, sub-angular, grey/dark grey, medium plastic clay, fine to coarse sand			
								0.80m			
				D 0.80 - 1.00 m	1		CL	FILL: Sandy CLAY: low plasticity, brown, fine to coarse sand	M (<PL)	St	
								1.50m			ALLUVIUM
				SPT 1.50 - 1.95 m 3, 4, 6 N*=10 REC=0.45 m				Sandy CLAY: low plasticity, brown, fine sand			
				D 1.80 - 2.00 m	2						
				SPT 2.50 - 2.95 m 2, 4, 4 N*=8 REC=0.45 m			CI		M (≈PL)		
				D 2.80 - 3.30 m	3						
				D 3.70 - 4.00 m							
				SPT 4.00 - 4.45 m 2, 3, 3 N*=6 REC=0.45 m	4			4.10m			
				D 4.20 - 4.40 m				Clayey SAND: fine to coarse, brown, medium plastic clay			
					5						
				SPT 5.50 - 5.95 m 2, 3, 5 N*=8 REC=0.45 m			SC	Sand fraction fine to medium.	M	L	
					6						
WB				SPT 7.00 - 7.45 m 3, 6, 16 N*=22 REC=0.45 m	7			7.20m		MD	
			SWL @ 7.00	SPT 7.50 - 7.95 m 11, 20, 16 N*=36 REC=0.45 m			SP	Gravelly SAND: medium to coarse, grey-brown mottle pale brown, fine to medium sub-rounded gravel	W	D	
								8.00m			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
PP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

CONSTRUCTION SCIENCES PTY LTD

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH01

Job No: 2128E.P.1330 **Sheet:** 2 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS

Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS

Date Started: 15/8/22 **Date Completed:** 16/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Drilling: Water	Sampling & Testing: Sample or Field Test	Depth (m)	Material Description: Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
WB				SPT 8.50 - 8.95 m 9, 15, 17 N*=32 REC=0.45 m	9		SC	Clayey Gravelly SAND: fine to coarse, grey-brown mottle pale brown, fine sub-rounded gravel, medium plastic clay	W	D	ALLUVIUM
				SPT 10.00 - 10.45 m 6, 6, 5 N*=11 REC=0.45 m	10		GP	10.10m GRAVEL: fine, sub-angular, orange-brown/blue, trace fine to coarse sand 10.25m		L to MD	
							CH	CLAY: high plasticity, grey-brown, trace fine to coarse sand		St	
				SPT 11.50 - 11.95 m 7, 10, 13 N*=23 REC=0.45 m	11					VSt	
				SPT 12.00 - 12.45 m 7, 13, 17 N*=30 REC=0.45 m	12			12.00m CLAY: high plasticity, grey-brown speckled dark brown, trace fine sand	M (≈PL)		
				SPT 13.00 - 13.45 m 8, 11, 16 N*=27 REC=0.45 m	13		CH	Grey mottle brown speckled dark brown.		VSt to H	
					14			Brown mottle grey.			
				SPT 14.50 - 14.95 m 12, 19, 29 N*=48 REC=0.45 m				14.95m		H	
					15			TERMINATED AT 14.95 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
PP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

CONSTRUCTION SCIENCES PTY LTD

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH02

Job No: 2128E.P.1330 **Sheet:** 1 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS
Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS
Date Started: 16/8/22 **Date Completed:** 17/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Depth (m)	Material Description: Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T				ASS 0.00 - 0.25 m			SM	FILL: Silty SAND: fine to coarse, black, low to medium plastic silt, rootlets	M	L	FILL
				ASS 0.25 - 0.50 m							
				ASS 0.50 - 0.75 m							
				ASS 0.75 - 1.00 m				0.40m			
				ASS 1.00 - 1.25 m SPT 1.00 - 1.45 m 2, 2, 1 N*=3 REC=0.3 m	1		CI	FILL: Sandy CLAY: medium plasticity, black/dark brown, fine to coarse sand, occasional rootlets			
				ASS 1.25 - 1.50 m							
				ASS 1.50 - 1.75 m				0.95m			
				ASS 1.75 - 2.00 m				Sandy CLAY: medium plasticity, brown, fine to coarse sand			ALLUVIUM
				ASS 2.00 - 2.25 m	2						
				ASS 2.25 - 2.50 m					M (<PL)	F to St	
				ASS 2.50 - 3.00 m			CI				
				ASS 3.00 - 3.50 m SPT 3.00 - 3.45 m 2, 3, 4 N*=7 REC=0.35 m	3			Sand fraction increasing.			
		HWT		ASS 3.50 - 4.00 m							
				ASS 4.00 - 4.50 m SPT 4.00 - 4.45 m 3, 4, 5 N*=9 REC=0.4 m	4			4.20m			
				ASS 4.50 - 5.00 m			SP	SAND: fine to medium, brown, with medium plastic clay			
				ASS 5.00 - 5.50 m	5			4.70m			
				ASS 5.50 - 6.00 m SPT 5.50 - 5.95 m 4, 3, 3 N*=6 REC=0.35 m			SM	Silty SAND: fine to medium, brown, negligible to low silt	M	L to MD	
				ASS 6.00 - 6.50 m	6						
				ASS 6.50 - 7.00 m				Clay fraction reducing.			
WB					7			6.50m			
							SP	SAND: fine to medium, brown, trace medium plastic clay	M to W		
				SPT 7.50 - 7.95 m 6, 10, 10 N*=20 REC=0.35 m				Trace of fine sub-angular gravel.	W		
								7.60m			
							SP	SAND: fine to coarse, brown, with fine to medium sub-round gravel		MD	

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
PP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

CONSTRUCTION SCIENCES PTY LTD

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH02

Job No: 2128E.P.1330 **Sheet:** 2 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS

Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS

Date Started: 16/8/22 **Date Completed:** 17/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Depth (m)	Material Description: Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
WB			SWL @0700		8.10m			Sandy CLAY: high plasticity, pale grey, fine to coarse sand	W	MD	ALLUVIUM
				SPT 9.00 - 9.45 m 6, 7, 14 N*=21 REC=0.45 m	9		CH		M (≈PL)	VSt	
					10.00m						
				SPT 10.50 - 10.95 m 12, 17, 21 N*=38 REC=0.4 m	10		SC	SAND: grey/orange-brown, with medium plastic clay	W	D	
				SPT 11.50 - 11.95 m 8, 8, 12 N*=20 REC=0.45 m	11						
					11.60m			CLAY: high plasticity, pale brown/grey with orange-brown staining, with fine to medium sand		VSt	
				SPT 13.00 - 13.45 m 11, 16, 19 N=35 REC=0 m	12						
				SPT 13.50 - 13.95 m 8, 12, 20 N*=32 REC=0.45 m	13		CH	Pale brown/grey speckled dark brown/black.	M (<PL)	H	
				SPT 14.50 - 14.95 m 11, 15, 20 N*=35 REC=0.45 m	14			Blue-grey mottle brown. Becoming residual.			
					14.95m						
					15			TERMINATED AT 14.95 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
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VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
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RELATIVE DENSITY
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Refer to explanatory notes for details of abbreviations and basis of descriptions

CONSTRUCTION SCIENCES PTY LTD

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH03

Job No: 2128E.P.1330 **Sheet:** 1 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS
Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS
Date Started: 18/8/22 **Date Completed:** 18/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Depth (m)	Graphic Log	Classification	Material Description: SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T		HWT	SWL @0800	D 0.30 - 0.50 m			SM	0.20m FILL: Silty SAND: fine to coarse, black/dark brown, medium plastic silt	M	L	FILL
				D 0.50 - 0.70 m			SC	0.40m FILL: Clayey SAND: fine to coarse, brown, medium plastic clay, trace fine sub-rounded gravel			
				D 0.70 - 1.00 m			SC	0.70m FILL: Clayey Gravelly SAND: fine to coarse, brown, fine sub-angular to sub-rounded gravel, medium plastic clay, remnants of bricks/decommisioned terracotta conduits			
				SPT 1.00 - 1.45 m 1, 3, 5 N*=8 REC=0.08 m	1		SC	FILL: Clayey SAND: fine to coarse, brown, medium plastic clay, remnants of bricks/decommisioned terracotta conduits Fine fraction increasing. 1.70m			
				D 1.20 - 1.60 m							
				D 1.70 - 2.10 m			CL	Sandy CLAY: low plasticity, brown, fine to medium sand, trace fine gravel	M (>PL)	St	ALLUVIUM
				D 2.20 - 2.50 m	2						
				SPT 2.50 - 2.95 m 3, 4, 4 N*=8 REC=0.45 m							
				D 2.80 - 3.10 m	3			Sand fraction increasing.			
				D 3.50 - 3.90 m							
				SPT 4.00 - 4.45 m 3, 3, 3 N*=6 REC=0.4 m	4			4.10m			
				D 4.70 - 5.00 m			SC	Clayey SAND: fine to coarse, brown, medium plastic clay 4.70m	M	L	
				D 5.20 - 5.40 m	5		CI	Sandy CLAY: medium plasticity, brown, fine to coarse sand 5.00m	M (>PL)	F to St	
				SPT 5.50 - 5.95 m 2, 3, 3 N*=6 REC=0.45 m			SC	Clayey SAND: fine to coarse, brown, medium plastic clay 6.30m	M	L	
				D 6.30 - 6.60 m	6		CI	Sandy CLAY: medium plasticity, brown, fine to coarse sand 7.80m	M (≈PL)	F to St	
WB				SPT 7.50 - 7.95 m 5, 6, 6 N*=12 REC=0.4 m	7					St	
							SP		W	L to MD	

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
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PBT - Plate Bearing Test
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VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

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D - Dry
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PL - Plastic limit
LL - Liquid limit
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VS - Very Soft
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RELATIVE DENSITY
VL - Very Loose
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MD - Medium Dense
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CONSTRUCTION SCIENCES PTY LTD

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH03

Job No: 2128E.P.1330 **Sheet:** 2 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS
Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS
Date Started: 18/8/22 **Date Completed:** 18/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Depth (m)	Graphic Log	Classification	Material Description: SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
WB					9		SP	SAND: fine to coarse, brown, with medium plastic clay *(continued)*		L to MD	ALLUVIUM
				SPT 9.00 - 9.45 m 9, 6, 9 N*=15 REC=0.2 m				9.00m SAND: fine to coarse, brown speckled blue-grey, with fine sub-angular gravel	W		
					10		SP			MD	
				SPT 10.00 - 10.45 m 8, 8, 13 N*=21 REC=0.45 m				10.15m			
							GP	10.30m GRAVEL: fine to medium, sub-rounded, blue-grey/brown			
					11		CI-CH	Sandy CLAY: medium to high plasticity, pale grey, fine to coarse sand	M (>PL)		
				SPT 11.50 - 11.95 m 9, 7, 14 N*=21 REC=0.45 m				11.65m		VSt	
					12			CLAY: high plasticity, grey/orange-brown, trace fine sand			
				SPT 13.00 - 13.45 m 10, 13, 18 N*=31 REC=0.45 m	13		CH	Brown-grey speckled dark brown.	M (≈PL)		
										H	
					14						
				SPT 14.50 - 14.95 m 12, 14, 20 N*=34 REC=0.45 m							
					15			14.95m Trace of fine gravel (quartzite fragments). TERMINATED AT 14.95 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
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WATER
Water Level on Date shown
water inflow
water outflow

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RELATIVE DENSITY
VL - Very Loose
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MD - Medium Dense
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CONSTRUCTION SCIENCES PTY LTD

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH04

Job No: 2128E.P.1330 **Sheet:** 1 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS
Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS
Date Started: 18/8/22 **Date Completed:** 19/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Drilling: Water	Sampling & Testing: Sample or Field Test	Depth (m)	Graphic Log	Classification	Material Description: SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T		HWT		ASS 0.00 - 0.25 m			SM	0.15m FILL: Silty SAND: fine to coarse, black/dark brown, medium plastic silt, rootlets	M	L	FILL
				ASS 0.25 - 0.50 m			GP	FILL: COBBLES: medium to coarse, blue-grey, coarse rock fill		L to MD	
				ASS 0.50 - 0.75 m				0.70m			
				ASS 0.75 - 1.00 m				Sandy CLAY: medium plasticity, brown, fine to coarse sand			ALLUVIUM
				ASS 1.00 - 1.25 m SPT 1.00 - 1.45 m 1, 2, 2 N*=4 REC=0.45 m	1						
				ASS 1.25 - 1.50 m							
				ASS 1.50 - 1.75 m							
				ASS 1.75 - 2.00 m							
				ASS 2.00 - 2.25 m	2		CI		M (≈PL)	F to S	
				ASS 2.25 - 2.50 m							
				ASS 2.50 - 3.00 m SPT 2.50 - 2.95 m 3, 3, 4 N*=7 REC=0.45 m							
				ASS 3.00 - 3.50 m	3			3.40m			
				ASS 3.50 - 4.00 m			SC	Clayey SAND: fine to coarse, brown, medium plastic clay	M	L	
								3.70m			
							CI	Sandy CLAY: medium plasticity, brown, fine to medium sand	M (<PL)	F to St	
				ASS 4.00 - 4.50 m SPT 4.00 - 4.45 m 3, 3, 4 N*=7 REC=0.45 m	4			4.50m			
				ASS 4.50 - 5.00 m			SC	Clayey SAND: fine to coarse, brown, medium plastic clay	M	L	
				ASS 5.00 - 5.50 m	5			5.20m			
							CI	Sandy CLAY: medium plasticity, brown, fine to coarse sand	M (≈PL)	F to St	
				ASS 5.50 - 6.00 m SPT 5.50 - 5.95 m 7, 5, 3 N*=8 REC=0.3 m				5.50m			
							SP	5.70m SAND: fine to coarse, pale brown, trace fine sub-rounded gravel	M	L to MD	
				ASS 6.00 - 6.50 m	6		SC	Clayey SAND: fine to coarse, brown, medium plastic clay Lenses of Sandy Clay 6.2-6.3, 6.4-6.5m	M		
				ASS 6.50 - 7.00 m							
WB					7			7.80m			
							SC		M to W	L to MD	

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
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WATER
Water Level on Date shown
water inflow
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FIELD TESTS
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SAMPLES
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U - Thin wall tube 'undisturbed'

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SOIL CONSISTENCY
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RELATIVE DENSITY
VL - Very Loose
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CONSTRUCTION SCIENCES PTY LTD

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH04

Job No: 2128E.P.1330 **Sheet:** 2 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS
Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS
Date Started: 18/8/22 **Date Completed:** 19/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Depth (m)	Material Description: Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
WB			SWL @0700	SPT 8.00 - 8.45 m 5, 5, 5 N*=10 REC=0.45 m	9		SC	SAND: fine to coarse, brown, with medium plastic clay *(continued)*	M to W	L to MD	ALLUVIUM
				SPT 9.00 - 9.45 m 4, 4, 5 N*=9 REC=0.45 m			SC	9.00m Clayey SAND: fine to coarse, brown, medium plastic clay	W		
				SPT 10.00 - 10.45 m 3, 4, 5 N*=9 REC=0.45 m	10		SC	9.80m Clayey SAND: fine to coarse, brown, medium plastic clay	M (>PL)	St	
				SPT 11.50 - 11.95 m 4, 4, 5 N*=9 REC=0.45 m	11		CI-CH	11.40m Sandy CLAY: medium to high plasticity, grey/brown, fine to medium sand	M (≈PL)		
					12		SP	12.20m SAND: fine to coarse, brown mottle grey-brown, trace medium plastic clay	W	MD	
							CH	12.60m 12.75m Sandy CLAY: high plasticity, grey, fine to coarse sand	M (≈PL)	St	
							SP	13.00m SAND: fine to coarse, brown mottle grey-brown, trace medium plastic clay	M to W	MD	
					13		GP	13.25m GRAVEL: fine to medium, sub-rounded to sub-angular, blue-grey mottle brown, washed appearance	W		
				SPT 13.50 - 13.95 m 7, 10, 15 N*=25 REC=0.45 m			CH	CLAY: high plasticity, grey mottle brown, trace fine to medium sand	M (≈PL)	VSt	
				SPT 14.50 - 14.95 m 7, 13, 17 N*=30 REC=0.45 m	14					H	
					15			15.00m TERMINATED AT 15.00 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
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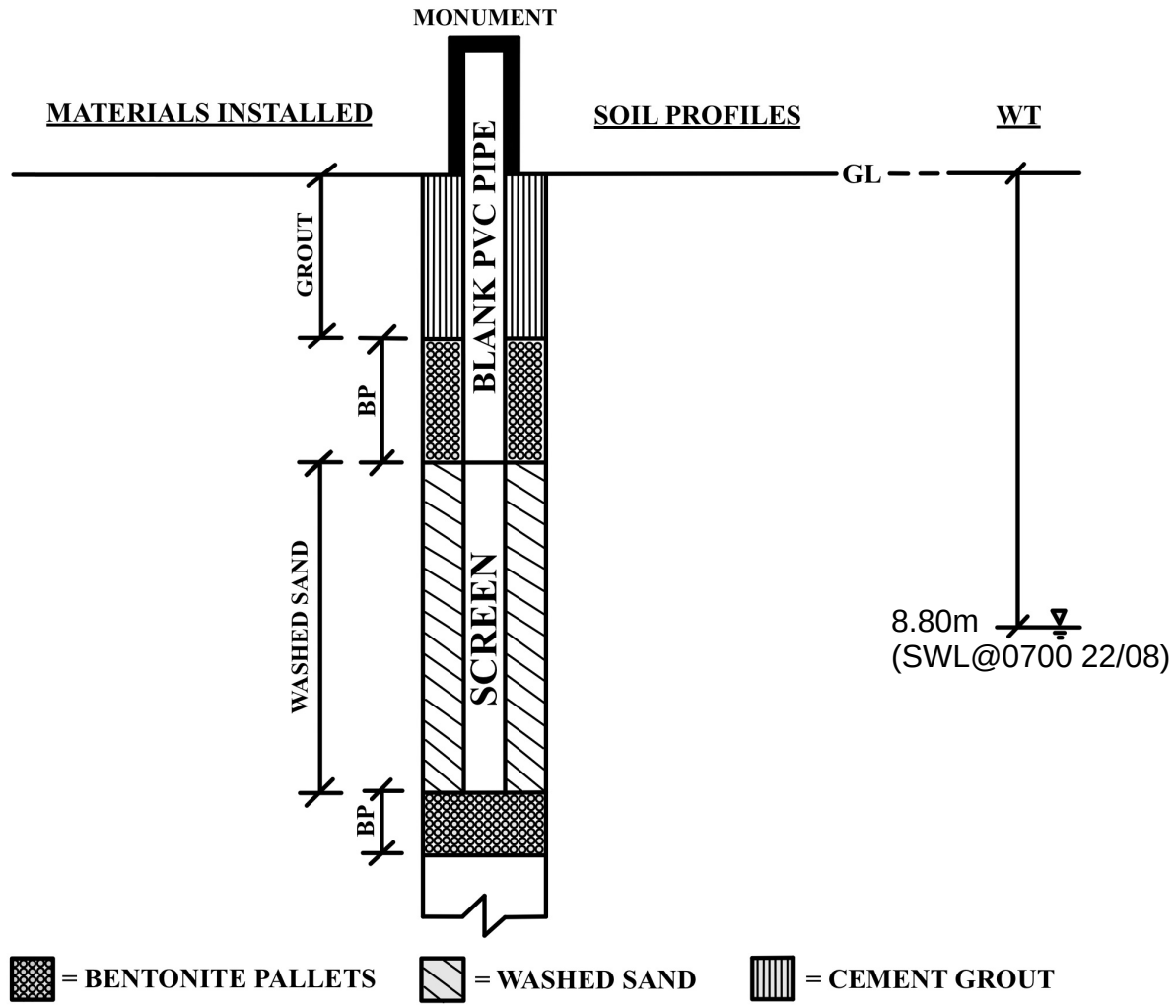
CONSTRUCTION SCIENCES PTY LTD

GROUNDWATER WELL INSTALLATION

Construction Sciences

Borehole Number: **Project Number:** **Date:**



Properties & Depths

Materials Installed	Soil Profiles
Monument Height: 0.75m	**Soil Profile 1:** as per 2128E.P.1330 Logs (BH04)
Cement Grout (1C/0.15B **):** 0.00-6.00m	**Soil Profile 2:**
Bentonite Plug (Top) (BP): 6.00-7.00m	**Soil Profile 3:**
Filter Sand (2-3mm **):** 7.00-15.00m	**Soil Profile 4:**
Bentonite Plug (Bottom) (BP): N/A	
Blank PCV Pipe: 0.00-9.00m	
PVC Screen: 9.00-15.00m	

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH05

Job No: 2128E.P.1330 **Sheet:** 1 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**

Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS

Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS

Date Started: 20/8/22 **Date Completed:** 20/8/22 **Logged By:** JB **Checked By:** PK

Drilling				Sampling & Testing		Material Description						
Method	Resistance	Casing	Water	Sample or Field Test	Depth (m)	Graphic Log	Classification	SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure		Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
AD/T		HWT	SWL @ 2.00	D 0.60 - 1.00 m	1		SM	FILL: Silty SAND: fine to coarse, black/dark brown, medium plastic silt	0.20m	M	L	FILL
							GP	FILL: COBBLES: medium to coarse, blue-grey, coarse rock fill	0.65m			
				SPT 1.00 - 1.45 m 3, 3, 3 N*=6 REC=0.4 m			CI-CH	FILL: Sandy CLAY: medium to high plasticity, brown, fine to medium sand	1.30m	M (>PL)	F to St	
				D 1.30 - 1.50 m			SC	Clayey SAND: fine to coarse, brown, medium plastic clay	2.30m	M	L	ALLUVIUM
				D 2.00 - 2.20 m	2							
				D 2.30 - 2.50 m			CI	Sandy CLAY: medium plasticity, brown, fine to coarse sand	2.80m	M (≈PL)	F to St	
				SPT 2.50 - 2.95 m 3, 3, 4 N*=7 REC=0.4 m			SC	Clayey SAND: fine to coarse, brown, medium plastic clay	3.40m	M	L	
				D 3.00 - 3.10 m	3							
				D 3.40 - 3.70 m			CI	Sandy CLAY: medium plasticity, brown, fine to coarse sand	3.70m	M (≈PL)	F to St	
				D 3.70 - 4.00 m			SC	Clayey SAND: fine to medium, brown, medium plastic clay	4.60m	M	L	
				SPT 4.00 - 4.45 m 4, 4, 3 N*=7 REC=0.25 m	4							
				D 5.00 - 5.50 m			CI	Sandy CLAY: medium plasticity, brown, fine to medium sand	5.60m	M (<PL)	F to St	
				SPT 5.50 - 5.95 m 3, 3, 4 N*=7 REC=0.4 m	5		SC	Clayey SAND: fine to coarse, brown, medium plastic clay	6.00m	M	L	
				D 6.00 - 6.50 m			CI	Sandy CLAY: medium plasticity, brown, fine to coarse sand	6.80m	M (>PL)	F to St	
WB				SPT 7.00 - 7.45 m 4, 6, 5 N*=11 REC=0.45 m	6		SC	Clayey SAND: fine to coarse, brown, medium plastic clay	7.80m	W	MD	
					7		SP					

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
PP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

CONSTRUCTION SCIENCES PTY LTD

Construction Sciences

BOREHOLE LOG SHEET

Client: Conrad Gargett
Project: Mackay Base Hospital - P Block
Location: Mackay QLD 4740

Hole No: BH05

Job No: 2128E.P.1330 **Sheet:** 2 of 2

Position: **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Truck Mounted Drill Rig **Mounting:** Truck **Driller:** GFS
Casing/Hole Diameter: HWT / 100 mm **Contractor:** GFS
Date Started: 20/8/22 **Date Completed:** 20/8/22 **Logged By:** JB **Checked By:** PK

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Depth (m)	Graphic Log	Classification	Material Description: SOIL TYPE, plasticity or particle characteristic, colour, secondary and minor components ROCK TYPE, grain size and type, colour, fabric & texture, strength, weathering, defects and structure	Moisture Condition	Consistency Relative Density	STRUCTURE & Other Observations
WB				SPT 8.50 - 8.95 m 3, 6, 4 N*=10 REC=0.4 m	9		SP	SAND: fine to medium, brown, with medium plastic clay *(continued)*	W	MD	ALLUVIUM
								9.70m			
				SPT 10.00 - 10.45 m 2, 3, 3 N*=6 REC=0.45 m	10		CL	Sandy CLAY: low plasticity, pale grey/brown, fine to coarse sand Brown.	M (>PL)	F to St	
				SPT 11.50 - 11.95 m 3, 5, 6 N*=11 REC=0.45 m	11					St	
				SPT 13.00 - 13.45 m 7, 10, 15 N*=25 REC=0.45 m	12					VSt	
					13			13.15m			
				SPT 14.50 - 14.95 m 11, 14, 21 N*=35 REC=0.45 m	14		CH	CLAY: high plasticity, grey/dark brown mottle red, trace fine to medium sand Blue-grey speckled pale grey/mottle brown. Becoming residual.	M (≈PL)	H	
								14.95m			
					15			TERMINATED AT 14.95 m Target depth			

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
AH Air hammer
PS Percussion sampler
AS Short spiral auger
AD/V Solid flight auger: V-Bit
AD/T Solid flight auger: TC-Bit
HFA Hollow flight auger
WB Washbore drilling
RR Rock roller

PENETRATION
VE Very Easy (No Resistance)
E Easy
F Firm
H Hard
VH Very Hard (Refusal)

WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
SPT - Standard Penetration Test
PP - Hand/Pocket Penetrometer
DCP - Dynamic Cone Penetrometer
PSP - Perth Sand Penetrometer
MC - Moisture Content
PBT - Plate Bearing Test
IMP - Borehole Impression Test
PID - Photoionisation Detector
VS - Vane Shear; P=Peak, R=Residual (uncorrected kPa)

SAMPLES
B - Bulk disturbed sample
D - Disturbed sample
ES - Environmental sample
U - Thin wall tube 'undisturbed'

MOISTURE
D - Dry
M - Moist
W - Wet
PL - Plastic limit
LL - Liquid limit
w - Moisture content

SOIL CONSISTENCY
VS - Very Soft
S - Soft
F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

RELATIVE DENSITY
VL - Very Loose
L - Loose
MD - Medium Dense
D - Dense
VD - Very Dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

CONSTRUCTION SCIENCES PTY LTD

Appendix C
Laboratory Test Results

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
2-4 Progress Drive,
Paget QLD 4740

Laboratory: **Mackay Laboratory**
Phone: 07 4952 4750
Fax: 07 4952 4173
Email: Mackay@constructionsciences.net

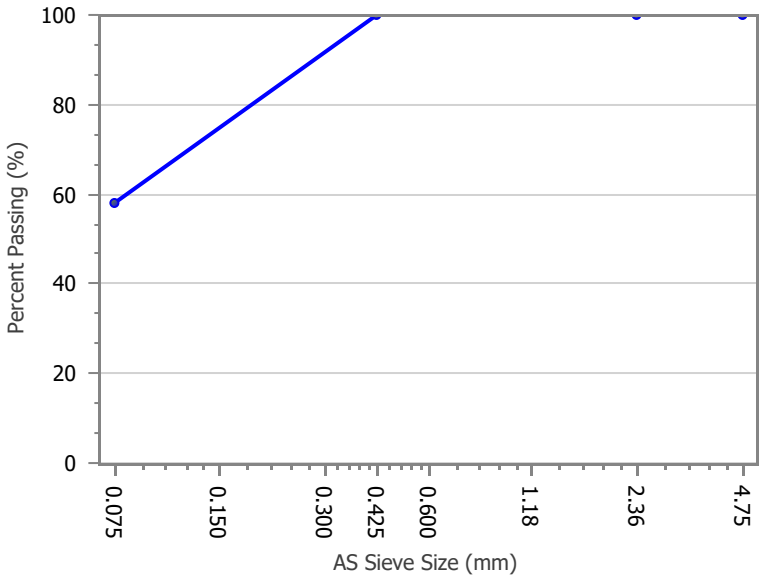
QUALITY OF MATERIALS REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82141-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	19/09/2022 Page 1 of 7

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, Q252, Q253, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	5676/S/208117	Borehole No	BH01
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	2.50-2.95m
Date Sampled	15/08/2022		
Sampled By	Joseph Brittain		
Date Tested	5/09/2022	Material Source	-
PSD Preparation	Unwashed / Oven	Material Type	-
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	Existing		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
4.75		**100**	
2.36		**100**	
0.425		**100**	
0.075		**58**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**28**		0.075/0.425 Fines Ratio		**0.58**	
Plastic Limit (%)		**19**		PI x 0.425 Ratio (%)		**898.9**	
Plastic Index (%)		**9**		LS x 0.425 Ratio (%)		**599.2**	
Linear Shrinkage (%)		**6.0**		Linear Shrinkage Defects	-		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5676

Approved Signatory: Craig Goss
Form ID: W85QTRep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
2-4 Progress Drive,
Paget QLD 4740

Laboratory: **Mackay Laboratory**
Phone: 07 4952 4750
Fax: 07 4952 4173
Email: Mackay@constructionsciences.net

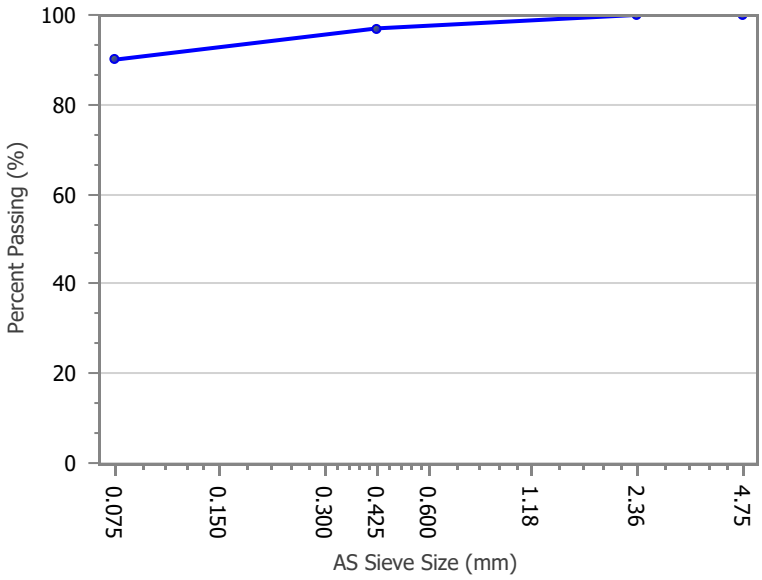
QUALITY OF MATERIALS REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82141-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	19/09/2022 Page 2 of 7

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, Q252, Q253, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	5676/S/208118	Borehole No	BH01
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	12.00-12.45m
Date Sampled	15/08/2022		
Sampled By	Joseph Brittain		
Date Tested	5/09/2022	Material Source	-
PSD Preparation	Unwashed / Oven	Material Type	-
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	Existing		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
4.75		**100**	
2.36		**100**	
0.425		**97**	
0.075		**90**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**57**		0.075/0.425 Fines Ratio		**0.92**	
Plastic Limit (%)		**24**		PI x 0.425 Ratio (%)		**3208.2**	
Plastic Index (%)		**33**		LS x 0.425 Ratio (%)		**1506.9**	
Linear Shrinkage (%)		**15.5**		Linear Shrinkage Defects	-		

Remarks

NATA

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Form ID: W85QTRep Rev 1

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Email: Mackay@constructionsciences.net

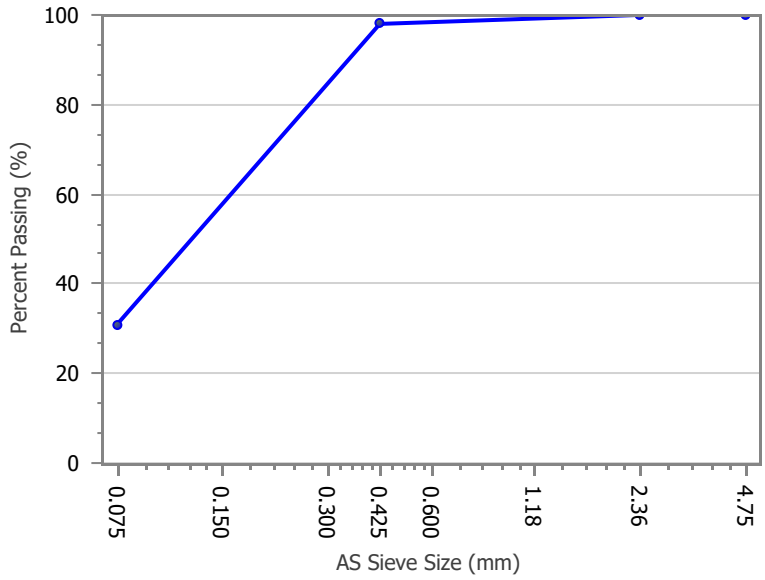
QUALITY OF MATERIALS REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82141-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	19/09/2022 Page 3 of 7

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, Q252, Q253, AS 1289.3.3.1		
Sample Number	5676/S/208119	Borehole No	BH02
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	5.50-5.95m
Date Sampled	16/08/2022		
Sampled By	Joseph Brittain		
Date Tested	5/09/2022	Material Source	-
PSD Preparation	Unwashed / Oven	Material Type	-
Atterberg Preparation	Dry Sieved / Air Dried	Prep Material > 53.0mm (%)	
Material Description	-		

AS Sieve (mm)	Specification Minimum (%)	Percent Passing (%)	Specification Maximum (%)
4.75		**100**	
2.36		**100**	
0.425		**98**	
0.075		**31**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	Result	Specification Maximum (%)	Test Result	Specification Minimum (%)	Result	Specification Maximum (%)
Liquid Limit (%)		**Can't be determined**		0.075/0.425 Fines Ratio		**0.31**	
Plastic Limit (%)		**Can't be determined**		PI x 0.425 Ratio (%)		-	
Plastic Index (%)		**Non Plastic**		LS x 0.425 Ratio (%)		-	
Linear Shrinkage (%)				Linear Shrinkage Defects			

Remarks

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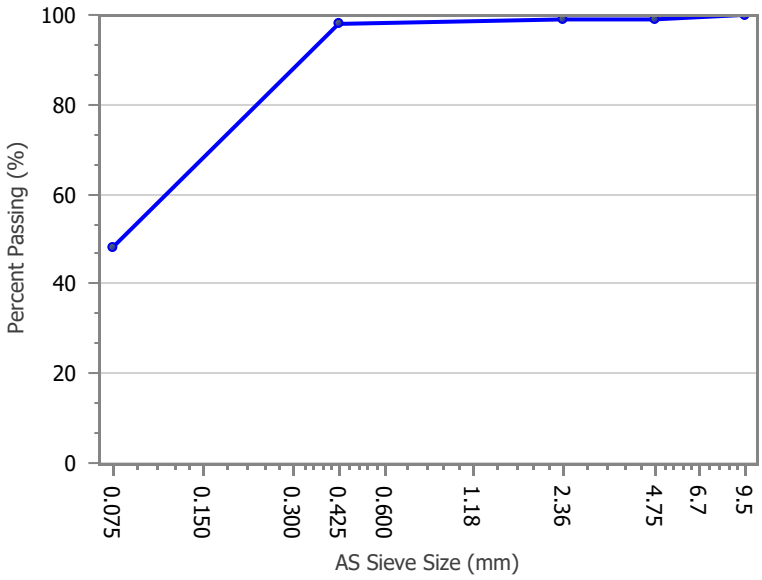
QUALITY OF MATERIALS REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82141-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	19/09/2022 Page 4 of 7

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, Q252, Q253, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	5676/S/208120	Borehole No	BH03
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	2.20-2.50m
Date Sampled	18/08/2022		
Sampled By	Joseph Brittain		
Date Tested	2/09/2022	Material Source	-
PSD Preparation	Unwashed / Oven	Material Type	-
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	Existing		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
9.5		**100**	
4.75		**99**	
2.36		**99**	
0.425		**98**	
0.075		**48**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**28**		0.075/0.425 Fines Ratio		**0.49**	
Plastic Limit (%)		**19**		PI x 0.425 Ratio (%)		**878.9**	
Plastic Index (%)		**9**		LS x 0.425 Ratio (%)		**634.7**	
Linear Shrinkage (%)		**6.5**		Linear Shrinkage Defects	-		

Remarks

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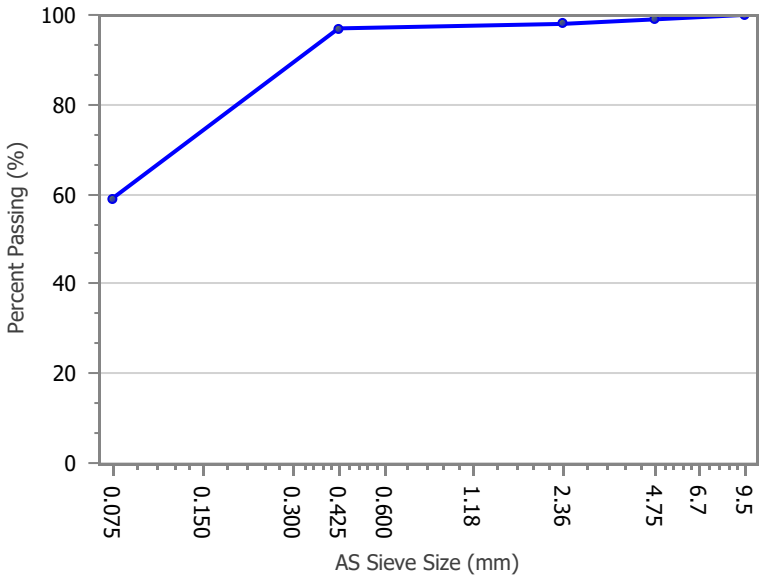
QUALITY OF MATERIALS REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82141-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	19/09/2022 Page 5 of 7

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, Q252, Q253, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	5676/S/208121	Borehole No	BH04
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	4.00-4.45m
Date Sampled	18/08/2022		
Sampled By	Joseph Brittain		
Date Tested	5/09/2022	Material Source	-
PSD Preparation	Unwashed / Oven	Material Type	-
Atterberg Preparation	Dry Sieved / Air Dried	Prep Material > 53.0mm (%)	
Material Description	-		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
9.5		**100**	
4.75		**99**	
2.36		**98**	
0.425		**97**	
0.075		**59**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**29**		0.075/0.425 Fines Ratio		**0.61**	
Plastic Limit (%)		**22**		PI x 0.425 Ratio (%)		**681.2**	
Plastic Index (%)		**7**		LS x 0.425 Ratio (%)		**292.0**	
Linear Shrinkage (%)		**3.0**		Linear Shrinkage Defects	-		

Remarks

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NATA

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Form ID: W85QTRep Rev 1

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Email: Mackay@constructionsciences.net

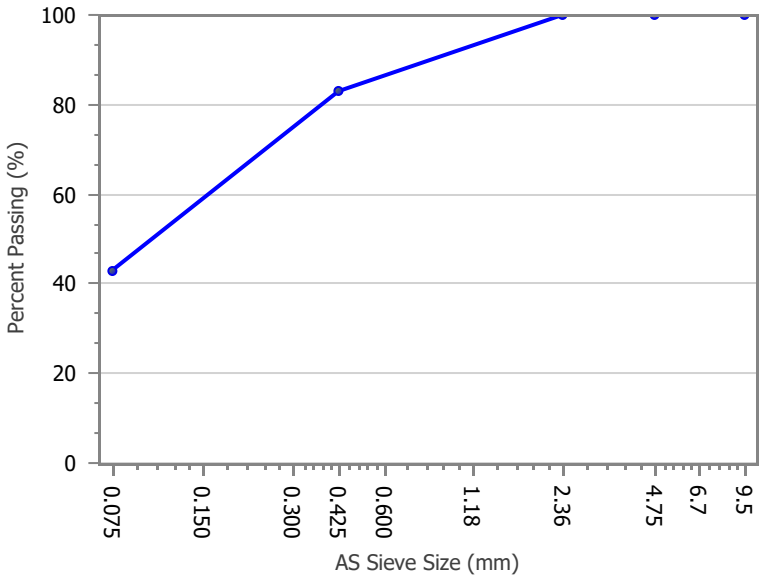
QUALITY OF MATERIALS REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82141-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	19/09/2022 Page 6 of 7

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, Q252, Q253, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	5676/S/208122	Borehole No	BH05
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	10.00-10.45m
Date Sampled	20/08/2022		
Sampled By	Joseph Brittain		
Date Tested	2/09/2022	Material Source	-
PSD Preparation	Unwashed / Oven	Material Type	-
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	Existing		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
9.5		**100**	
4.75		**100**	
2.36		**100**	
0.425		**83**	
0.075		**43**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**28**		0.075/0.425 Fines Ratio		**0.51**	
Plastic Limit (%)		**17**		PI x 0.425 Ratio (%)		**916.8**	
Plastic Index (%)		**11**		LS x 0.425 Ratio (%)		**666.8**	
Linear Shrinkage (%)		**8.0**		Linear Shrinkage Defects	-		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5676

Approved Signatory: Craig Goss
Form ID: W85QTRep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
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Laboratory: **Mackay Laboratory**
Phone: 07 4952 4750
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Email: Mackay@constructionsciences.net

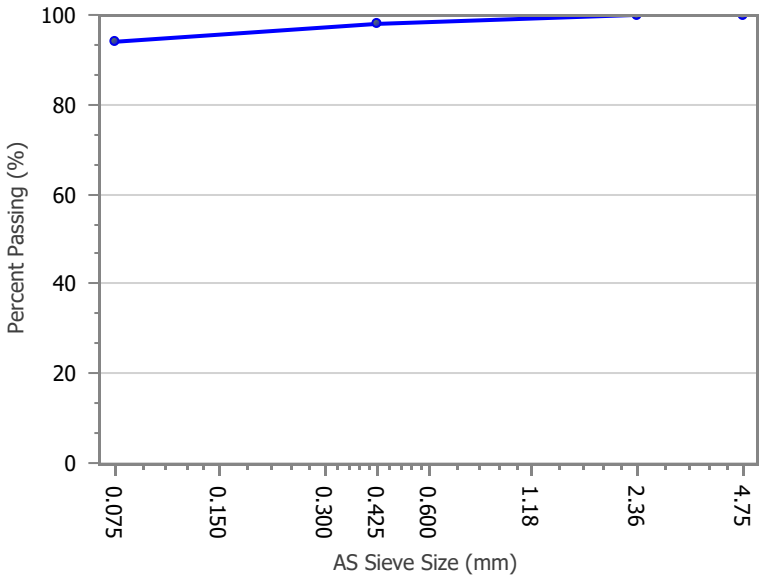
QUALITY OF MATERIALS REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82141-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	19/09/2022 Page 7 of 7

Test Procedures	AS1289.3.6.1, AS1289.3.1.2, AS1289.3.2.1, AS1289.3.4.1, Q252, Q253, AS1289.2.1.1, AS 1289.3.3.1		
Sample Number	5676/S/208123	Borehole No	BH05
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	14.50-14.95m
Date Sampled	20/08/2022		
Sampled By	Joseph Brittain		
Date Tested	5/09/2022	Material Source	-
PSD Preparation	Unwashed / Oven	Material Type	-
Atterberg Preparation	Dry Sieved / Oven Dried	Prep Material > 53.0mm (%)	
Material Description	Existing		

AS Sieve (mm)	Specification Minimum (%)	**Percent Passing (%)**	Specification Maximum (%)
4.75		**100**	
2.36		**100**	
0.425		**98**	
0.075		**94**	

PARTICLE SIZE DISTRIBUTION GRAPH



Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)	Test Result	Specification Minimum (%)	**Result**	Specification Maximum (%)
Liquid Limit (%)		**56**		0.075/0.425 Fines Ratio		**0.95**	
Plastic Limit (%)		**24**		PI x 0.425 Ratio (%)		**3149.3**	
Plastic Index (%)		**32**		LS x 0.425 Ratio (%)		**1574.7**	
Linear Shrinkage (%)		**16.0**		Linear Shrinkage Defects	-		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5676

Approved Signatory: Craig Goss
Form ID: W85QTRep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
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Laboratory: **Mackay Laboratory**
Phone: 07 4952 4750
Fax: 07 4952 4173
Email: Mackay@constructionsciences.net

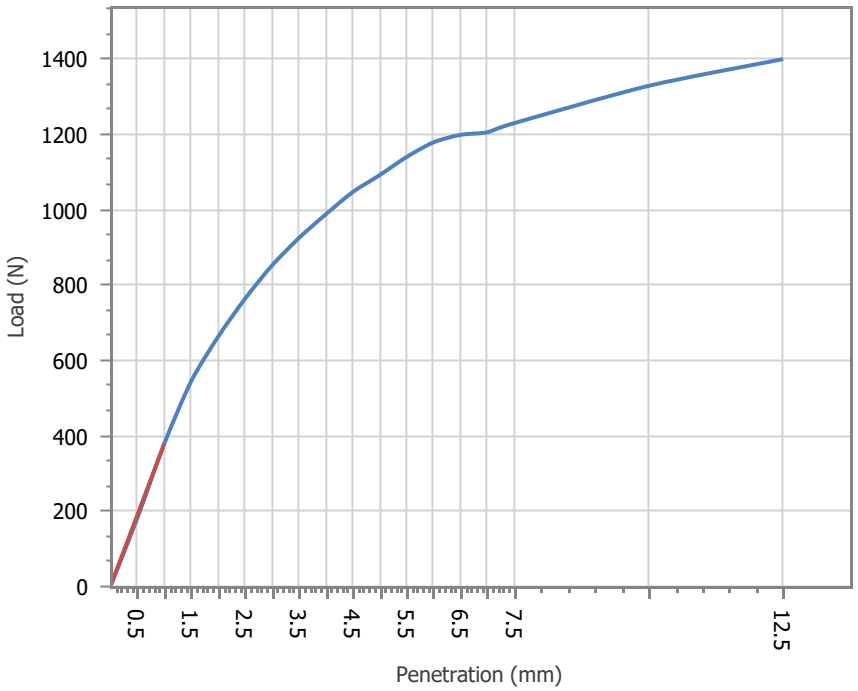
CALIFORNIA BEARING RATIO REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82137-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	BH01
Location:	Mackay	Internal Test Request:	5676/T/51582
Supplied To:	n/a	Client Reference/s:	2128E/CC/1172
Area Description:		Report Date / Page:	19/09/2022 Page 1 of 3

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1		
Sample Number	5676/S/208114	Borehole No	BH01
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	0.8-1.2m
Date Sampled	18/08/2022		
Sampled By	Joseph Brittain		
Date Tested	10/09/2022	Prep Material > 53mm (%)	-
Material Source	-	Material Limit Start	-
Material Type	-	Material Limit End	-
Client Reference	2128E/S/7907	Compactive Effort	Standard
Material Description	Existing		

Maximum Dry Density (t/m³):	1.68
Optimum Moisture Content (%):	21.0
Field Moisture Content (%):	22.0
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	100
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.66
Placement Dry Density Ratio (%):	99.0
Placement Moisture Content (%):	21.4
Placement Moisture Ratio (%):	102.0
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	4.5
Dry Density After Soak (t/m³):	1.64
Total Curing Time (hrs)	90
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	24.8
Moisture (remainder) After Soak (%)	23.2
CBR Swell (%):	1.0
Minimum CBR Specification (%):	-
CBR Value @ 2.5mm (%):	**6**

CBR PENETRATION PLOT



Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5676

Approved Signatory: Craig Goss
Form ID: W2ASRep Rev 3

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
2-4 Progress Drive,
Paget QLD 4740

Laboratory: **Mackay Laboratory**
Phone: 07 4952 4750
Fax: 07 4952 4173
Email: Mackay@constructionsciences.net

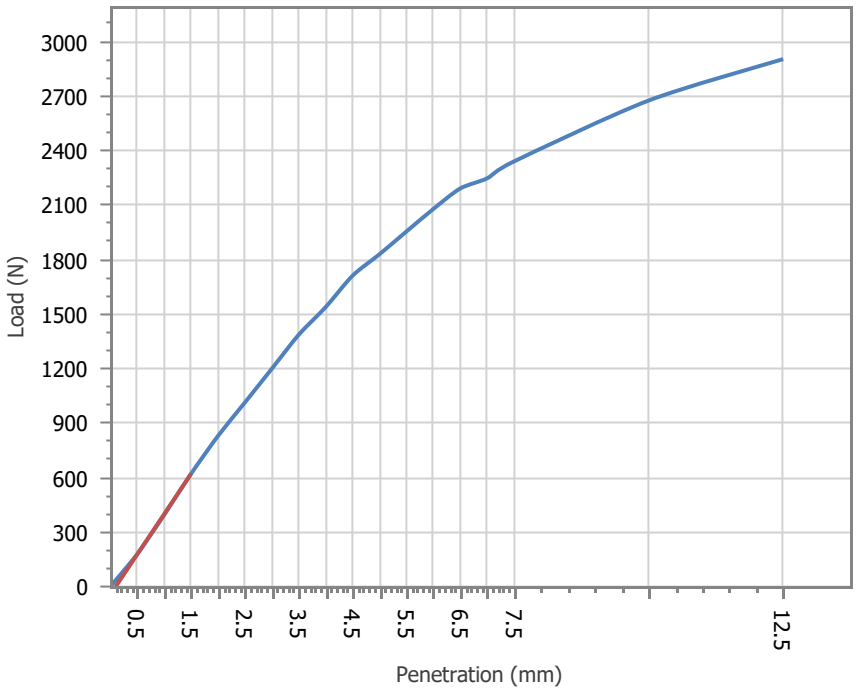
CALIFORNIA BEARING RATIO REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82137-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	BH02
Location:	Mackay	Internal Test Request:	5676/T/51582
Supplied To:	n/a	Client Reference/s:	2128E/CC/1172
Area Description:		Report Date / Page:	19/09/2022 Page 2 of 3

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1		
Sample Number	5676/S/208115	Borehole No	BH02
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	0.9-1.2m
Date Sampled	18/08/2022		
Sampled By	Joseph Brittain		
Date Tested	10/09/2022	Prep Material > 53mm (%)	-
Material Source	-	Material Limit Start	-
Material Type	-	Material Limit End	-
Client Reference	2128E/S/7908	Compactive Effort	Standard
Material Description	Top soil		

Maximum Dry Density (t/m³):	1.69
Optimum Moisture Content (%):	17.5
Field Moisture Content (%):	19.0
Sample Percent Oversize (%)	0.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	100
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.70
Placement Dry Density Ratio (%):	100.5
Placement Moisture Content (%):	17.9
Placement Moisture Ratio (%):	101.5
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	4.5
Dry Density After Soak (t/m³):	1.70
Total Curing Time (hrs)	90
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	20.1
Moisture (remainder) After Soak (%)	19.5
CBR Swell (%):	0.0
Minimum CBR Specification (%):	-
CBR Value @ 5.0mm (%):	**9**

CBR PENETRATION PLOT



Remarks

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Approved Signatory: Craig Goss
Form ID: W2ASRep Rev 3

Construction Sciences

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Email: Mackay@constructionsciences.net

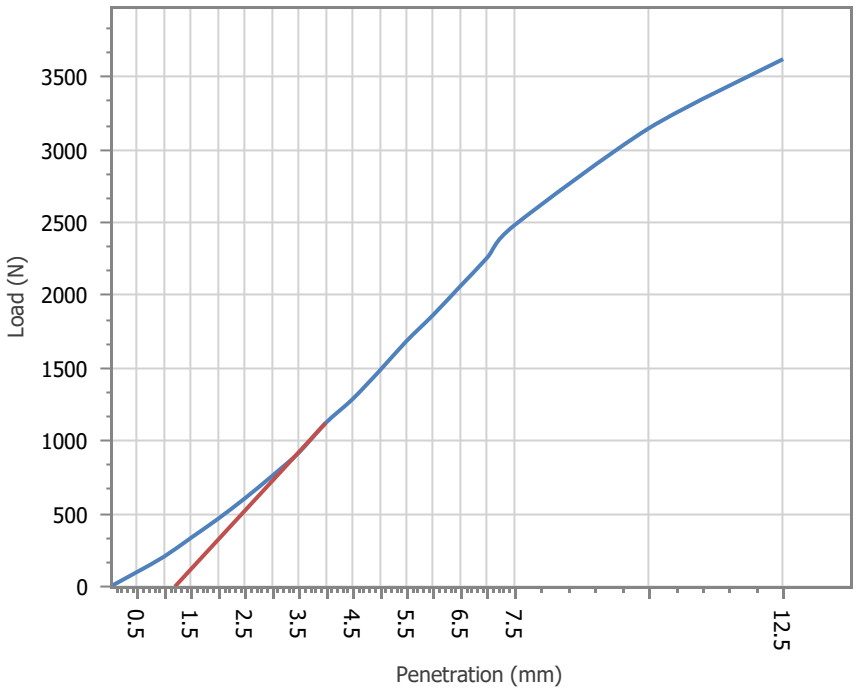
CALIFORNIA BEARING RATIO REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82137-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	BH03
Location:	Mackay	Internal Test Request:	5676/T/51582
Supplied To:	n/a	Client Reference/s:	2128E/CC/1172
Area Description:		Report Date / Page:	19/09/2022 Page 3 of 3

Test Procedures	AS1289.6.1.1, AS1289.5.1.1, AS1289.2.1.1		
Sample Number	5676/S/208116	Borehole No	BH03
Sampling Method	AS1289.1.2.1 Cl 6.5.3	Depth m	0.9-1.2m
Date Sampled	18/08/2022		
Sampled By	Joseph Brittain		
Date Tested	10/09/2022	Prep Material > 53mm (%)	0.0
Material Source	-	Material Limit Start	-
Material Type	-	Material Limit End	-
Client Reference	2128E/S/7909	Compactive Effort	Standard
Material Description	Existing		

Maximum Dry Density (t/m³):	1.76
Optimum Moisture Content (%):	16.5
Field Moisture Content (%):	12.1
Sample Percent Oversize (%)	1.0
Oversize Included / Excluded	Excluded
Target Density Ratio (%):	100
Target Moisture Ratio (%):	100
Placement Dry Density (t/m³):	1.75
Placement Dry Density Ratio (%):	99.5
Placement Moisture Content (%):	16.5
Placement Moisture Ratio (%):	101.0
Test Condition / Soaking Period:	Soaked / 4 Days
CBR Surcharge (kg)	4.5
Dry Density After Soak (t/m³):	1.75
Total Curing Time (hrs)	90
Liquid Limit Method	Estimation
Moisture (top 30mm) After Soak (%)	18.1
Moisture (remainder) After Soak (%)	17.7
CBR Swell (%):	0.0
Minimum CBR Specification (%):	-
CBR Value @ 5.0mm (%):	**10**

CBR PENETRATION PLOT



Remarks

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Approved Signatory: Craig Goss
Form ID: W2ASRep Rev 3

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Email: Mackay@constructionsciences.net

MOISTURE CONTENT REPORT

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/82138-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	19/09/2022 Page 1 of 1

Test Procedures:	AS1289.2.1.1

Sample Number	5676/S/208117	5676/S/208118	5676/S/208119	5676/S/208120
ID / Client ID	2128E/S/7910	2128E/S/7911	2128E/S/7912	2128E/S/7913
Lot Number	-	-	-	-
Date / Time Sampled	15/08/2022	15/08/2022	16/08/2022	18/08/2022
Sampling Method	AS1289.1.2.1 Cl 6.5.3	AS1289.1.2.1 Cl 6.5.3	AS1289.1.2.1 Cl 6.5.3	AS1289.1.2.1 Cl 6.5.3
Sampled By	Joseph Brittain	Joseph Brittain	Joseph Brittain	Joseph Brittain
Tested By	Geordie Page	Geordie Page	Geordie Page	Geordie Page
Date Tested	2/09/2022	2/09/2022	2/09/2022	2/09/2022
Material Source	-	-	-	-
Material Type	-	-	-	-
Borehole No	BH01	BH01	BH02	BH03
Depth	2.50-2.95m	12.00-12.45m	5.50-5.95m	2.20-2.50m
Moisture Content (%)	**20.2**	**26.2**	**9.9**	**19.2**

Sample Number	5676/S/208121	5676/S/208122	5676/S/208123	
ID / Client ID	2128E/S/7914	2128E/S/7915	2128E/S/7916	
Lot Number	-	-	-	
Date / Time Sampled	18/08/2022	20/08/2022	20/08/2022	
Sampling Method	AS1289.1.2.1 Cl 6.5.3	AS1289.1.2.1 Cl 6.5.3	AS1289.1.2.1 Cl 6.5.3	
Sampled By	Joseph Brittain	Joseph Brittain	Joseph Brittain	
Tested By	Geordie Page	Geordie Page	Geordie Page	
Date Tested	2/09/2022	2/09/2022	2/09/2022	
Material Source	-	-	-	
Material Type	-	-	-	
Borehole No	BH04	BH05	BH05	
Depth m	4.00-4.45m	10.00-10.45m	14.50-14.95m	
Moisture Content (%)	**15.7**	**22.3**	**23.7**	

Remarks

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NATA

Accreditation Number: 1986
Corporate Site Number: 5676

Approved Signatory: Craig Goss
Form ID: W20Rep Rev 3

Construction Sciences

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SHRINK SWELL INDEX

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/81784-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	BH02
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	7/09/2022 Page 1 of 2

Test Procedures:	AS1289.7.1.1, AS1289.2.1.1	Borehole No	BH02
Sample Number	5676/S/208124	Depth m	2.50-2.80m
Sampling Method	AS1289.1.2.1 Cl 6.5.3		
Date Sampled	1/09/2022		
Sampled By	Joseph Brittain	Material Source	-
Date Tested	2/09/2022	Material Type	-

Soil Description:	Insitu		
Cracking / Crumbling:	Nil		
Estimated Inert Inclusions (%):	4.00	Swell Pre-Soak Moisture Content (%)	19.6
Shrinkage Moisture Content (%):	19.2	Swell Post-Soak Moisture Content (%)	22.6

Shrinkage Strain (%)	0.7	Shrink / Swell Index	0.4
Swell Strain (%)	0.0		

Remarks

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NATA

Accreditation Number: 1986
Corporate Site Number: 5676

Approved Signatory: Rawiri Gray
Form ID: W21Rep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

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Paget QLD 4740

Laboratory: **Mackay Laboratory**
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Email: Mackay@constructionsciences.net

SHRINK SWELL INDEX

Client:	Construction Sciences Rockhampton Engineering	Report Number:	5676/R/81784-1
Client Address:	,	Project Number:	5676/P/5231
Project:	Conrad Gargett - Mackay Hospital-GI	Lot Number:	BH04
Location:	Mackay	Internal Test Request:	5676/T/51583
Supplied To:	n/a	Client Reference/s:	2128E/CC/1173
Area Description:		Report Date / Page:	7/09/2022 Page 2 of 2

Test Procedures:	AS1289.7.1.1, AS1289.2.1.1	Borehole No	BH04
Sample Number	5676/S/208125	Depth m	1.50-1.80m
Sampling Method	AS1289.1.2.1 Cl 6.5.3		
Date Sampled	1/09/2022		
Sampled By	Joseph Brittain	Material Source	-
Date Tested	2/09/2022	Material Type	-

Soil Description:	Insitu		
Cracking / Crumbling:	Nil		
Estimated Inert Inclusions (%):	4.00	Swell Pre-Soak Moisture Content (%)	18.8
Shrinkage Moisture Content (%):	19.6	Swell Post-Soak Moisture Content (%)	22.2

Shrinkage Strain (%)	1.3	Shrink / Swell Index	0.7
Swell Strain (%)	0.1		

Remarks

Accredited for compliance with ISO/IEC 17025 – Testing

NATA

Accreditation Number: 1986
Corporate Site Number: 5676

Approved Signatory: Rawiri Gray
Form ID: W21Rep Rev 1

www.biotrack.com.au
781 Mt Glorious Rd Highvale 4520

Certificate of Analysis

Signatory:

Phone: +617 3289 7179 Bio-Track Pty Ltd ABN 91 056 237 275

Test Code/Name	**[15] Aggressive Soil Suite #1 for AS2159 Piling Code**		
Lab Reference (LR)	**090922.465**	Client Name	Construction Sciences Pty Ltd
SampleID(s)	**(As Listed)**	Client Contact	Joseph Brittain
		Project Name	Mackay Base Hospital - P Block Expansion
Report Date	15/09/2022	Job Number	2128E.P.1330
Sample Received Date	8/09/2022	Order Number	2128E.P.1330
Sample Disposal Date	8/11/2022	Chain of Custody	
Sample Packaging	Plastic Bag	Client Email	joseph.brittain@constructionsciences.net
Temperature	Ambient	Client Address	101 High Street North Rockhampton Queensland 4701

Analytical Method: As per ASTM G187 - 12 a. Resistivity **R**15.5 standardised to a resistance at 15.5'C (per ASTM G187 - 12 a) Resistivity will be ***lower*** at temperatures above 15.5 'C which may apply to field conditions.

Resistivity at reported temperature

* NM = Not Measured

S#	SampleID	Resistivity (Ohms.cm) #	Temp # 'C	Resistivity (Ohms.cm) R15.5	pH
1	BH01 10-10.45	2400	21	2700	7.2
2	BH02 11.5-11.95	630	21	720	7.6
3	BH03 10-10.45	17000	21	19000	7.5
4	BH03 11.5-11.95	730	21	830	7.7
5	BH05 11.5-11.95	4200	21	4800	7.6

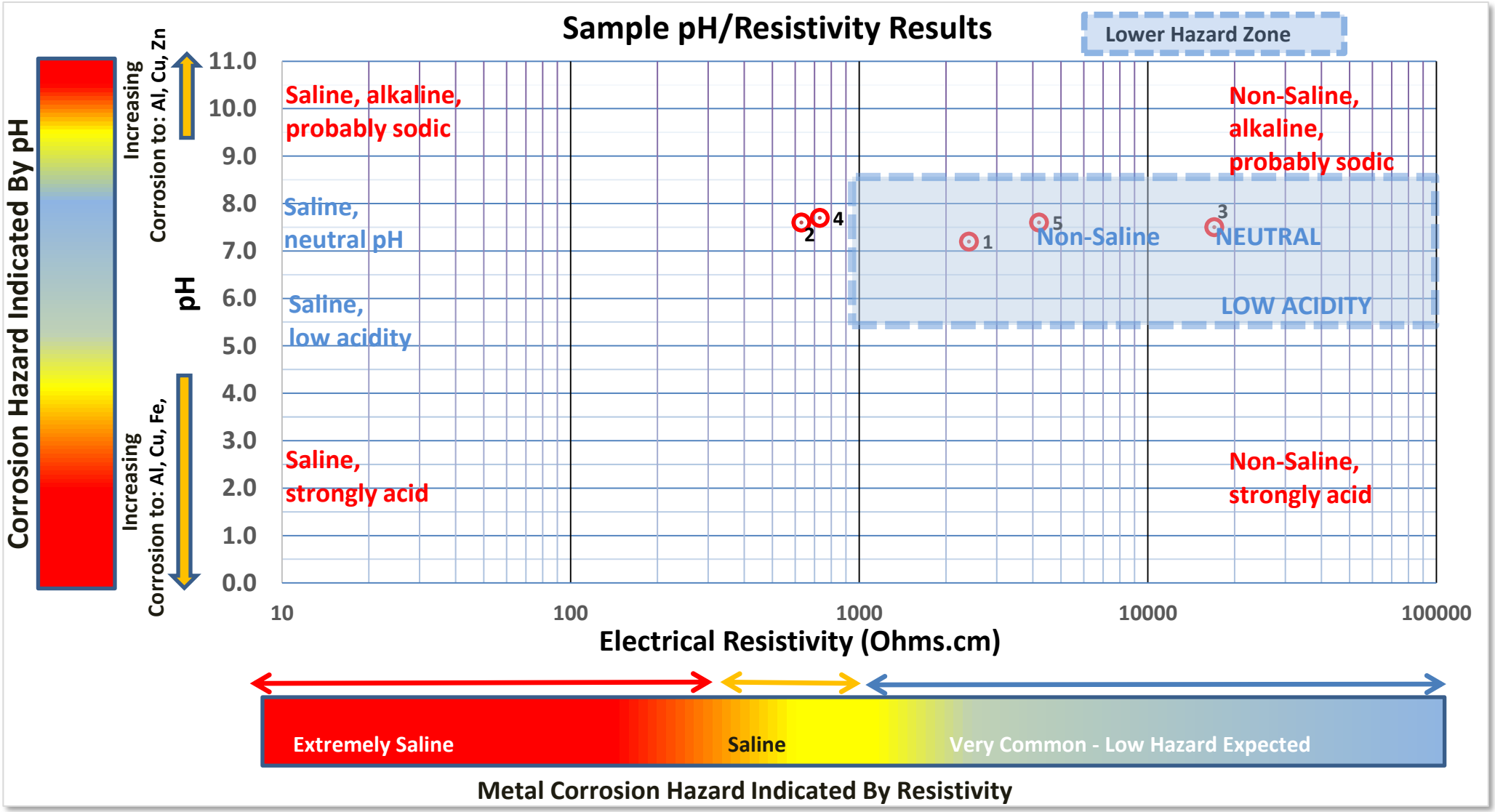
www.biotrack.com.au
781 Mt Glorious Rd Highvale 4520

Certificate of Analysis

Signatory:

Phone: +617 3289 7179 Bio-Track Pty Ltd ABN 91 056 237 275

Test Code/Name	[15] Aggressive Soil Suite #1 for AS2159 Piling Code		
Lab Reference (LR)	090922.465	Client Name	Construction Sciences Pty Ltd
SampleID(s)	(As Listed)	Client Contact	Joseph Brittain
		Project Name	Mackay Base Hospital - P Block Expansion



CERTIFICATE OF ANALYSIS

Analysis By: Bio-Track Pty Ltd
ABN 91 056 237 275
Mt. Glorious Road
Highvale, Brisbane, Australia, 4520
Ph. 07 3289 7179 Fx. 07 3289 7155

DATE OF REPORT 19 SEPTEMBER 2022 Page 1 of 1 Report Pages.
CLIENT NAME Joseph Brittain c/o Construction Sciences Pty Ltd
CLIENT ADDRESS 101 High Street North Rockhampton 4701
PROJECT NAME Mackay Base Hospital - P Block Expansion YOUR PROJECT/JOB REFERENCE 2128E.P.1330
SAMPLING DATE NUMBER OF SAMPLES 5 SAMPLE TYPE:Soil/Solid
PACKAGING Plastic Bag ** SAMPLES DISPOSED ON 8/11/2022
DATE RECEIVED 9/09/2022 11:05:59 AM LAB REF. LR090922.465

METHODOLOGY: EC Cl as 1:5, pH 1:2.5; air dried soil in water, 30 minute rolling shake, Cl by ion selective electrode. S as 1:40 IN KCl extract measured by ICP OES. RESIS:soil resistivity per AS1289.4.4.1 SO4 calculated as S x 3 SO3 calculated as S x 2.5

SAMPLE ID m depth	EC dS/m	pH	Cl mg/kg	S mg/kg	SO4 %	SO3 %	RESIS ohm-cm
BH01 10-10.45	0.04	7.2	1	<1	<0.1	<0.1	2400
BH02 11.5-11.95	0.03	7.6	<1	40	<0.1	<0.1	630
BH03 10-10.45	0.03	7.5	<1	<1	<0.1	<0.1	17000
BH03 11.5-11.95	0.02	7.7	<1	<1	<0.1	<0.1	730
BH05 11.5-11.95	0.02	7.6	<1	<1	<0.1	<0.1	4200

Signatory

For and behalf of Bio-Track Pty Ltd

Construction Sciences

Construction Sciences Pty Ltd
ABN 74 128 806 735

2 Progress Drive
Paget QLD 4741
Australia

PO Box 6735
Mackay MC QLD 4741
Australia

Phone: 61 7 4952 4750

www.constructionsciences.net

Report on
pH_{fox} Field screen

CLIENT: Construction Sciences Rockhampton Engineering PROJECT #: 5683/P/5231

ADDRESS: 7 Lawson St, Parkhurst Qld 4702

PROJECT**:** Conrad Gargett - Mackay Hospital-GI

DATE TESTED: 06/09/22 TESTED BY: GP

TEST REQUEST: 5676/T/51628

MATERIAL: Existing DATE SAMPLED: 18/08/22

SAMPLING LOCATION: Refer Below SAMPLING METHOD:AS1289.1.2.1 Cl 6.5.3

SAMPLED BY: JB

REPORT NO: 5676/R/208414 DATE OF REPORT: 07/09/22

Sample No:	Location:	pH	pH_{fox}	Hydrogen Peroxide Reaction
5676/S/208414	BH04 : 0.00 – 0.25m	7.47	4.89	Slight
5676/S/208415	BH04 : 0.25 – 0.50m	7.64	4.97	Nil
5676/S/208416	BH04 : 0.50 – 0.75m	7.53	5.27	Slight
5676/S/208417	BH04 : 0.75 – 1.00m	7.64	5.63	Nil
5676/S/208418	BH04 : 1.00 – 1.25m	7.58	5.77	Slight
5676/S/208419	BH04 : 1.25 – 1.50m	7.57	5.21	Slight
5676/S/208420	BH04 : 1.50 – 1.75m	7.74	5.77	Volcanic
5676/S/208421	BH04 : 1.75 – 2.00m	7.60	5.15	Slight
5676/S/208422	BH04 : 2.00 – 2.25m	7.66	6.04	Moderate
5676/S/208423	BH04 : 2.25 – 2.50m	7.46	6.49	Volcanic
5676/S/208424	BH04 : 2.50 – 3.00m	7.15	6.73	Volcanic
5676/S/208425	BH04 : 3.00 – 3.50m	7.29	6.84	High
5676/S/208426	BH04 : 3.50 – 4.00m	7.50	7.31	High
5676/S/208427	BH04 : 4.00 – 4.50m	7.44	7.29	High
5676/S/208428	BH04 : 4.50 – 5.00m	7.46	6.63	Moderate
5676/S/208429	BH04 : 5.00 – 5.50m	7.50	7.15	High
5676/S/208430	BH04 : 5.50 – 6.00m	7.55	7.39	Volcanic
5676/S/208431	BH04 : 6.00 – 6.50m	7.43	7.41	High
5676/S/208432	BH04 : 6.50 – 7.00m	7.36	7.12	High

Remarks:

Approved Signatory: Craig Goss

Located across Australia and New Zealand

QLD
Airlie
Beenleigh
Brisbane (Acacia Ridge)
Brisbane (Beenleigh)
Brisbane (Brendale)
Brisbane (Petrie)
Cairns
Emerald
Gladstone
Gold Coast
Mackay
Moranbah
Rockhampton
Petrie
Sunshine Coast
Toowoomba
Townsville

NSW
Ballina
Coffs Harbour
Grafton
Lynwood
Newcastle
Sydney (Glendenning)
Sydney (Seven Hills)
Sydney (St Peters)
Taree
Wollongong

VIC
Ararat
Bendigo
Echuca
Melbourne (Chadstone)
Melbourne (Keysborough)
Melbourne (Pakenham)
Melbourne (Oaklands Junction)
Melbourne (Sunshine West)
Traralgon

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T 07 3844 5900

Design Brief

Mackay Hospital Expansion

Prepared for: Besix Watpac (QLD) Pty Ltd

Document No: NA230008

Revision No: Revision 4

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Revisions

Revision	Description	Date	Prepared by	Approved by
0	Information	07.10.23	MB	JN
1	Information	13.10.23	MB	JN
2	Information	02.11.23	MB	JN
3	Information	17.11.23	MB	JN
4	SD Milestone	06.12.23	MB	JN

Table of Contents

List of Tables

1 Introduction

Block P development is located between blocks A and F on a presently landscaped section of the existing hospital site. It comprises 4 storeys of habitable spaces plus 1 storey of plant with a roof level heliport.

A future proofing provision of additional levels on the northern wing has been allowed.

The following report summarises design criteria and input for design of structural components of the Mackay Hospital Expansion Project.

2 References

AS1170.0-2002 Structural design actions – General principles

AS1170.1-2002 Structural design actions – Permanent imposed and other actions

AS1170.2-2021 Structural design actions – Wind actions

AS1170.4-2007 Structural design actions – Earthquake actions

AS2159-2009 Piling – Design and installation

AS2312.1-2014 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings – Paint coatings

AS2312.2-2014 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings – Hot dip galvanizing

AS2670.1-2001 Evaluation of human exposure to whole-body vibration – General requirements

AS2870-2011 Residential slabs and footings

AS3600-2018 Concrete Structures

AS3610-1995 Formwork for concrete

AS3700-2018 Masonry structures

AS4100-2020 Steel structures

AS4600-2018 Cold-formed steel structures

AS5131-2016 Structural Steelwork – Fabrication and erection

Australian Building Codes Board *Handbook of Structural Robustness*

Smith et al (2009) *Design of Floors for Vibration: A New Approach,* Steel Construction Institute, UK

3 Importance Level

The building is designed for Importance Level 4 (IL4) and is required to perform a post-disaster function.

4 Design Life

Design life of the structure is to be 50 years.

5 Loading

5.1 Superimposed Dead Loads

5.1.1 Roofing and Ceilings

The following allowances have been made regarding the roofing and ceiling construction for the proposed building; noting that in general the roof structures are concrete suspended slabs for which reference should be made to Section 5.1.2. The ceiling construction of each section may include:

Table 1 Weight Assumptions

ELEMENT	MAXIMUM ALLOWANCE (WITH MAXIMUM DOWNWIND)	MINIMUM ALLOWANCE (WITH MAXIMUM UPLIFT WIND)
Sheeting	4.9kg/m²	4.9kg/m²
Purlins	12.1kg/m²	6.4kg/m²
Thermal Insulation	5.0kg/m²	0kg/m²
Ceiling:		
Timber (19mm)	20 kg/m²	10 kg/m²
Plasterboard (13mm)	9 kg/m²	9 kg/m²
CFC (9mm)	15 kg/m²	10 kg/m²
Fire rated ceilings (3x16mm layers)	39 kg/m²	39 kg/m²
Roofing extras:		
Sarking	0.35kg/m²	0.35kg/m²
Electrical	5.0kg/m²	0kg/m²
Roof PV panel allowance	25kg/m²	0kg/m²
A/C ductwork	20 kg/m²	0 kg/m²
Operable walls typically	46 kg/m² (wall height)	0 kg/m²

All roofs to have an allowance for future PV panel installation.

The various ceiling elements have been combined to provide the following general SDL allowances for different categories of ceiling construction:

Table 2 SDL Roof Allowances

AREA CATEGORY	MAXIMUM ALLOWANCE (WITH MAXIMUM DOWNWIND)	MINIMUM ALLOWANCE (WITH MAXIMUM UPLIFT WIND)
Basic roof without architectural ceilings over (plant)	0.75kPa	0.3kPa
Basic roof with architectural ceilings over (Wards/Consulting Suites)	0.75kPa	0.3kPa
Architectural ceiling	0.75kPa	0.3kPa
Fire rated ceiling	0.9kPa	0.5kPa
External eaves	0.75kPa	0.3kPa

5.1.2 Floors (on grade and suspended)

The following allowances are made for superimposed dead loads on floors

Table 3 SDL Floor Allowance

AREA CATEGORY	ALLOWANCE
Partitions, services and floor coverings (generally including access floors)	1.0kPa
Toilet areas (75mm grout/tile)	1.8kPa
Stairs	N/A (no finishes)
Plant/comms (plinths)	1.2kPa
External topping slab (average 100mm)	2.4kPa

Refer loading plan drawings.

5.2 Cladding and facades

External facades will be applied to the analysis models as loads on structural elements.

CLADDING TYPE	ALLOWANCE
Precast concrete	22kN/m
Blockwork (190mm thick)	15kN/m
Lightweight	5kN/m

5.3 General live loading

Live loading allowances are taken from AS1170.1. The following allowances are made for general live loads on floors based on the following architectural building area designations:

Table 4 General Live Loads

AREA CATEGORY	ALLOWANCE	
	UNIFORMALY DISTRIBUTED LOAD	POINT LOAD
Birthing Suites	3.0kPa	2.7kN
Maternity/Day Assessment Unit	3.0kPa	2.7kN
Neonatal	3.0kPa	2.7kN
Consulting Suites	3.0kPa	2.7kN
General office	3.0kPa	2.7kN
Bathroom areas	2.0kPa	1.8kN
Stairs	4.0kPa	4.5kN
Plant	5.0kPa	4.5kN
Communications / Server room	5.0kPa	4.5kN
Circulation areas (pedestrian only)	4.0kPa	4.5kN
Store rooms	5.0kPa	4.5kN
Compactus	10.0kPa	7.0kN
Roofs	0.25kPa	1.4Kn
Helipad	Loads from helipad TBC from supplier (including reactions from helipad structure, attached equipment, tank loads, and helicopter loads). Provisional allowance of 15kPa has been used in concept design	

Consideration of specific loads such as safes, birthing baths, patient hoists etc will be taken into account once the room layouts are finalised. This will include equipment travel paths for installation.

Refer Appendix A for floor loading diagrams.

5.4 Wind Loads

5.4.1 Basic wind pressures

As per NCC Table B1.2b Design Events for Safety:

- Annual probability of exceedance for ULS wind pressures = 1/2000
- Annual probability of exceedance for SLS wind pressures = 1/25.

Regional wind speeds calculated using "AS1170.2 Structural Design Actions Part 2: Wind Actions", for an annual probability of exceedance of 1/2000 in a Cyclonic region "C", results in a regional wind speed of 72m/s

On inspection of the surrounding topography, the site has been assessed to have a hybrid terrain category based on areas of TC3 from the south-east direction, and TC2 from any other direction. A $M_{z,cat}$ of 0.95 and a $M_{z,cat}$ of 1.08 has been calculated respectively from AS1170.2 based on these terrain categories.

Assuming shielding and topographical factors = 1.0 (refer AS1170.2), the following basic pressures have been used for ultimate and serviceability limit states (assuming AS1170.2 loading):

Table 5 Ultimate Limit State Wind Pressures

BUILDING	IMPORTANCE LEVEL	AVERAGE ROOF HEIGHT (m)	ULS					
			R	$M_{Z.CAT}$	M_c	V_R (m/s)	V_{ULS} (m/s)	q_{ULS} (kPa)
Main Building (TC=3)	4	21	2000	0.95	1.05	72	64.6	2.5
Main Building (TC=2)	4	21	2000	1.08	1.05	72	73.5	3.2

Table 6 Serviceability Limit State Wind Pressures

BUILDING	IMPORTANCE LEVEL	AVERAGE ROOF HEIGHT (m)	SLS					
			R	$M_{Z.CAT}$	M_c	V_R (m/s)	V_{SER} (m/s)	q_{SER} (kPa)
Main Building (TC=3)	4	21	25	0.95	1.05	47	42	1.1
Main Building (TC=2)	4	21	25	1.05	1.05	47	48	1.4

Note that M_d = 0.90 in the reporting of these basic pressures.

5.4.2 Internal wind pressure coefficients

Building envelopes in cyclonic regions are normally required to be designed to withstand impact from windborne debris, or alternatively, designed to withstand large internal pressures if the envelope is compromised.

The building will be designed for “dominant opening” internal pressures under ultimate limit states, but “normal” internal pressures for the serviceability limit states. This is recommended in “Design Guidelines for Queensland Public Cyclone Shelters” by the Queensland Government Department of Public Works.

The internal wind pressure coefficients are tabulated below:

Table 7 Internal Wind pressure Coefficients

SELECTED METHODOLOGY	WIND PRESSURE COFFICIENT
Design building for dominant internal pressures in addition to main building fabric	+0.7 and -0.65
Design building assume no dominant openings due to building fabric	+0.2 and -0.30

5.4.3 External wind pressure coefficients

The following code clauses are used in the determination of external wind applied to buildings:

Table 8 External Wind Pressure Codes References

Wind Component	WIND PRESSURE COFFICIENT
Windward wall	Table 5.2(A)
Leeward wall	Table 5.2(B)
Side wall	Table 5.2(C)
Roofs	Table 5.3(A)
K_a (applied to major elements)	Table 5.4
K_c (applied to major elements)	Table 5.5
K_l (applied to purlins and girts)	Table 5.6
Pressures to internal walls and ceilings	Table 5.3.4
Pressures under eaves	Similar to those at adjacent walls

5.4.4 Free roofs and awnings

Attached awnings (regardless of size) are to be designed to Appendix D4 of AS1170.2 for pressures perpendicular to the roof surface. Drag coefficients are calculated in accordance with Appendix E and friction is calculated for both surfaces in accordance with Table D3.

Free roofs are to be designed to Appendix D3 of AS1170.2 for pressures perpendicular to the roof surface. Drag coefficients on members are calculated in accordance with Appendix E and friction is calculated for both surfaces in accordance with Table D3.

5.4.5 Exterior-mounted Mechanical, Electrical and Communications Equipment

Any proprietary roof mounted equipment will need to be nominated by the manufacturer to suit the elevated wind speeds appropriate to Mackay Hospital as noted in this report. It is also noted that it is unlikely that this equipment

will be debris resistant, so an operations plan will be required to be developed by stakeholders to account for potential debris damage during a storm event.

5.4.6 Internal Partitions and Ceilings

Internal partitions must be designed by specialist suppliers with consideration of higher internal pressures. The design pressures have been provided for specialist design.

Internal glazing heads are to be provided where required.

5.5 Earthquake Loading

The following earthquake design criteria have been assessed in accordance with AS1170.4:2007 Structural design actions Part 4: Earthquake actions in Australia.

As the facility is required to be serviceable following a major disaster, the building's seismic design will consider two performance requirements:

5.5.1 Life Safety Earthquake:

The structure is designed for a major earthquake with an annual probability of exceedance of 1:1500. The primary design objective is to avoid loss of life and total or partial collapse is to be prevented. It is expected that following the event, the building will suffer extensive damage including permanent plastic deformations and may ultimately require demolition.

Table 9 Life Safety Earthquake

LIFE SAFETY EARTHQAUKE	
Annual probability of exceedance	1/1500
Probability Factor, k_p:	1.5
Hazard Factor, Z:	0.08
Site Subsoil Class:	Ce*
Earthquake Design Category:	II
Structural Ductility Factor	3
Structural Performance Factor	0.67

*to be confirmed following geotechnical investigation

The new building should be separated from the existing building by 1% of the structure height for to satisfy section 5.5.5 of AS1170.4 for pounding effects.

The "inter-storey drift at the ultimate state shall not exceed 1.5% of the storey height" (section 5.5.4 from AS1170.4).

5.5.2 Serviceability Design Earthquake:

For an IL4 building, the design serviceability earthquake will have an annual probability of exceedance of 1:500 years. Following such an event, the Hospital is to remain fully operational. To ensure immediate occupancy and ongoing operation of the centre following a 1:500 year seismic event the design drift for the serviceability design earthquake will be limited to 0.8% (as recommended in the Commentary to AS1170.4) and all structural elements designed to remain elastic.

Table 10 Serviceability Design Earthquake

SERVICEABILITY DESIGN EARTHQUAKE	
Annual probability of exceedance	1/500
Probability Factor, k_p:	1.0
Hazard Factor, Z:	0.08
Site Subsoil Class:	Ce*
Earthquake Design Category:	II
Structural Ductility Factor	1
Structural Performance Factor	0.77

*to be confirmed following geotechnical investigation

The building and its components are to be designed to meet the requirements of AS 1170.4:2007 Structural Design Actions Part 4: Earthquake actions in Australia. Non-structural parts and their components and their fastenings that are not shown on structural drawings are also to be designed in accordance with Section 8 of AS1170.4. These items include but are not limited to:

- Façade elements.
- Non-structural walls and partitions
- Ceilings and bulkheads
- Furniture
- Mechanical and Electrical components

6 Design Philosophies

6.1 Framing and stability

6.1.1 Foundations

The results of a site-specific geotechnical investigation are still awaited. It is understood that adjacent buildings have been constructed on CFA piles.

6.1.2 Ground Slab

The results of a site-specific geotechnical investigation are still awaited. Ground floor slabs are expected to be slab on ground construction. It is expected that some removal and replacement of uncontrolled fill will be required.

6.1.3 Suspended floors – Levels 1 to Roof

All structural floors within the building are expected to be flat plate reinforced concrete slabs with edge beams to support the precast concrete facade loads.

To allow for future proofing, some slabs are designed to support the construction of the proposed levels over while maintaining use of the levels below (i.e. to negate the need for back-propping). Refer to Section 8.

Where pour depths exceed 270mm safety mesh will be documented for any situation where the top layer of reinforcement is spaced at greater than 200mm centres.

6.1.4 Vertical Elements

The vertical structure of the building will be reinforced concrete columns and walls supporting the floor structure.

All columns will typically be 600 SQ. To maximise room space available part of the concrete façade on the lower two levels could be used as load bearing elements. Lift and stair core walls are typically 350mm thick reinforced concrete.

6.1.5 Lateral Stability

Reinforced concrete walls will provide the building with adequate resistance to lateral loading from wind and seismic events. Specific sway criteria for seismic events have been discussed previously in Section 5.5.

6.2 Serviceability Deflections

In general, the floor slabs are designed for a 1:300 span to deflection ratio. Overall deflections are also limited to prevent issues with the facade and partition walls. The deflection that occurs after the addition or attachment of finishes will be limited to 1:500. Deflection limitations for cantilevers will be half the values stated above.

6.3 Durability

Durability of the concrete structure will be designed in accordance with Section 4 of AS3600. Internal concrete will be exposure classification A2 and external concrete will be exposure classification B1.

Paint systems on internal steel structures to have 15-25 years to first maintenance based on corrosion category C1 in accordance with AS2312.1. Minimum coating requirement to be 75μm zinc phosphate primer plus 50μm two-pack acrylic. External steel work to be hot dip galvanised in accordance with AS2312.2 and AS4680.

6.4 Fire

The building structure will be designed for a fire resistance level (FRL) of 120/120/120 on the basis of a Class 9 building in accordance with the NCC.

7 Geotechnical

A site-specific geotechnical investigation is to be undertaken to provide input into the seismic analysis and footing design for the building.

8 Future Expansion

The building is designed for future expansion of the northern wing, with the additional of two extra levels (reference ACONEX correspondence XBURO-GCOR-000333). The location of the proposed expansion is the northern wing at Grids F to H and Grids 10 to 21. The extent of future expansion allowed is shown on the loading drawings.

The footings, bracing and lateral elements for this building are designed to allow for this expansion.

The roof slab(s) below the location of the future expansion are designed for construction activities such that back-propping is not required through the existing levels for the proposed future expansion.

9 Rooftop Helipad

The helipad will be a proprietary design by a specialised contractor. An allowance for the loading from the helipad has been allowed for (refer Section 5.3). These loads will be confirmed once the helipad design is completed (reference ACONEX correspondence PSNK-CADV-000014 and PSNK-CADV-000007).

10 Robustness and Progressive Collapse

Reference is made to the “Handbook of Structural Robustness” published by the Australian Building Codes Board. The Certifier has confirmed that there are no unusual risks that are not covered by the Australian Standards, and that therefore a Deemed to Satisfy (DTS) solution is adequate to meet the level of robustness required for this building (reference ACONEX correspondence BWTP-RFID-000134).

11 Floor Vibration Criteria

The vibration performance of the floor slabs has been evaluated in accordance with AS2670.1 (which is equivalent to ISO2631).

The design of the floor slabs has targeted a Response Factor of 1.4 for a night ward (reference ACONEX correspondence BWTP-RFID-000134).

The evaluation has been undertaken in accordance with the recommendations in the following publication:

Smith et al (2009) *Design of Floors for Vibration: A New Approach,* Steel Construction Institute, UK

The following parameters were used:

- Load case 1.0G + 0.7Q for the natural frequency calculations
- Weight of person = 85kg mass
- Load frequency = 1.8Hz
- RMS acceleration = 0.005 m/s/s
- Damping ratio = 3%

Yours faithfully,
ACOR CONSULTANTS PTY LTD

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21/07/2023

Besix Watpac
470 St Pauls Terrace
Fortitude Valley
QLD 4006

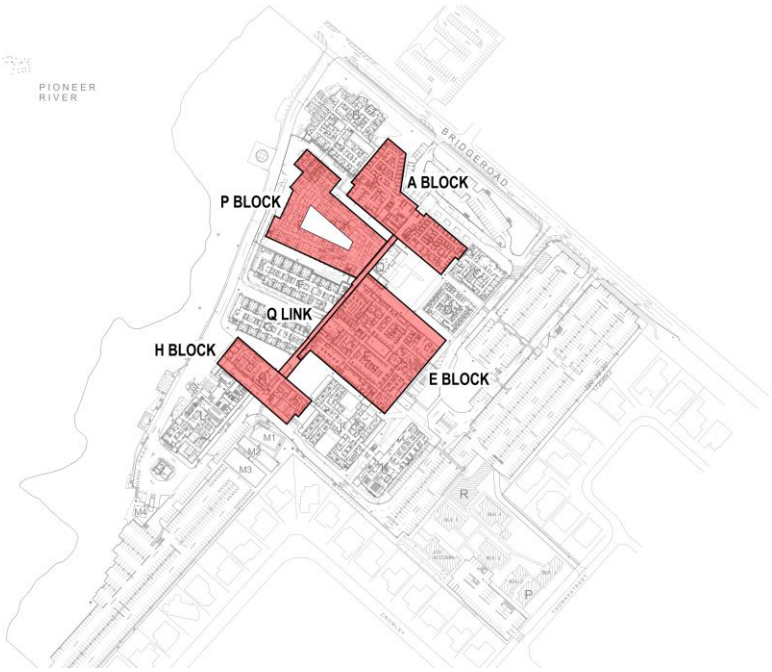
Attention: Mark Michaelis

Dear Mark

Re: Mackay Hospital Expansion – Geotechnical Brief

This letter outlines a geotechnical brief that can be used to obtain fee proposals for a site investigation.

The geotechnical investigation is to inform the design of a proposed new building (P Block) at the Mackay Base Hospital. The project consists of a 4 storey building with an internal courtyard (refer part site plan below).



It is anticipated that the building will be supported on piles. The magnitude of working loads for the piles is in the order of 12,000kN. It is also expected that some piles will need to resist significant tension loads due to seismic and wind considerations.

We will require the scope of works to include assessment of groundwater levels. Boreholes should include RL of the ground level. Previous geotechnical information indicates rock depths up to 30m in this location. Borehole depths must be sufficient for the design of piles socketed into the rock to achieve the expected loads.

Could you please prepare as a separate item a fee proposal for an acid sulphate management report for consideration by the client.

We will require your scope of works to include, but not be limited, to the following items:

- Site Classification to AS2870 for footing design and plumbing fixture design
- Site Sub-Soil Class to AS1170.4 – 2007, Section 4
- Recommended foundation type(s)
- Bearing pressure on the founding strata
- Predicted ground surface movement ‘Ys’
- Founding Levels
- Predicted settlement
- Suitable reuses of cut material
- Compaction Standards
- Stripping Depths
- Trafficability
- Excavatability
- Temporary safe batter angles for cuts
- Fill batter slopes
- Pile type recommendations along with design parameters
- Retaining wall design parameters
- CBR
- Emerson class for top 2m of material (for erosion and sediment control)
- Topsoil depth

The figure below shows the proposed borehole layout. The final layout may need to be adjusted for any site obstructions etc.

Yours faithfully,
ACOR CONSULTANTS PTY LTD

Michael Bugeja
Senior Structural Engineer