Geotechnical Investigation Report - Scobies Lane, Oakhampton Heights

MCC 2023/24 Capital Works Program

304100979-005

Prepared for
Maitland City Council

6 December 2023

Stantec

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1 Introduction

This report presents the findings of a geotechnical investigation undertaken by Stantec Australia Pty Ltd (Stantec) (*formerly Cardno*) for a proposed flood access road and adjoining road sections located in proximity to Scobies Lane, Oakhampton Heights. The investigation was undertaken in general accordance with Stantec's proposal (ref. 3041-FY23-041-001-v1.3, dated. 14 November 2022), commissioned by Babita Subedi of Maitland City Council (MCC).

MCC have provided concept design plans including design long sections (ref. 4105-PPI, rev. A, date. 02.11.22) for a proposed flood access road and minor upgrades to short sections of existing Scobies Lane, S Willards Lane and Oakhampton Road pavement sections (tie-in sections). Based on the supplied plans, MCC are considering the construction of a new flood access road and reconstruction/rehabilitation to the existing tie-in sections, which forms part of the MCC 2023/24 Capital Works Program. The proposed works are understood to comprise the following:

- Construction of new approximately 730m long flood access road, including embankment and pavement construction, linking Oakhampton Rd to the Scobies Lane / S Willards Lane intersection.
- Pavement rehabilitation / reconstruction of the existing tie-in sections of Scobies Lane, S Willards Lane, and Oakhampton Rd.
- Construction of related civil infrastructure.

The investigation was undertaken to obtain geotechnical and environmental information on surface and subsurface conditions to the proposed flood access road and adjoining sections of pavement as a basis for the following comments and recommendations:

- Existing pavement performance based on surface and subsurface condition.
- Evaluation of the existing subsurface / subgrade conditions within the proposed flood access road alignment and existing pavement sections footprints.
- Recommendations for earthwork procedures and guidelines.
- Preliminary acid sulfate soil assessment.
- Preliminary ENM / Waste Classification assessments.
- Pavement thickness design for the proposed flood access road and adjoining pavement sections.

2 Desktop Review

2.1 Existing Flood Control Levee

The following information was supplied by the client for review in relation to the existing Maitland Power House Control Structure (flood control levee) which is situated immediately south of the proposed flood access road at Ch 0-450m:

- Surveyed cross section plans from 1985 showing the levee profile;
- Preliminary rehabilitation design plans (not dated) showing the levee layout and proposed cross section (it is not known if the levee was rehabilitated as per this design); and
- Email from floodplain engineer from Department of Planning and Environment dated 9/12/2022, providing some high level history of the levee design and maintenance.

Additionally, a geotechnical investigation report by NSW Public Works (1990) [1] was sourced online from MinView [2], which provided limited details from three hand excavated pits through the levee, seemingly following breach of a section of the wall (not confirmed in the report).

The limited information available for review and discussions with the client indicates the following.

- The levee is designed to slow the velocity of north to south overland flows during major flood events, and protect developed areas located further south.
- The levee was originally designed in 1964, and rehabilitated in 1998.
- There does not appear to be discrete spillway locations along the alignment, rather the whole levee acts as a spillway during operation.
- The levee is constructed from the following, based predominantly from the 1990 geotechnical investigation (plan extract from separate works provided in Figure 2-1):
  - A central core comprising low plasticity sandy silt to clayey silty sand materials, with in-situ compaction at ≥85% modified compaction;
  - Filter zone consisting of poorly graded, fine to coarse gravel, 250 to 300mm in thickness;
  - Coarse filter zones consisting of predominantly boulder sized material, with maximum particle sizes generally in the order of 400 to 800mm; and
  - Reno mattresses, 500 mm thick, provided to the crest and down gradient (southern) batter surfaces (presumably placed in 1998 rehabilitation), tied down through a system of cables and concrete anchor blocks.

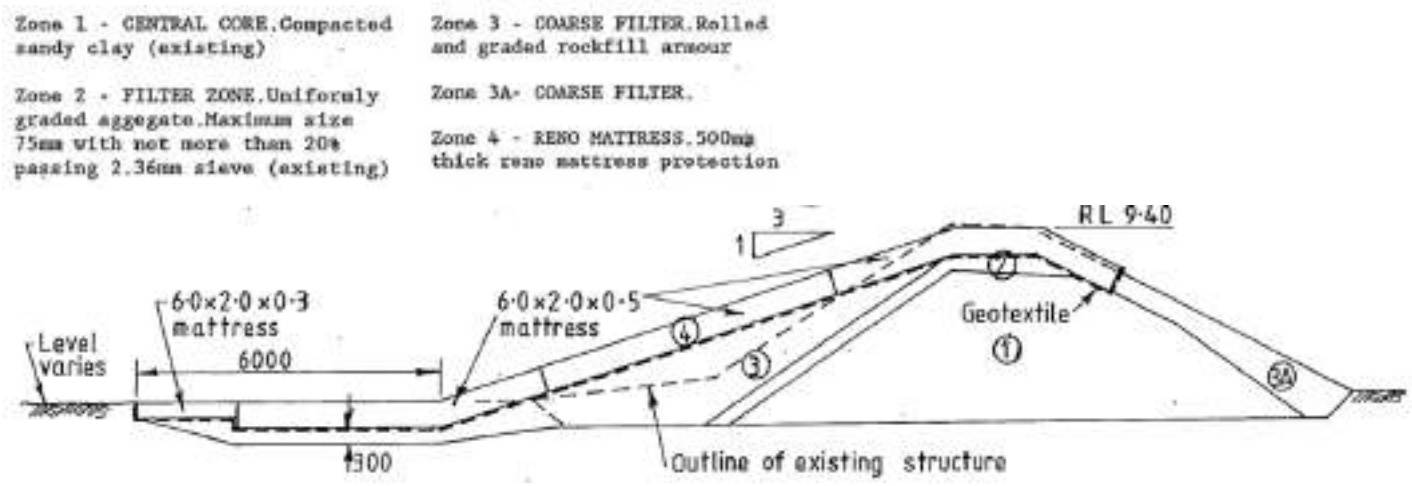

Figure 2-1 Typical spillway section (extract from proposed rehabilitation plan)

2.2 Published Data

2.2.1 Soil Landscape Maps

Review of the Office of Environment and Heritage, Electronic Soil Profiling Maps V2.2 [3] indicates the proposed flood access road alignment and adjoining road sections work areas spans the *Hunter* (9232hu and 9232hub) landscape along Oakhampton Rd and Ch. 0 to 510 of the proposed flood access road, with S Willards Lane, Scobies Lane, and Ch. 510 to 820m of the flood access road located in the *Bolwarra Heights* (9232bh) landscape.

The *Hunter* soil landscape is known to comprise extensive floodplains on Quaternary alluvial soils derived from the Hunter and Paterson rivers, composed of clay, silt and sand to depths in excess of 40m. Topography is known to be predominantly level with slope gradients typically <1%, and elevations commonly 2 to 4m.

The *Bolwarra Heights* soil landscape is known to comprise rolling low hills on sandstone, siltstone and conglomerate of the *Branxton Formation*. Topography is known to comprise rolling low hills and narrow, incised drainage lines, with predominant slope gradients of 5 to 10%, occurring at elevations of 40 to 100m.

2.2.2 Acid Sulfate Soils

Review of acid sulfate soils (ASS) risk maps for the Oakhampton Heights area indicates that Oakhampton Road and approx. Ch. 0 to 450m of the proposed flood access road is situated within an area mapped as having a low probability of ASS occurrence, generally at depths greater than 3m below ground surface. The remainder of the site (approximate Ch. 450 to 820m) is not situated within a mapped ASS risk area.

2.2.3 Regional Geology

Review of the New South Wales Seamless Geology dataset [2] indicates the proposed site area spans multiple geological formations and deposits.

Approximate Ch. 0 to 450m of the proposed flood access road alignment is underlain by various Quaternary-aged alluvial deposits, typically comprising fluvially deposited sand, silt, clay and gravel materials.

A minor portion of the alignment to the south-west (approx. Ch. 450m) is underlain by anthropogenic materials, mapped as comprising a range of generally coarse fragments including large concrete blocks, quarried cobbles and boulders.

Approximate Ch. 450 to 820m of the proposed flood access road is underlain by the *Mulbring Siltstone (*Pmtm) formation of the Maitland Group, known to comprise predominantly siltstone and claystone rocks and soils formed from decomposition of these rocks.

The approximate site bounds are shown overlaid onto the regional geology extract in Figure 2-2 below.

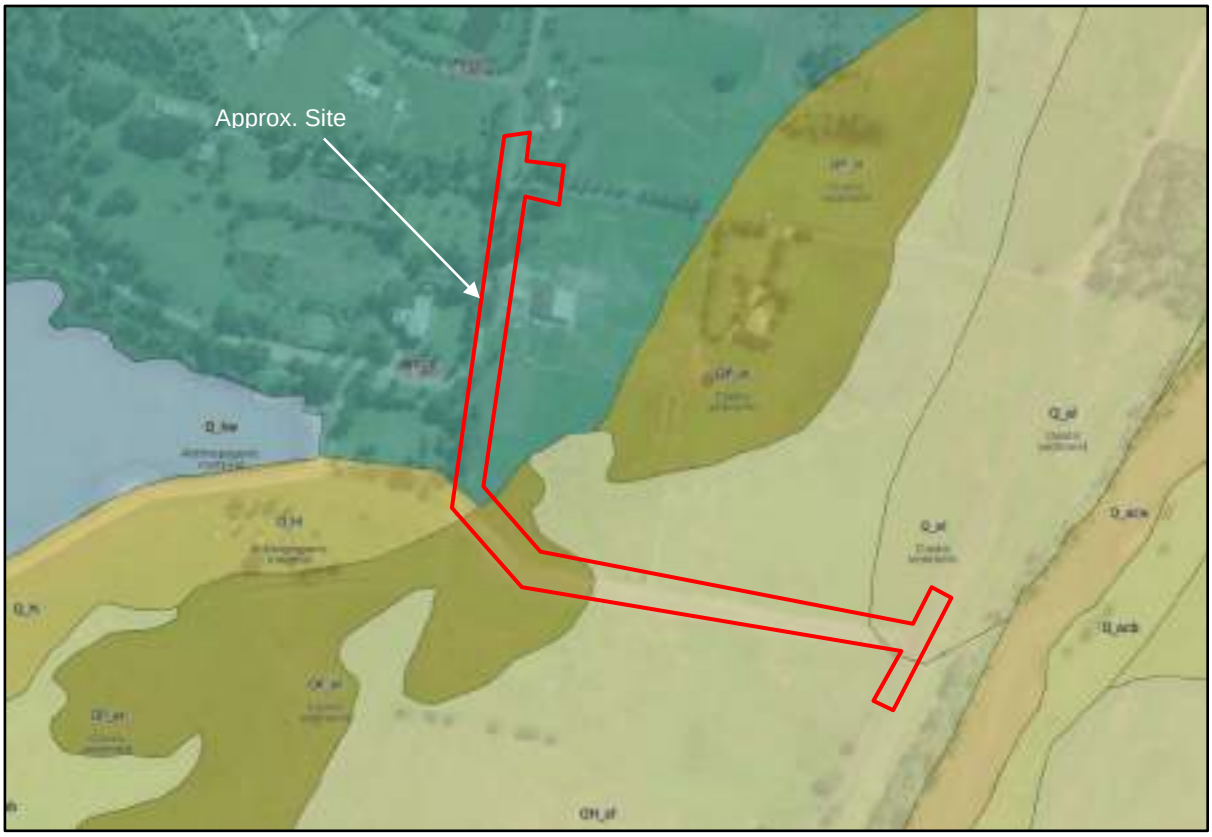

Figure 2-2 NSW Seamless Geology extract (site denoted by red outline)

3 Site Description

The proposed flood access road is located in Oakhampton Heights, with the 820m long alignment commencing on Oakhampton Road in the east and extending west and north for approximately 750m (Ch.0 to 750m), before transitioning into the existing Scobies Lane and South Willards Lane pavement sections (Ch. 750-820m).

Land use of the proposed alignment and surrounds generally comprises; improved and unimproved pasture used for horse grazing along the majority of the alignment, large lot residential development to the north-west, and the former Walka Waterworks facility to the west, now utilised as a public recreational area.

Topographically, the proposed alignment spans a predominantly level alluvial floodplain to the south and east of the alignment, associated with the nearby Hunter River to the east, with the western to northern portion of the alignment is situated on footslopes of gently undulating terrain. Site slopes from elevated site areas in the west and north-west typically fall to the east towards the alluvial floodplain area and intersecting gully line. Drainage to the site is generally expected to follow the existing site slopes towards the gully line and alluvial flood plain, and ultimately to Hunter River located closely to the east.

Figure 3-1 Site locality

The following features were observed during the investigation.

- Vegetation to the site comprised long grass and maintained grass within smaller confined paddocks, with isolated semi-mature trees noted in proximity to the S Williams Lane / Scobies Lane intersection.
- North-east trending gully line intersecting the proposed alignment at approx. Ch. 400, noted to be dry in condition at time of investigation.
- General pavement condition along the existing road sections proposed to adjoin the flood access road is shown in below figures and described in Section 5.1.1.

> Flood control levee constructed from rock fill extending east-west, parallel to the proposed alignment, extending from Oakhampton to the former Walka Waterworks pumping station. Rockfill levee noted to comprise:
  - Reno mattress lining, with cable and concrete post tie-down support.
  - Rockfill consisted of rounded, cobble to boulder sized material.
  - Embankment height predominantly from 0.5 to 1.5m, with heights in excess of 2m where levee spans the existing gullies.
  - Batter angles to the flood levee were generally in the order of 2H:1V on the northern side, and approx. 5H:1V on the southern side.

> Existing small diameter culvert identified below the rockfill levee at approximately Ch. 180 of the proposed alignment, with culvert noted to be partially blocked by rockfill.

Figure 3-2 S Willards Lane general view, looking south

Figure 3-3 Oakhampton Rd general view, looking south

Figure 3-4 Scobies Lane general view, looking east

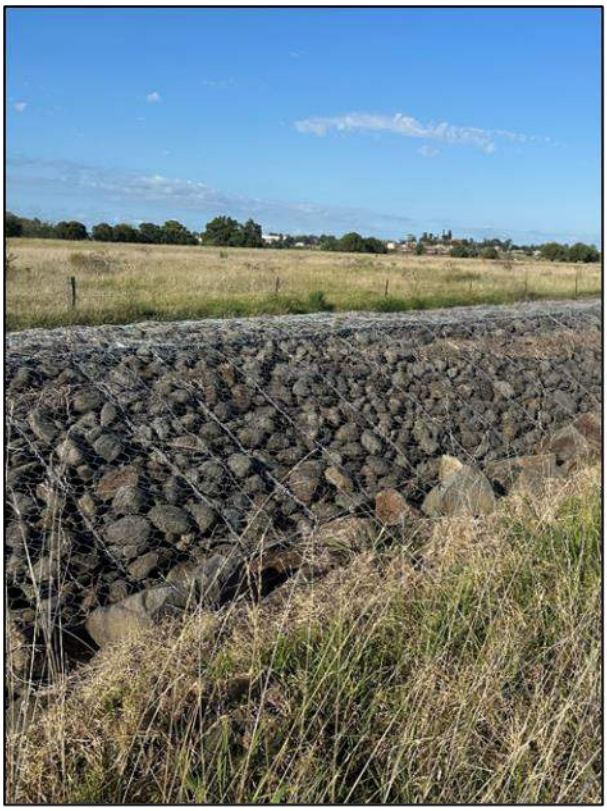

Figure 3-5 Flood control levee, looking east

Figure 3-6 Flood control levee, looking south-west

Figure 3-7 Blocked existing culvert below flood levee

4 Investigation Methodology

4.1 Site Investigation

Site investigation was undertaken on 5 and 8 December 2022 and comprised the following:

- Site walkover and visual appraisal to identify site geotechnical features and map existing pavement surface defects.
- Underground service location in proximity to proposed intrusive test locations by an accredited service locator. All bores were positioned with sufficient clearance from any underground assets.
- Boreholes / test bores were located using a handheld tablet with GPS function. It is expected that test location accuracy would be in the order of ± 5m.
- Drilling of seven (7) boreholes (BH01-BH07) with a ute-mounted drilling rig fitted with solid flight augers. Boreholes were advanced to target depths from 2.0 to 6.0m below ground level (bgl) along the proposed flood access road alignment. Refusal on weathered rock was encountered within borehole BH07 at a depth of 1.3m bgl.
- Drilling of five (5) pavement test bores (TB501-TB505) with a mini-excavator fitted with a large diameter solid flight auger. Test bores were drilled to a target depth of 2.0m bgl within the existing road pavement tie-in sections. Refusal on weathered rock was encountered within TB502 at a depth of 1.1m bgl.
- Dynamic Cone Penetrometer (DCP) testing was conducted at the majority of test locations to assess the in-situ soil strength conditions.
- Standard Penetration Testing (SPT) was undertaken at regular intervals within boreholes (BH01-BH07) to assess in situ soil strength conditions and recover subsurface samples.
- Disturbed samples of representative materials were recovered for subsequent geotechnical and environmental laboratory testing.
- All pavement test bores were backfilled with excavation spoil and imported road base material, followed by compaction and reinstatement with cold mix asphalt.

Based on the outcomes of the initial site investigation described above, additional investigation was undertaken on 8 February 2023, comprising Cone Penetrometer Testing (CPT) at five (5) test locations. The CPT locations (CPT01-CPT05) were distributed along the proposed flood access road alignment, conducted to depths ranging from approximately 7.0 to 27.0m bgl, in order to capture a continuous indication of subsurface composition and strength conditions. The CPT's were conducted using a track mounted Geoprobe with a self-anchoring system. A sixth CPT test was attempted, however shallow weathered rock was encountered from 0.8m bgl during anchor drilling and as such no CPT testing was conducted (BH101).

All fieldwork including logging of subsurface profiles and collection of samples was carried out by a geotechnical consultant from Stantec. Subsurface conditions are summarised in Section 5 and detailed in engineering logs of test bores attached in Appendix B.

All test locations are shown overlaid on aerial imagery and client supplied layout plans extracts on Figure F1, attached within Appendix A.

4.1.1 Sampling and Contamination Procedures

The investigation included collection of environmental soil samples for the purpose of preliminary environmental assessment. Environmental sampling was undertaken in accordance with Stantec's standard operating procedures, with sampling data recorded on Chain of Custody sheets. General sampling procedure comprised the following:

- Suitable decontamination of flight augers prior to drilling of test bores.
- Sampling of pavement and subgrade materials from the test bore side wall or from auger returns/cuttings using suitably decontaminated hand tools.
- Cross-contamination prevention by using and changing disposable gloves between each sampling event.
- Decontamination of all sampling equipment using a 3% solution of phosphate free detergent (Decon 90) and tap water between each sampling event.
- Appropriate laboratory supplied containers used for all soil sample storage.

> Recovered environmental samples stored in chilled and insulated containers prior to dispatch to testing laboratory.

4.2 Laboratory Testing

Laboratory testing was undertaken on samples recovered during fieldwork for the purpose of geotechnical and preliminary environmental assessment. All geotechnical testing was conducted at NATA accredited construction materials and chemical testing laboratories.

Results of the laboratory testing is summarised in Section 5.3 below, and detailed in the laboratory report sheets attached in Appendix C.

Laboratory testing comprised the following:

> Three (3) Particle Size Distribution (PSD) tests and four (4) Atterberg Limits tests to assist in subsurface material classification.

> Four (4) four-day soaked California Bearing Ratio (CBR) tests on existing and proposed subgrade materials, including field moisture content and standard compaction testing.

> Four (4) foreign materials and soil chemical tests on samples of existing natural and fill materials at subgrade level, with the following analytes tested:

- Eight heavy metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn).
- Total Recoverable Hydrocarbons (TRH).
- BTEXN (Benzene, Toluene, Ethyl-benzene, Xylenes & Naphthalene).
- Polycyclic Aromatic Hydrocarbons (PAH).

> Two (2) Toxicity Characteristic Leaching Procedure (TCLP) Tests.

> Ten (10) acid sulfate soil (ASS) tests using the field screening method.

> Three (3) detailed ASS tests using the Chromium Reducible Sulphur (SCr) method.

5 Investigation Findings

5.1 Existing Pavements

5.1.1 Pavement Surface Conditions

Observed pavement surface conditions within the tie-in sections of Scobies Lane, S Willards Lane and Oakhampton Rd is summarised below in Table 5-1.

Table 5-1 Existing Pavements - Surface Condition Summary

Road Section	Existing Surface Condition	Pavement Condition / Defect Description
S Willards Lane	Reasonable	Existing S Willards Lane pavement section comprised a spray seal wearing course, and concrete gutter along the NB shoulder only. No significant surface defects were identified along the section of road, outside of edge defects along the SB shoulder associated with the lack of drainage infrastructure / edge support.
Scobies Lane	Poor	Existing Scobies Lane pavement section (Ch. 0 to 82m) comprised a spray seal wearing course with no kerb and gutter along both sides. Observed defects comprised the following: ▪ Significant seal edge breaking along the EB lane shoulder, with former patchwork evident. ▪ Patched potholes within both travel lanes. ▪ Minor rutting and seal flushing along the existing wheel paths.
Oakhampton Road	Reasonable	Existing Oakhampton Rd pavement section (Ch. 0 to 600m) comprised a spray seal wearing course with no kerb and gutter along both sides. Observed defects comprised the following: ▪ Minor isolated potholes observed along the alignment, with patchwork undertaken. ▪ Patched potholes within both travel lanes. ▪ Minor rutting along the existing wheel paths. ▪ No significant edge breaking was observed.

5.1.2 Subsurface Conditions

Subsurface conditions encountered in test bores (TB501-TB505) drilled in the existing pavement profiles within the tie-in sections are summarised below, with detailed engineering logs attached in Appendix B.

> Sprayed seal wearing course (thicknesses / depths provided in Table 5-2 below). Overlying;

> Pavement materials comprising fine to coarse Sandy / Silty Sandy GRAVEL and fine to coarse grained Gravelly SAND, noted to be dry to moist in condition. Evidence of previous overlay pavement construction was observed within test bores along Oakhampton Rd (TB503-TB505). Overlying;

> Granular fill materials comprising fine to coarse grained Gravelly Silty SAND, noted to be moist in condition. Overlying;

> Natural subgrade materials consisting of:

- Predominantly alluvial Sandy SILT of low plasticity, encountered along Oakhampton Rd (TB503-TB505). Alluvial subgrade soils were assessed as ranging from below to above plastic limit in moisture condition, and soft to firm in consistency (at subgrade level) based on limited DCP testing.
- Predominantly residual Sandy / Silty Sandy CLAY of medium to high plasticity, overlain by minor alluvial Sandy SILT (TB501), encountered along S Willards Lane and Scobies Lane (TB501-TB502). Residual subgrade soils ranged from below to above the plastic limit in moisture condition, with stiff to very stiff consistency in TB501 and soft to firm consistency within TB502 at 0.5-1.0m bgl (based on DCP results). Residual soils appeared to grade towards weathered rock, with drilling refusal encountered at 1.1m bgl within TB502 on Scobies Lane.

Table 5-2 Summary of Encountered Profile Depths - Existing Pavements

Bore ID	Road Name	Chainage (m)	Wearing Course Thickness (mm)	Base of Pavement Profile (m bgl)	Base of Granular Fill (m bgl)	Base of Natural Subgrade (m bgl)
TB501	S Willards Lane	776(1)	40	0.58	NE	>2.00
TB502	Scobies Lane	61	20	0.17	0.45	1.10(3)
TB503	Oakhampton Road	394	20	0.60	0.85	2.00
TB504	Oakhampton Road	290	20	1.00(2)	NE	>2.00
TB505	Oakhampton Road	200	20	0.63(2)	1.10	>2.00

Notes to table:
(1) Based on proposed flood access road chainage.
(2) Evidence of former overlay pavement construction.
(3) Drilling refusal encountered on weathered rock.

No groundwater or seepage was encountered within any of the pavement test bores at the time of investigation. It should be noted that groundwater levels are likely to fluctuate in response to variations in climatic and site conditions.

Foreign materials (ceramic fragments) were encountered in TB502 at a depth of 0.17-0.50m in granular filling.

5.2 Proposed Flood Access Route

5.2.1 Subsurface Conditions

Subsurface conditions along the proposed flood access road have been summarised below based on encountered materials within boreholes (BH01-BH07) and interpreted material composition from CPT's (CPT01-CPT05) using the CPT-based soil behaviour type classification system (*Robertson, 2010*). Detailed engineering logs and CPT results are attached within Appendix B.

Table 5-3 Summary of Encountered Subsurface Conditions

Unit ID	Origin	Material Description
Unit T1	Topsoil / Topsoil Fill	Sandy SILT surficial material and Silty SAND / Clayey SILT fill material with organics (topsoil fill).
Unit F1	Fill	Uncontrolled fill materials of variable composition, comprising fine to coarse, angular to sub-angular Sandy GRAVEL and medium to high plasticity Silty CLAY, typically dry to moist in condition.
Unit A1	Alluvium	Alluvial soils of variable composition, generally comprising medium to high plasticity Silty / Sandy CLAY, low plasticity Sandy / Clayey / Sandy Clayey SILT, and fine to medium grained Silty / Clayey SAND. Fine grained alluvial soils (silts, clays) typically ranged from below to above the plastic limit in moisture condition, and variable concistency with depth in the range of firm to very stiff consistency. Granular alluvial soils were generally very loose to medium dense and typically moist in condition, with isolated wetter zones.
Unit R1	Residual	Low to medium plasticity Silty / Silty Sandy CLAY, typically below to equal the plastic limit and very stiff to hard in consistency.
Unit XW1	Extremely Weathered Material (EWM)	Extremely weathered SANDSTONE/SILTSONE material generally consistent with fine to coarse grained Clayey SAND and low plasticity Silty / Sandy CLAY. EWM clayey sands ranged from dense to very dense, and dry to moist in condition. EWM clays were generally hard in consistency and below the plastic limit in moisture condition. Drilling refusal on weathered rock was encountered within TB501 and BH07 at the base of the EWM profile.

Table 5-4 Summary of Encountered / Interpreted Profile Depths - Proposed Flood Access Route

Bore / CPT ID	Chainage (m)	Topsoil Thickness (mm)	Base of F1 - Fill (m bgl)	Base of A1 - Alluvium (m bgl)	Base of R1 - Residual (m bgl)	Base of XW1 - EWM (m bgl)	Depth to Weathered Rock (m bgl)
TB504(1)	0	-	1.00	>2.0	NE	NE	NE
BH04	25	200	0.5	>3.0	NE	NE	NE
CPT01	75	-	-	27.1(2)	-	-	27.1(3)
BH05	140	150	NE	>6.0	NE	NE	NE
CPT02	216	-	-	25.0(2)	-	-	25.0(3)
BH03	310	150	NE	>3.0	NE	NE	NE
CPT03	405	-	-	7.7(2)	-	-	7.7(3)
BH01/CPT04	435	100	NE	9.8(2)	-	-	9.8(3)
BH02/CPT05	490	300	0.80	7.0(2)	-	-	7.0(3)
BH07	540	100	0.30	NE	1.0	1.3	1.3(3)
Site Observation	600	-	0.50	NE	0.8	NE	0.8
BH06	662	-	1.00	NE	1.4	>2.0	NE
TB501(1)	773	-	0.58	0.85	1.3	>2.0	NE

Notes to table:
(1) Pavement test bores drilled within proposed flood access road alignment included, with existing pavement profile included in overall fill profile. Refer to Section 5.1.2 for summary of existing pavement profile breakdown.
(2) Assumed alluvial profile overlying weathered rock profile in CPT tests.
(3) CPT / Drilling refusal on weathered rock profile.

Standing groundwater was encountered within the alluvial profile in BH02 and BH05 at depths of 1.6m and 3.5m bgl, respectively, with possible seepage occurring from 0.9m bgl in BH02. No groundwater or seepage was encountered within the remaining borehole locations.

5.3 Laboratory Test Results

5.3.1 Acid Sulfate Soils

Results of acid sulfate soil (ASS) laboratory testing comprising preliminary field screenings and detailed ASS testing (Chromium Reducible Sulphur Method) undertaken on selected samples are summarised and compared against relevant guidelines in Figure 5-1 below. The results in relation to the adopted criteria are discussed further in Section 6.3 below.

Location	Depth (m)	Date Sampled	Origin	Material Description	pH_F	pH_{FOX}	pH_F - pH_{FOX}	Reaction Rate	pH kcl	Acid Trail (TAA)	Sulfur Trail (SCr)		Net Acidity		Liming rate	
					pH units	pH units	pH units		pH units	mole H+/t	%w/w	mole H+/t	%w/w	mole H+/t	kg $CaCO_3$/t	(-ANCE) kg CaCO3/t
TB501	0.70 - 0.75	8/12/22	Alluvium	Sandy Silt	7.1	3.2	*3.9*	*Low*	5.5	<5	0.02	10	0.02	13	1	0.96
TB505	1.60 - 1.70	8/12/22	Alluvium	Sandy Silt	6.7	5.1	*1.6*	*Medium*	-	-	-	-	-		-	-
BH02	0.45	5/12/22	Fill	Silty Clay	7.1	4.5	*2.6*	*Low*	-	-	-	-	-		-	-
BH02	0.95	5/12/22	Alluvium	Clayey Silt	7.2	5.8	*1.4*	*High*	-	-	-	-	-		-	-
BH03	0.45	5/12/22	Alluvium	Silty Clay	7.2	6.2	1.0	Extreme	-	-	-	-	-		-	-
BH04	0.45	5/12/22	Fill	Sandy Clay	7.2	5.1	*2.1*	*Extreme*	6.1	<5	0.009	6	0.009	5.5	<0.75	-
BH05	0.95	5/12/22	Alluvium	Clayey Silt	7.2	6.1	*1.1*	*High*	-	-	-	-	-	-	-	-
BH05	1.45	5/12/22	Alluvium	Silty Sand	7.2	5.6	*1.6*	*High*	-	-	-	-	-	-	-	-
BH06	0.60 - 0.70	8/12/22	Fill	Silty Clay	6.7	4.1	*2.6*	Low	4	74	0.01	7	0.13	81	6	6.1
BH07	0.40 - 0.50	8/12/22	Residual	Silty Clay	7.0	6.0	1.0	Low	-	-	-	-		-	-	-
Guideline Value				**Envirolab PQL**	-	-	-	-	-	5	0.005	3	0.005	3	0.75	0.75
ASSMAC (1998) Potential Acid Sulfate Soil Indicator Value					4 - 5.5 [1]	< 3 [3]	1 [4]	-	-	-	-	-	-	-	-	-
ASSMAC (1998) Actual Acid Sulfate Soil Indicator Value					≤ 4 [2]	-	-	-	-	-	-	-	-	-	-	-
ASSMAC (1998) Action Criteria - Coarse Soils (1 - 1000 tonnes) [5]					-	-	-	-	-	-	-	-	0.03	18	-	-
ASSMAC (1998) Action Criteria - Medium Soils (1 - 1000 tonnes) [6]					-	-	-	-	-	-	-	-	0.06	36	-	-
ASSMAC (1998) Action Criteria - Fine Soils (1 - 1000 tonnes) [7]					-	-	-	-	-	-	-	-	0.10	62	-	-
ASSMAC (1998) Action Criteria - Coarse Soils (>1000 tonnes) [5]					-	-	-	-	-	-	-	-	0.03	18	-	-
ASSMAC (1998) Action Criteria - Medium Soils (>1000 tonnes) [6]					-	-	-	-	-	-	-	-	0.03	18	-	-
ASSMAC (1998) Action Criteria - Fine Soils (>1000 tonnes) [7]					-	-	-	-	-	-	-	-	0.03	18	-	-

Notes to Table:

1 - pH values >4 and <5.5 are acid and may be the result of some previous or limited oxidation of sulfides, but is not confirmatory of actual acid sulfate soils

2 - pH readings of pH≤4, indicates that actual acid sulfate soils are present with the sulfides having been oxidized in the past, resulting in acid soils (and soil pore water)

3 - The lower the final pH_{FOX} value is, the better the indication of a positive result.
» If the pH_{FOX} < 3 and there was a strong reaction to the peroxide, there is a high level of certainty of a potential acid sulfate soils. The more the pH_{FOX} drops below 3, the more positive the presence of sulfides.
» A pH_{FOX} 3-4 is less positive and laboratory analyses are needed to confirm if sulfides are present.
» For pH_{FOX} 4-5 the test is neither positive nor negative. Sulfides may be present either in small quantities and be poorly reactive under quick test field conditions.
» For pH_{FOX} >5 and little or no drop in pH from the field value, little net acid generating ability is indicated.

4 - If the pH_{FOX} value is at least one unit below field pH_F, it may indicate potential acid sulfate soils. The greater the difference between the two measurements, the more indicative the value is of a potential acid sulfate soils.

5 - Coarse soils comprise sands to loamy sands - Approximate clay content (% < 0.002mm) ≤ 5%

6 - Medium soils comprise sandy loams to light clays - Approximate clay content (% < 0.002mm) between 5 and 40%

7 - Fine soils comprise medium to heavy clays and silty clays - Approximate clay content (% < 0.002mm) ≥ 40%

Contaminant Exceedance Indicators:

Bold	Indicates the laboratory result is within the specified range of the ASSMAC (1998) Actual Acid Sulfate Soil Indicator Values
Italics	Indicates the laboratory result either exceeds or is within the specified range of the ASSMAC (1998) Potential Acid Sulfate Soil Indicator Values
	Indicates exceedance of the ASSMAC (1998) Action Criteria

Figure 5-1 Acid Sulfate Soils Results Analysis Table

5.3.2 ENM Exemption

Results of the soil chemical testing for analytes forming the ENM exemption guidelines are presented in the summary tables attached in Appendix C, for ease of comparison against relevant guidelines and discussed in Section 8 below.

5.3.3 California Bearing Ratio (CBR)

Results of the 4-day soaked CBR testing, including standard compaction, undertaken on representative samples of existing and future subgrade materials summarised in Table 5-5 below.

Table 5-5 Summary of CBR Test Results

Bore ID	Depth (m bgl)	Material Description	W (%)	SOMC (%)	SMDD (t/m^3)	Swell (%)	CBR (%)
TB502	0.50 - 1.00	Silty Sandy CLAY (*existing pavement subgrade*)	15.1	15.5	1.78	0.0	8.0
TB504	0.70 - 1.00	Sandy SILT (*existing pavement subgrade*)	7.8	6.0	1.90	0.5	8.0
BH03	0.15 - 0.50	CLAY (*proposed embankment subgrade*)	29.0	31.5	1.40	0.5	2.0
BH04	0.30 - 0.65	Sandy CLAY (*proposed embankment subgrade*)	16.7	20.0	1.62	0.5	6.0

Notes to table:
W: Field Moisture Content
SOMC: Standard Optimum Moisture Content
SMDD: Standard Maximum Dry Density

5.3.4 Atterberg Limits & Particle Size Distribution (PSD)

Results of the Atterberg Limits and PSD testing undertaken on representative soil samples along the proposed flood access road alignment is summarised in Table 5-6 below.

Table 5-6 Material Quality Test Results

Bore ID	Depth (m bgl)	Material Description	Fines (%)	Sand (%)	Gravel (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
BH03	0.15 - 0.50	Silty CLAY *(proposed embankment subgrade)*	-	-	-	46	25	21
BH04	0.30 - 0.65	Sandy CLAY *(proposed embankment subgrade)*	66	34	0	33	21	12
BH04	1.70 - 2.00	Silty Sandy CLAY *(proposed embankment subgrade)*	-	-	-	31	19	12
BH05	0.70 - 1.00	SAND with clay *(proposed embankment subgrade)*	10	90	0	30	19	11
BH05	1.20 - 1.50	Silty SAND *(proposed embankment subgrade)*	15	85	0	-	-	-

6 Geotechnical Comments & Recommendations

6.1 Settlement Assessment

Settlement calculations have been conducted to approximate expected settlements as a result of surcharge loading of the existing shallow filling and deep alluvial profile within the flood access road embankment.

The magnitude of settlement will to vary with the height of the embankment along the alignment and depth / condition of existing low strength layers of firm/loose consistency. Based on the findings of the investigation, observed (boreholes) and interpreted (CPT) subsurface conditions generally indicated shallow filling in some locations over variably layered alluvial soils along majority of the alignment, typically composed of firm to very stiff clay/fine-grained soils and very loose to medium dense sand/granular soils, encountered depths up to 27m bgl. Isolated, thin (<0.5m thick) layers of soft clays and very loose sands were encountered in some locations. With reference to supplied concept plans, embankment height generally ranged from approximately 0.5m up to a maximum height of 2.8m (including pavement).

For the purpose of this assessment, settlement analysis was undertaken at discrete CPT locations along the proposed alignment where full depth and condition of the soil profile was ascertained, varying the fill embankment height to provide a range of settlement magnitude. Settlement analysis was generally focused within the alluvial flood plain area (approx.Ch. 0 to 500m) where deeper and variable soil conditions were present.

6.1.1 Design Parameters

A summary of the assumed geotechnical design parameters adopted for the settlement analysis are presented in Table 6-1 below.

Table 6-1 Geotechnical Design Parameters - Settlement

Material	Density / Consistency	γ (kN/m^3)	v'	v_U	E' (MPa)	E_U (MPa)	m_v (m^2/kN)
Sands(1)	Very Loose	16	0.3	-	6	-	1.2 x 10^{-4}
	Loose	17	0.3	-	10	-	7.4 x 10^{-5}
	Medium Dense	18	0.3	-	35	-	2.1 x 10^{-5}
Clays(1)	Soft	17	0.3	0.5	2.5	3	3.0 x 10^{-4}
	Firm	18	0.3	0.5	5	6	1.5 x 10^{-4}
	Stiff	19	0.3	0.5	15	17	5.0 x 10^{-5}
	Very Stiff	20	0.3	0.5	30	35	2.5 x 10^{-5}

Notes to table:
(1) Material characteristics inferred from CPT-based soil behaviour type classification system (Robertson, 2010)

6.1.2 Design Assumptions

Primary consolidation settlement calculations have been undertaken based on the geotechnical parameters above and the following assumptions:

- 1-D and 2-D loading conditions have been adopted in settlement analysis based on variable soil depth to embankment load width ratios.
- Ideal elastic soil conditions, with secondary consolidation / creep settlement assumed to be negligible based on existing material strength / composition.
- Applied surcharge pressure of 20kPa per metre height of the embankment.
- Nominal applied surcharge pressure of 10kPa to account for typical vehicle traffic comprising predominantly light vehicles, allowing for reduction provided by the pavement structure.

Where the parameters assumed above vary, for example embankment fill with unit weight exceeding 20 kN/m^3 and/ or high traffic loadings from heavy vehicles, the settlement analysis required review.

6.1.3 Analysis & Recommendations

The analysis conducted revealed predicted values of primary consolidation settlement in the order of up to 40-50mm at a maximum, where the lowest strength materials are modelled under the highest design embankment height. As noted settlement will be variable along the alignment, and the analysis indicates settlements generally in the order of less than 30mm along majority of the alignment, which would usually be considered acceptable for flexible pavements.

There are several flexible pavement options that could be considered for the proposed Flood Access Road. Construction of a flexible unbound pavement with sprayed seal wearing course may be preferable, which would have more capacity for tolerating differential settlements without adverse performance, in comparison to other pavement structures. Bound pavements could also be considered due to performance benefits and significantly reduced moisture sensitivity, however if impacted by settlements would not be as readily maintained as an unbound pavement.

Ideally the embankment would be constructed to the underside of pavement and survey monitored to ensure settlements have reduced to acceptable levels prior to pavement construction, however may not be feasible due to timing implications. Protection of the pavement from impacts of flooding will be essential in any case, through providing effective waterproof sealing, geometry (e.g. cross fall) and drainage.

Reactive soil movements have also been considered due to reactive clay soils encountered, and are expected to result in movements in the order of 40-50 mm between extremes in moisture content, particularly at low embankment heights. The importation of low reactivity fill (refer Section 6.2.2.4) will assist in mitigating reactive soil movements.

6.2 Earthworks

6.2.1 Excavations

With reference to the supplied long sections, it is understood that no significant excavations are proposed to achieve design levels for the proposed flood access road and tie-in section upgrades. It is generally expected that some shallow excavations would be required in areas for pavement boxing, utility trenching and over-excavation of uncontrolled filling and unsuitable subgrade materials. Excavations into the shallow site soils are expected to be readily undertaken by use of conventional earth moving equipment.

It should be noted, drilling refusal was encountered on the weathered rock profile in BH07 and TB501 at depths of 1.3m and 1.1m bgl, respectively. Where deeper excavations are required in areas of observed shallow rock, the civil contractor should form their own assessment on plant requirements, in conjunction with this report and the attached borehole logs.

6.2.2 Flood Access Road Filling & Batter Slopes

Based on the supplied long sections, it is understood that the majority of the proposed flood access road alignment is to be constructed on a fill embankment, from approximate Ch. 0 to 600m, before transitioning to predominantly on-grade pavement construction, from approx. Ch. 600 to 820m. The proposed fill embankment height typically varies from approximately 0.5m up to 2.8m, dependent on the underlying topography.

6.2.2.1 Methodology

All general embankment filling should be placed and compacted in accordance with AS 3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments* [4], and the following procedure:

- Removal of any existing topsoil, deleterious or low strength materials from the areas where fill is to be placed. Any unsuitable material including foreign matter must be removed from the fill areas.
- Draining of any ponded water and removal of any sediment within the existing creek lines which intercept the proposed flood access route alignment, the need for which will be dependent on prevailing climatic conditions.
- Static proof-roll the exposed subgrade using a heavy (minimum 10 tonne) roller under the direction of an experience geotechnical consultant, with any loose or yielding areas excavated and replaced with compacted select fill or suitable subgrade replacement comprising of material of similar consistency to the subgrade. The investigation results do not indicate significant bridging treatments would be required to support the embankment, with localised removal and subgrade replacement expected to be suitable, subject to inspection by a geotechnical consultant during construction.
- Benching of the slopes where fill is to be placed with slopes steeper than 8H:1V will be required.
- Placement of fill in uniform horizontal layers with compaction of each layer to a minimum dry density ratio of 98% Standard Compaction (AS 1289-5.1.1) at moisture contents in the order of 85-115% of SOMC or ±2% but generally as close to SOMC as practical. Over compaction should be avoided.
- Fill within the road subgrade level (minimum 0.5m below design subgrade level) should be in accordance with Section 7.4.1 below. This includes increased compaction criteria and variations to the moisture specification.

6.2.2.2 Flood Control Levee Interface

Current design plans show the proposed fill embankment is planned to be constructed over the northern / up gradient side of the existing flood control levee, with the road height approx. 0.5m below the top of spillway (refer Figure 6-1 below). It is understood other configurations were considered such as offsetting the proposed embankment from existing levee so that it would not be relied upon for structural support, however this created issues with drainage in the zone between the embankment and levee.

The proposed design is considered feasible, providing suitable subgrade preparation is undertaken prior to embankment construction and the embankment does not impede the flood control levee's function. The following comments are provided:

- The pavement shall not be located closer than 1V:1H zone from the toe of existing flood control levee (denoted by dashed red line in Figure 6-1 below), which may result in widening of the proposed embankment shown in the current design.

- Removal of any uncontrolled filling and surface vegetation within the existing levee footprint is required prior to embankment construction, including adjustment of / reinstating roughly placed boulder size rock fill within the existing Zone 3A to ensure it is a suitable embankment foundation.
- Geofabric is recommended to be placed over the existing flood control levy surface (predominantly rock fill and reno mattresses) prior to fill placement.
- Existing culvert pipes beneath the levee require extension underneath the proposed fill embankment.

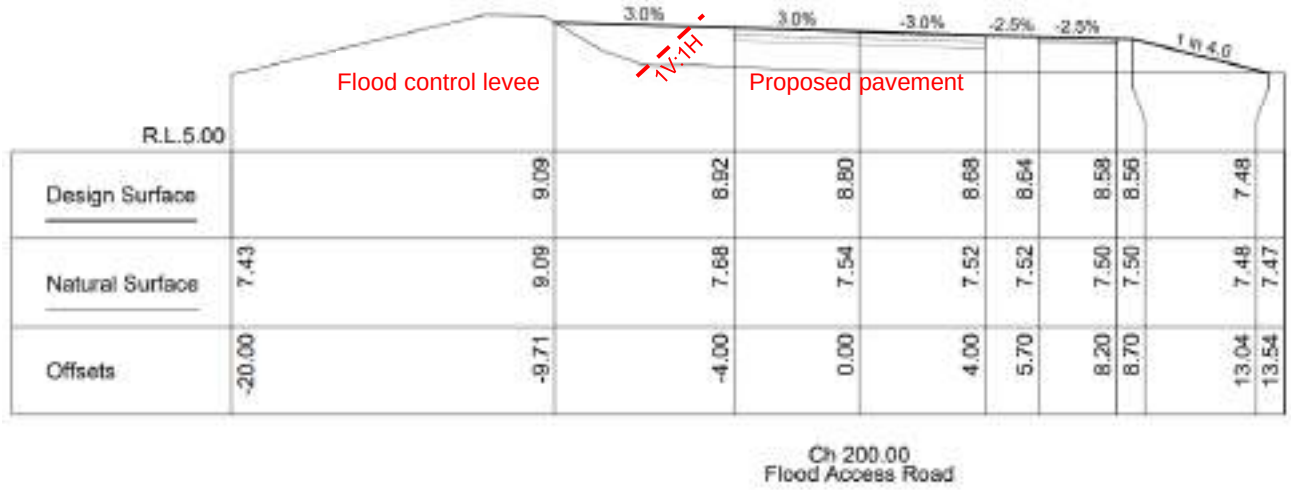

Figure 6-1 Flood access road design plan extract

6.2.2.3 Batter Slopes

All fill should be battered at a slope of 4H:1V or preferably flatter and temporary erosion control should be provided. To prevent erosion in the long term, provision of protection by vegetation and with the provision of adequate drainage is also required. Proposals to batter slopes steeper would be subject to geotechnical review and MCC approvals.

6.2.2.4 Fill Materials

Based on the supplied long sections, imported fill materials are expected to be utilised within construction of the proposed fill embankment. It is recommended that proposals to import fill materials be subject to geotechnical review prior to import, as to advise on any adverse impacts to the current geotechnical recommendations.

Generally, imported fill materials should conform to Maitland City Council (MCC) requirements and be sourced considering the following:

- Material should generally be of uniform composition and consistency.
- Material is to be free of deleterious material, vegetation or other organic matter. Imported fill composed of silt materials or materials high in silt content would require blending with other materials to render suitable as general fill.
- Maximum particle sizes should not exceed 150mm or 2/3 of the compacted layer thickness for general fill
- Maximum particle sizes should not exceed 100mm or 1/3 the compacted layer thickness for subgrade filling or subgrade replacement.
- Fill material imported shall be of low reactivity to reduce impacts from reactive soil movements, with a shrink swell index (Iss) of ≤1%.
- Material with properties/characteristics equal to (or better) than those assumed in design for fill materials e.g. soaked CBR value.

6.3 Preliminary Acid Sulfate Soils Assessment

Preliminary acid sulfate soils (ASS) assessment has been undertaken to assess the potential for ASS to be present within the anticipated disturbance zone for construction and rehabilitation works.

The assessment comprised the following:

- A review of available published geological data and acid sulfate soils risk maps.
- Subsurface investigation, soil sampling and laboratory testing of representative soil samples.
- Acid sulfate soil laboratory testing comprising ten (10) screening tests and three (3) detailed tests.

The laboratory testing was conducted by external Envirolab laboratories who hold current NATA accreditation, in accordance with NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC) Acid Sulfate Soil Manual (ASSM) [5] and the Queensland Acid Sulfate Soil Technical Manual (QASST) Soil Management Guidelines [6].

6.3.1 Proposed Works

As discussed the proposed works comprise new embankment and pavement construction within the proposed flood access road, and pavement rehabilitation / reconstruction works within the adjoining tie-in sections.

Based on the desktop review (refer Section 2.2.2 above) the primary risk for acid sulfate soils to be exposed would be within Ch 0-450m during embankment foundation preparation, however samples from a range of site areas have been tested to assess the likelihood of encountering ASS during the works. The depth of assessment was limited to a nominal 2m given the limited depth of excavations expected as part of the works based on current design plans.

6.3.2 Acid Sulfate Soil Action Criteria

The action criteria indicating the requirements for an ASSMP is detailed in the Acid Sulfate Soil Manual (ASSM) [5] which suggests values of the percentage of oxidisable sulfur and actual acidity for soil types broadly categorised as fine texture, medium texture and coarse texture.

The alluvial and fill soils tested range from fine to coarse textured soils.

The action criteria is also based on the extent of the proposed ASS soil disturbance, with various trigger values for where 1-1000 tonnes or where greater than 1000 tonnes is disturbed. Based on the proposed works, soil volumes less than 1000 tonnes in total are expected to be disturbed.

The relevant action criteria where <1000 tonnes is disturbed from Table 4.4 of ASSM [5] ranges from:

- Sulfur trail of 0.03% or 18 mole H+/tonne and acid trail of 18 mole H+/tonne for fine soils; to
- Sulfur trail of 0.10% or 62 mole H+/tonne and acid trail of 62 mole H+/tonne for fine soils.

The criteria is shown in the analysis table in Figure 5-1 above.

6.3.3 Acid Sulfate Soil Laboratory Test Results

Acid sulfate soil test results are compared against the adopted ASSM criteria in Figure 5-1 above, with complete test reports attached in Appendix C.

One exceedance to the adopted criteria was detected in a sample of clay fill from BH06 at 0.6-0.7m depth, with a net acidity of 0.13% / 81 mole H+/tonne marginally exceeding the criteria limit of 0.10% / 62 mole H+/tonne.

6.3.4 Acid Sulfate Soil Assessment

The investigation indicates that ASS are not present at the site within a depth of 1.7m below existing surface levels (depth range of samples tested), which is consistent with the risk mapping review which indicated the potential for ASS at a depth of >3m.

The exceedance to the adopted criteria detected in one sample is more indicative of a naturally acidic fill material imported from an off-site source. Given the condition of the filling encountered (stiff consistency and not over wet) significant disturbance of this material encountered at 0.5-1.0m is not envisaged, and as such treatment as an actual ASS is not considered to be required to protect the surrounding environment.

Given the limited testing conducted across the range of site areas, additional ASS testing prior to any offsite reuse of materials is recommended (i.e. implications to ENM assessment), or if significant disturbance of the identified acidic materials is proposed.

The above assessment requires review where any of the assumptions around disturbance quantities or depths made are not correct.

7 Pavement Design

7.1 Existing Pavement Performance & Rehabilitation Options

Inspection of the existing pavements along S Willards Lane, Scobies Lane and Oakhampton Rd indicates generally reasonable performance considering the nature of the road sections, with localised areas along Scobies Lane performing poorly.

The intrusive ground investigation within pavement test bores (TB501-TB505) generally revealed variable pavement thicknesses within the tie-in sections, with pavement overlay construction evident in test bores along Oakhampton Rd.

Natural subgrade conditions to the existing Oakhampton Rd and Scobies Lane pavement sections were generally poor, comprising soft to firm alluvial sandy silt material to an observed depth of 1.3m along Oakhampton Rd and soft to firm residual silty sandy clay to a depth of approx. 1.0m along Scobies Lane. Oakhampton Rd is noted to be located in close proximity and parallel to the Hunter River alignment (approx. 50m west), with periodic inundation of the pavement expected to contribute to the poor subgrade conditions observed.

Reasonable subgrade conditions were encountered within the S Willards Lane section, comprising stiff to very stiff alluvial sandy silt and natural clays.

Based on conditions encountered at the time of fieldwork, rehabilitation could be considered for the S Willards Lane section, however full depth pavement reconstruction for Oakhampton Rd and Scobies Lane sections would be required where longer term performance and reduced maintenance risk is required due to the poor surface and subgrade conditions present.

Pavement rehabilitation options for S Willards Lane could range from resealing, through to granular overlaying with basecourse material in areas of increased vertical alignment.

There are a range of pavement reconstruction options available, including the use of asphalt, unbound and bound materials. It is assumed that the use of unbound and bound materials would be preferred due to economics, and bound materials would be recommended in areas expected to be inundated during inclement weather / flooding of the Hunter River.

7.2 Pavement Thickness Design

Pavement thickness design has been undertaken based on the findings of the geotechnical investigation and Maitland City Council (MCC) requirements. The following guidelines have been adopted for the design of the Dalveen Road section investigated:

- Pavement thicknesses for flexible pavements in accordance with Austroads Part 2 [7]; and
- Maitland City Council (MCC) Manual of Engineering Standards, Chapter 5: Pavement Design [8].

7.2.1 Design Parameters

7.2.1.1 Design Subgrade

Review of the supplied long sections to the proposed flood access road and existing road alignments in conjunction with subsurface conditions encountered during the investigation, subgrade conditions along the proposed and existing alignments are generally expected to comprise generally granular filling, residual clays, and variable alluvial soils.

Results of the laboratory testing, undertaken on subgrade samples recovered along the proposed flood access road alignment and existing pavement sections indicated soaked CBR values of 2% to 8% for the encountered alluvial soils and 6% for the residual silty sandy clay profile. The CBR value of 2% was obtained on a sample of alluvial clay from BH03 located at approx. Ch 310m where approx. 2.5m height of embankment fill is proposed above the material tested.

Field testing along the proposed flood access road alignment and existing road sections indicated areas of low strength natural subgrade conditions, which would have an in-situ CBR in the order of 2%. Subgrade treatment will be required in areas where weak subsurface soils are present close to pavement formation level. Poor subgrade conditions were generally encountered below the existing pavement and fill materials along Oakhampton Rd and Scobies Lane, and between approx. Ch. 350 to 500m of the proposed flood access road. It is noted that poor existing subgrade conditions along the proposed flood access road alignment (approx. Ch. 350 to 500m) occurs where proposed embankment fill height is typically in exceedance of 1m, as such it is anticipated to have sufficient cover to not adversely impact to the overall pavement performance.

On the basis that effective subgrade treatment is conducted to address low strength materials (refer Section 7.2.2 below), and considering the embankment height above low strength alluvial clays, a minimum design subgrade CBR of 3% has been considered for pavement design. Fill materials for the proposed embankment is yet to be confirmed, as such, pavement design on fill subgrades may require re-evaluation during construction, following confirmatory testing and review of proposed subgrade fill materials.

7.2.1.2 Design Traffic

Design traffic loading for the proposed flood access road has been determined in accordance with Austroads Part 2 [7] and based on the following supplied traffic data:

- ADT (average daily traffic) of 1417 for Oakhampton Road from August 2017, with 5.5% heavy vehicles;
- ADT of 679 for existing Scobies Lane from September 2016; and
- An ADT of 1430 is expected for the proposed flood access road, accounting for planned future upgrades to Walka Water Works which will be accessed off the road.

Design traffic calculations have been conducted with the results shown in Table 7-1 below, with output sheets showing assumptions attached in Appendix D.

Table 7-1 Design Traffic Loading

Road Section	Design Period & Design Traffic (ESA)	
	20 years	30 years
Oakhampton Road	1.4×10^6	2.3×10^6
Proposed Flood Access Road (2)	- (3)	1.1×10^6
Scobies Lane & S Willards Lane (2)	3.6×10^5	6.1×10^5

Notes to table:
(1) Design traffic loading determined based on client supplied traffic data.
(2) Reduced heavy vehicle proportion of 3% adopted in the absence of supplied data.
(3) Rehabilitation design period not considered for new construction.

7.2.2 Subgrade Treatment

Low strength materials have been encountered at existing subgrade level within Oakhampton Road and Scobies Lane. Soft to firm alluvial silts were encountered over the full subgrade depth at Oakhampton Road and soft to firm residual clays down to 1.0m bgl within Scobies Lane.

There are a range of subgrade treatment options available to facilitate pavement reconstruction (where conducted), and given the significant depth of low strength material it is assumed that construction of a bridging layer from either a lightly bound material or coarse rock fill would be feasible.

A nominal 300 mm bridging layer with geogrid at the base of layer could be provisioned for, which would require confirmation by a geotechnical consultant at the time of construction, and would vary based on the material type utilised and the prevailing weather conditions.

Alternatively pavement rehabilitation would reduce the depth of over excavation and replacement, albeit at a reduced design life expectation. Overlaying and/or in situ stabilisation could be considered to rehabilitate the existing pavements, discussed further in Section 7.3 below.

7.2.3 New Construction / Pavement Reconstruction: Flexible Unbound Pavement

Design pavement thickness calculated for the proposed flood access road is summarised in Table 7-2 below. It must be noted that the design thickness presented below are minimum thicknesses regardless of construction tolerances.

Table 7-2 New Construction / Pavement Reconstruction: Flexible Unbound Materials

Road Sections	Scobies Lane & S Willards Lane	Proposed Flood Access Road		Oakhampton Road	Recommended Material Type (1)
Wearing Course	Sprayed Seal				-
Base Course	130mm	135mm	135mm	145mm	DGB or NGB
Subbase	380mm (2)	400mm (2)	165mm	425mm (3)	DGS20/DGS40
Subgrade Treatment (4)	(300mm)	(300mm)	-	(300mm)	CBR ≥ 15%
Total Pavement Thickness (excluding treatment layer)	510mm	535mm	300mm	570mm	-
Minimum Design CBR	3%	3%	8% (5)	3%	-
Design Traffic	6.1×10^5 DESA	1.1×10^6 DESA	1.1×10^6 DESA	2.3×10^6 DESA	-
Design Life	30 years				-

Notes to table:
(1) Refer to Section 7.3.2 for material specifications.
(2) Could be reduced to minimum MCC design requirement of 125mm where 300mm subgrade treatment (rock fill or lightly bound material) is adopted.
(3) Could be reduced to 135mm where 300mm subgrade treatment (rock fill or lightly bound material) is adopted.
(4) Bridging layer required in some areas due to depth of low strength subgrade encountered – refer Section 7.2.2 above.
(5) Design CBR 8% composition only suitable where minimum 0.5m fill embankment material with CBR 10% provided below underside pavement.

Where a thin asphalt is preferable for example 45mm of AC14, the thickness could be reduced from the subbase thicknesses shown, providing the MCC minimum 125mm subbase is maintained.

7.2.4 New Construction / Pavement Reconstruction: Heavily Bound Base

Pavement construction with a heavily bound base, comprising of slag with 10% ash based products is considered a suitable alternative to flexible unbound construction, and would provide performance benefits and significantly reduced moisture sensitivity in comparison to the flexible option.

It should be noted that the layer thicknesses detailed include a construction tolerance of 10 mm. Reference should also be made to the material requirement and compaction specification in this report.

Table 7-3 New Construction / Pavement Reconstruction: Heavily Bound Base

Road Sections	Scobies Lane & S Willards Lane	Proposed Flood Access Road		Oakhampton Road	Recommended Material Type (1)
Wearing Course (2)	Sprayed Seal				-
Bound Basecourse (3)	335mm	345mm	300mm	360mm	HBB R73 [9]
Subgrade Treatment (4)	(300mm)	(300mm)	-	(300mm)	CBR ≥ 15%
Total Pavement Thickness (excluding treatment layer)	335mm	345mm	mm	mm	-
Minimum Design CBR	3%	3%	8% (5)	3%	-
Design Traffic	6.1×10^5 DESA	1.1×10^6 DESA	1.1×10^6 DESA	2.3×10^6 DESA	-
Design Life	30 years				-

Notes to table:
(1) Refer to Section 7.3.2 for material specifications.
(2) Wearing course and binder design shall be confirmed in consultation with the sealing contractor and following determination of the HBB material and depending on weather conditions during construction. Primer seal not necessarily required in conjunction with heavily bound basecourse.
(3) No significant thickness reduction where select layer adopted, and basecourse thickness to be maintained.
(4) Bridging layer required in some areas due to depth of low strength subgrade encountered – refer Section 7.2.2 above.
(5) Design CBR 8% composition only suitable where minimum 0.5m fill embankment material with CBR 10% provided below underside pavement.

Where a thin asphalt is preferable for example 45mm of AC14, the thickness could be reduced from the basecourse thicknesses shown, which would need to be confirmed by design checks.

Where a thin bituminous wearing course is employed in conjunction with a heavily bound pavement, reflective cracking in the pavement should be expected. Use of a polymer modifed or rubber seal can assist in delaying the appearance of reflective cracking in the seal. Where a self-cementing material is used: the cracks, if sealed promptly, are not of structural significance and are of aesthetic consideration only. The use of slag or ash based products with a 48-hour working time should reduce the risk of cracking compared to cement stabilised material; however where cracking is not acceptable, Stantec should be consulted.

7.3 Pavement Rehabilitation

There are a range of pavement rehabilitation options available for the existing tie-in sections of pavement. As discussed, poor performance indicated by visual inspection and poor subgrade conditions are present within the existing Scobies Lane and Oakhampton Road subject sections which would limit the effectiveness of pavement rehabilitation.

S Willards Lane could be considered for rehabilitation, given the reasonable performance observed and existing pavement / granular fill thickness of 580mm. Considering the short length of the section the following options are considered feasible:

- Ripping and recompacting the existing pavement followed by resealing; or
- Granular overlaying with 100mm basecourse material and resealing, where the proposed vertical alignment can accommodate this height change.

Rehabilitation of S Willards Lane would be expected to improve serviceability in the medium term. Rehabilitation utilising similar options could be considered for Scobies Lane and Oakhmapton Road, with in-situ stabilisation also potentially feasible for Oakhmapton Road due to the length of the section and existing pavement thickness, however would only be considered short term options. Where in-situ stabilisation is considered further laboratory UCS test trials would need to be conducted.

Stantec is happy to consider other options that MCC prefer, and further advice can be provided.

7.4 Pavement Construction

7.4.1 Subgrade Preparation

7.4.1.1 Existing Pavement Reconstruction

Subgrade preparation for reconstruction of existing sections of road should be in general accordance with MCC specifications and the following procedures.

Subgrade preparation for the proposed Flood Access Road is detailed in Section 6.2.2.1 above.

- Any organic material, existing uncontrolled fill, or other deleterious material should be removed from areas of any proposed widening.
- Removal of the existing seal for offsite disposal or recycling.
- Excavation to design subgrade level, including the removal and stockpiling of existing pavement and granular fill materials for reuse as select fill, subject to potential reconditioning and removal of oversized material. Care should be exercised during excavation to avoid contamination of suitable granular material with subgrade materials. Following excavation, inspection of exposed subgrade by a geotechnical consultant would be required.
- Construction of bridging treatment within Scobies Lane and Oakhampton Road sections as detailed in Section 7.2.2 above.
- Where low strength materials have not been identified; static proof-roll the exposed subgrade using a heavy (minimum 10 tonne) roller under the direction of an experience geotechnical consultant, with any loose or yielding areas excavated and replaced with compacted select fill or suitable subgrade replacement comprising of material of similar consistency to the subgrade.
- Where filling or subgrade replacement is required, the materials employed should be free of organics or other deleterious material and could comprise of the existing salvaged pavement gravels. The material should also have a maximum particle size of 100 mm or one third of the layer thickness, with a minimum CBR 3%.
- Compaction of the subgrade, filling or select should be to a minimum 100% of SMDD in layers of not greater than 250 mm loose thickness. Moisture contents should be within -2 to 0% of SOMC.

7.4.1.2 Pavement Rehabilitation - Overlaying

- Removal and replacement of highly deformed areas and any patching, under supervision of geotechnical consultant.
- Tyning of the pavement and seal to a depth not exceeding 150 mm and recompacted.
- Widening of the shoulders where required to a full depth pavement, and with subgrade preparation as per guidelines in Section 7.4.1.
- Reshaping where required to address shape deficiency and to ensure a minimum 3-4% cross-fall is achieved.
- Compaction of pavement material to a minimum of 102% SMDD at moisture contents of 60-90% of SOMC.
- Overlay with basecourse quality material, as per the specifications and compaction criteria as per Section 7.4.2 below.

7.4.2 Specification and Compaction Requirements

Pavement materials and compaction requirements for the new pavement construction should conform to Maitland City Council specifications and the following requirements.

Table 7-4 Material Specification and Compaction Requirements

Pavement Course	Material Specification	Compaction Requirements
Basecourse High quality crushed rock base or natural gravel pavement material	Material complying with MCC Pavement Material Properties Appendix D	Min 98% Modified (AS1289 5.2.1) or Min 102% Standard (AS1289 5.1.1) (60-90% of OMC)
Subbase Quality crushed rock subbase or natural gravel pavement material	Material complying with MCC Pavement Material Properties Appendix D	Min 95% Modified (AS1289 5.2.1) or Min 100% Standard (AS1289 5.1.1) (60-90% of OMC)
Select Crushed rock or gravel	CBR ≥ 15%	Min 100% Standard (AS1289 5.1.1) (60-90% of SOMC)
Subgrade or replacement	Minimum CBR 3%	Min 100% Standard (AS1289 5.1.1)

7.4.3 Alternative Construction Materials

Alternative materials used in the construction should comply with the specifications indicated in this report. It is suggested that Stantec be consulted prior to the use of alternate materials. Contractors should specify materials to be used in construction at the time of tendering, with all materials to be approved by Council prior to incorporation in the works.

Relatively low permeability and durable pavement materials would be recommended for new flexible reconstruction given the subgrade conditions.

7.4.4 Wearing Courses

Wearing Courses should be designed in accordance with MCC specifications with consideration to TfNSW QA Specifications R117 [10] and APRG Report No. 18 [11] methodology. The design and construction of wearing courses should be done in consultation with the preferred supplier taking into account traffic volume and type.

Application of the final surfacing should be delayed as long as practical and a minimum of 14 days, to allow reflective cracking prior to application of the wearing course. This would add to the sealing costs due to the need for a second establishment; however, would be required for the primer seal to cure and volatiles to escape.

7.4.5 Pavement Compaction

Difficulty obtaining specified compaction requirements can be expected in areas of low strength subgrade which are evident in areas where the road is to be constructed in fill, firm clays and loose to medium dense sands near surface are expected and subgrade replacement is not undertaken. Vibratory compaction can lead to potential problems with the development of excess pore pressures and permanent deformation of the subgrade. Large capacity oscillating rollers are better suited to deep lift compaction. Static or low amplitude rolling may be appropriate in conjunction with thinner layers in poor subgrade areas.

It is essential to ensure that compaction is achieved though the full thickness of any pavement layers. A rough interface and bond is required between all pavement layers, generally achieved through scarification of the first layer prior to placement and compaction of the second and subsequent pavement layers.

7.4.6 Drainage

The pavement thickness designs have been provided assuming drained pavement conditions. The selection, construction and maintenance of appropriate drainage mechanisms is required for adequate performance. Particular care is required to provide a waterproof seal for the pavement materials, together with adequate surface and sub-surface drainage of the pavement and adjacent areas. Sealing of the shoulders be undertaken beyond the edge line.

Provision of adequate cross fall to direct runoff from the pavement to drainage lines should be achieved regardless of the option adopted and as a minimum, roadside open drains should be reformed and adequately maintained. The drains should be provided where the road is on grade or in cut and be constructed so that the base of the drain is below subgrade level along both the sides of the road. The subgrade should also be constructed with sufficient cross fall (approximately 3%) to assist in any moisture entering the pavement not becoming trapped.

Provision of a subsoil drain at the toe of the Flood Access Road embankment against the existing flood control levee should be considered, particularly in low embankment height areas. This would be aimed at ensuring moisture does not become trapped following inundation of the embankment and impact pavement performance, and would be subject to the extent of drainage upgrades and final geometry proposed.

7.4.7 Pavement Interface and Tie-in

Where new pavement construction abuts an existing pavement, care should be exercised to bench into the base course layer for a minimum of 0.3 m for the entire pavement width.

Vertical joints associated with road intersections, require positioning outside proposed wheel path locations (where possible).

Adequate compaction of the subgrade and pavements in this area is essential to maximise performance of the pavement. It is noted that where variable pavements are abutted, the potential for localised failure is generally greater. Consideration should be given to sealing any cracks that may develop between existing and new pavements. The use of a strain alleviating membrane at the interface may also be appropriate. It may also be prudent to install intra-pavement drainage at subgrade level at interfaces of variable existing and new pavements.

7.4.8 Construction Inspection

The subgrade will require inspection by an experienced geotechnical consultant after boxing out or filling to design subgrade level. The purpose of inspections is to confirm design parameters, assess the suitability of the subgrade to support the pavement and delineate areas which may require subgrade replacement / select and areas requiring remedial treatment prior to rehabilitation.

7.4.9 References

All works and materials used in construction should be designed and constructed in accordance with MCC Specifications or as specified in this report. Where discrepancies may occur, clarification should be sought from Council.

Earthworks and testing should generally be undertaken in accordance with AS 3798-2007 Guidelines on Earthworks for Commercial and Residential Developments [4] where not otherwise specified.

8 Preliminary Environmental Assessment

8.1 Extent of Assessment

Preliminary assessment of likely surplus materials from the proposed pavement rehabilitation / reconstruction works for offsite reuse or disposal has been undertaken.

The material types sampled, tested and analysed as part of the assessment three samples of granular fill materials between depths of 0.08-0.7m (BH06, TB502, TB503) and one sample of sandy silt material from the top of subgrade level (TB501).

The actual material descriptions and location details are shown in the analysis tables attached in Appendix C. The areal and depth extent of the materials encountered during the investigation are detailed through the site plan figures and test bore logs attached in Appendix A and B, respectively.

The assessment provided is considered preliminary as the nature of the works and discrete testing quantities would not satisfy classification criteria. A more detailed and targeted investigation would be required to provide a full environmental assessment.

8.2 Assessment Criteria

The following contaminant threshold concentrations were considered for preliminary assessment of the in-situ materials encountered during the investigation.

- NSW EPA Waste Classification Guidelines - Part 1: Classifying Waste (2014) [12].
- NSW EPA Excavated Natural Material Order 2014 [13] (ENM).
- NSW EPA 'The excavated public road material order 2014' [14].

The laboratory test results are presented in the summary tables attached in Appendix C, followed by complete test reports.

8.3 Laboratory Results

Laboratory testing, along with sampling and decontamination procedures outlined in Section 4, was conducted, with the results presented in a summary table attached in Appendix C. A brief summary of these results are discussed below with reference to the adopted criteria.

- **Granular Fill Materials**
  - ENM [13]:
    - Exceedance of the absolute maximum concentration for Lead within TB503 (0.6-0.7m).
    - Detection of Benzo(a)pyrene equal to the absolute maximum concentration within TB502 (0.4-0.5m).
    - Exceedance of the average maximum concentration for TRH (C10-C36) within TB502 (0.4-0.5m).
    - Exceedance of absolute maximum concentration for foreign materials within TB502 (0.4-0.5m) and TB503 (0.6-0.7m) – which is consistent with site observations during test bore drilling.
    - The results from BH06 (0.08-0.1m) within the proposed flood access road alignment did not exceed ENM guidelines [13].
  - Waste Classification Guidelines [12]:
    - Exceedance of the CT1 limit (for general solid waste) for lead within TB503 (0.6-0.7m).
    - Exceedance of the CT1 limit for Benzo(a)pyrene within TB502 (0.4-0.5m).
    - Subsequent TCLP test results for both above samples were below TCLP1 limits.
    - The results from BH06 (0.08-0.1m) within the proposed flood access road alignment did not exceed CT1 limits.
- **Sandy Silt Subgrade Material**
  - No exceedances to either ENM criteria or Waste Classification Guidelines detected**.**

8.4 Quality Assurance & Quality Control

Envirolab has undertaken internal quality assurance testing which involves duplicate analysis on selected samples, method blanks and matrix spikes, and a review of the QA results and interpretation. Results are contained within the laboratory report sheets and are attached to this report.

The review of internal QA indicates that sufficient internal QA was undertaken for all analytes and that, Recovery of Surrogates, Recovery of Spikes, Relative Percentage Differences for Duplicates, Triplicate results and holding times where within acceptance criteria as defined by Envirolab Pty Ltd.

The data obtained from this testing is considered accurate and the results can be relied on to the for the purpose of the preliminary assessment.

8.5 Comments & Recommendations

The following preliminary comments are provided.

- It is unlikely that existing granular fill materials which were encountered in the 0.17-1.1m depth range, within existing pavement areas (proposed tie-in sections upgrades) would be classified as ENM [13], due to various analytes and foreign materials content exceeding the criteria. If the materials were disposed of offsite at a licenced waste facility, they could be considered for general solid waste classification.
- Shallow granular fill within the proposed flood access road alignment (BH06 location) could be considered for ENM classification [13] or general solid waste classification if offsite disposal is required, providing that further acid sulfate soil testing confirms there is no presence of potential or actual acid sulfate soils.
- Sandy silt subgrade material within existing pavement areas (proposed tie-in sections upgrades – TB501 location) could be considered for ENM classification [13] or general solid waste classification if offsite disposal is required.

No testing was conducted on the pavement materials encountered, however could be exempt under the NSW EPA ‘The excavated public road material order 2014’ [14]. Inspection of existing pavement materials during construction by suitable environmental consultant would be required to confirm classification under the order [14].

As mentioned, the assessment is preliminary due to the unknown nature of works proposed at the site, limited testing and resultant material quantities. The material quantities and appropriate classifications would be dependent on the construction methodology adopted, for example excavations that can separate different material types, opposed to continuous milling over a set depth with no separation between e.g. wearing course and underlying pavement and existing fill materials.

Following confirmation of the type of works and material quantities, further assessment should be conducted prior to / during construction to provide finalised classifications for reuse or disposal. Further detailed assessment would be required to satisfy Waste Classification Guidelines [12] and NSW ENM [13] requirements.

9 Limitations

Stantec has performed investigation and consulting services for this project in general accordance with current professional and industry standards. The extent of testing was limited to discrete test locations and variations in ground conditions can occur between test locations that cannot be inferred or predicted.

A geotechnical consultant or qualified engineer shall provide inspections during construction to confirm assumed conditions in this assessment. If subsurface conditions encountered during construction differ from those given in this report, further advice shall be sought without delay.

Stantec, or any other reputable consultant, cannot provide unqualified warranties nor does it assume any liability for the site conditions not observed or accessible during the investigations. Site conditions may also change subsequent to the investigations and assessment due to ongoing use.

This report and associated documentation was undertaken for the specific purpose described in the report and shall not be relied on for other purposes. This report was prepared solely for the use by Maitland City Council and any reliance assumed by other parties on this report shall be at such parties own risk.

10 References

[1] Geotechnical Centre - NSW Public Works, “Maitland Power House Control Structure: Geotechnical Investigation (Ref. 90239),” NSW Government, Novemeber 1990.

[2] NSW Department of Planning, Industry & Environment, “MinView,” [Online]. Available: minview.geoscience.nsw.gov.au. [Accessed 2023].

[3] NSW Office of Environment and Heritage, “eSPADE V2.2,” NSW Office of Environment and Heritage, April 2022. [Online]. Available: http://www.environment.nsw.gov.au/eSpade2WebApp#. [Accessed 23 June 2022].

[4] Australian Standard AS3798-2007, “Guidelines on Earthworks for Commercial and Residential Structures,” Standards Australia, 2007.

[5] ASSMAC, “Acid Sulfate Soil Manual, New South Wales,” Acid Sulfate Soil Management Advisory Committee, August 1998.

[6] Queensland Acid Sulfate Soil Technical Manual, “Soil Management Guidelines,” Department of Science, Information Technology, Innovation and the Arts, Queensland Government, June 2014.

[7] Austroads AGPT02-17, “Guide to Pavement Technology Part 2: Pavement Structural Design,” Austroads Ltd, 2017.

[8] Maitland City Council, “Manual of Engineering Standards: Chapter 5 - Pavement Design,” Maitland City Council, 2014.

[9] TfNSW QA Specification R73 (Ed 3 Rev 2), “Construction of Plant Mixed Heavily Bound Pavement Course,” Transport for NSW, June 2020.

[10] RMS QA Specification R117 (Ed 1 Rev 1), “Light Duty Dense Graded Asphalt,” Roads and Maritime Services, July 2013.

[11] Austroads APRG Report No. 18, “Selection & design of asphalt mixes: Australian provisional guide,” Austroads, May 1997.

[12] NSW EPA, “Waste Classification Guidelines - Part 1: Classifying Waste,” NSW Environment Protection Authority, Sydney, November 2014.

[13] NSW EPA, “The Excavated Natural Material Order 2014,” NSW Environment Protection Authority, 2014.

[14] NSW EPA, “The Recovered Aggregate Order 2014,” NSW Environment Protection Authority, 2014.

APPENDIX

A

FIGURES

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NOTES:

Image underlay adapted from nearmap aerial imagery and client supplied proposed flood access road layout plan (ref. 4105-PPI, rev. A, date. 02.11.2022).

LEGEND:

- BHXXX Approximate borehole locations.
- TBXXX Approximate pavement test bore locations.
- CPTXX Approximate cone penetrometer test locations.
- Approximate gully alignment.

0 50 100m

SCALE 1:2500 @A3

NORTH

Stantec
Stantec Australia Pty Ltd | ABN 17 007 820 322
Suite 2, Level 2, 22 Honeysuckle Drive
Newcastle, NSW 2300
Tel: 02 4965 4555 Fax: 02 4965 4666
Web: www.stantec.com

Drawn	MH	Date 19.12.2022
Checked	TB	Date 08.02.2023
Designed		Date
Verified		Date
Approved		

Client: MAITLAND CITY COUNCIL

Project: MCC CAPITAL WORKS PROGRAM
GEOTECHNICAL INVESTIGATION
SCOBIES LANE, OAKHAMTPON HEIGHTS

Title: TEST LOCATION SITE PLAN

Status: FOR INFORMATION ONLY
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Project Number	Scale	Size
304100979-005	1:2500	A3

Figure Number	Revision
F1	A

DATE PLOTTED: 22 February 2023 1:28 PM BY : TED BARTLETT

XREFs:
CAD File: N:\Projects\810\PY23 - 304100979_MCC Capital Works Package 1_Data In\Drawing\005- Scobies Ln\Scobies Ln - Site Plan (final).dwg

APPENDIX

B

ENGINEERING LOGS

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TEST BORE LOG SHEET

Client: Maitland City Council
Project: Pavement Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: TB501

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 776m **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 3.5 tonne Excavator **Excavation Method:** 300mm AS

Excavation Dimensions: **Contractor:** Stantec

Date Excavated: 5/12/22 **Logged By:** BC **Checked By:** TB

Drilling				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		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
300mm AS		Stable	Not Encountered	B 0.00 - 0.30 m	25	0.5			0.04m SPRAY SEAL			PAVEMENT
									PAVEMENT: Sandy GRAVEL; fine to coarse sub-rounded to sub-angular, pale grey-brown, fine to coarse grained sand, with clay			
									0.25m: trace cobbles <90mm	M		0.25 m: possible select fill layer
									0.58m			
				ES 0.70 - 0.75 m	7 9				Sandy SILT; low plasticity, dark brown, fine to medium grained sand	M (<PL)	VSt	ALLUVIUM
									0.75m: becoming light grey			
				B 0.90 - 1.50 m	5 6	1.0			0.85m			
					12				Sandy CLAY; medium to high plasticity, dark grey mottled yellow-brown, fine to medium grained sand, trace fine to medium sub-rounded to sub-angular gravel	M (>PL)	St - VSt	RESIDUAL SOIL
					12				1.30m			
									Silty Sandy CLAY; medium to high plasticity, dark brown-grey, fine to coarse grained sand, trace fine sub-rounded gravel		VSt	EXTREMELY WEATHERED
					20	1.5				M (<PL)		
					22						H	
					22							
						2.0			2.00m			
									TERMINATED AT 2.00 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
- HP - 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=Resdual (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

STANTEC AUSTRALIA PTY LTD

Stantec

TEST BORE LOG SHEET

Client: Maitland City Council
Project: Pavement Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: TB502

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 61m **Angle from Horizontal:** 90° **Surface Elevation:**

Machine Type: 3.5 tonne Excavator **Excavation Method:** 300mm AS

Excavation Dimensions: **Contractor:** Stantec

Date Excavated: 5/12/22 **Logged By:** BC **Checked By:** TB

Drilling			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		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
300mm AS		Stable	Not Encountered	B 0.00 - 0.15 m					0.02m SPRAY SEAL PAVEMENT: Silty Sandy GRAVEL; fine to coarse sub-rounded to angular, light brown-grey, fine to coarse grained sand	M		PAVEMENT
									0.17m FILL: Silty Gravelly SAND; fine to coarse grained, dark grey, fine to medium sub-angular gravel, trace cobbles Foreign materials noted including ceramic fragments	M		FILL
				ES 0.40 - 0.50 m					0.50m			
				B 0.50 - 1.00 m	1 2	0.5			Silty Sandy CLAY; medium to high plasticity, dark grey, fine to coarse grained sand, trace fine sub-rounded gravel	M (>PL)	S - F	RESIDUAL SOIL
					1 2	1.0			1.00m			
					10				Clayey SAND; fine to coarse grained, yellow-brown, trace fine sub-rounded gravel	D	VD	EXTREMELY WEATHERED
					10/25 Bouncing				1.10m TERMINATED AT 1.10 m Refusal on Weathered Rock			
						1.5						
						2.0						

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
HP - 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=Resdual (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
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F - Firm
St - Stiff
VSt - Very Stiff
H - Hard

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

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

STANTEC AUSTRALIA PTY LTD

Stantec

TEST BORE LOG SHEET

Client: Maitland City Council
Project: Pavement Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: TB503

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 394m **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 3.5 tonne Excavator **Excavation Method:** 300mm AS
Excavation Dimensions: **Contractor:** Stantec
Date Excavated: 5/12/22 **Logged By:** BC **Checked By:** TB

Drilling				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		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
300mm AS		Stable	Not Encountered	B 0.00 - 0.30 m	12	0.5			0.02m SPRAY SEAL PAVEMENT: Silty Gravelly SAND; fine to coarse grained, pale brown, fine to coarse sub-rounded gravel 0.30m: becoming reddish brown 0.60m	M		PAVEMENT
				ES 0.60 - 0.70 m	26				FILL: Gravelly Silty SAND; fine to coarse grained, brown, fine to medium sub-rounded gravel 0.85m	M		FILL
				B 0.90 - 1.30 m	5 1 2 2	1.0			Sandy SILT; low plasticity, dark brown, fine to coarse grained sand, with fine to medium sub-rounded gravel 1.30m	M (<PL)	S - F	ALLUVIUM
					3				Silty SAND; fine to medium grained, brown 1.50m	D - M	L - MD	
					3 2 4	1.5 2.0			Sandy SILT; low plasticity, brown, fine grained sand 2.00m	M (>PL)	F - St	
									TERMINATED AT 2.00 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

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VH Very Hard (Refusal)

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Water Level on Date shown
water inflow
water outflow

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D - Dense
VD - Very Dense

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

STANTEC AUSTRALIA PTY LTD

Stantec

TEST BORE LOG SHEET

Client: Maitland City Council
Project: Pavement Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: TB504

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 290m **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 3.5 tonne Excavator **Excavation Method:** 300mm AS
Excavation Dimensions: **Contractor:** Stantec
Date Excavated: 5/12/22 **Logged By:** BC **Checked By:** TB

Drilling			Water	Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability		Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		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
300mm AS		Stable	Not Encountered	B 0.00 - 0.25 m					0.02m SPRAY SEAL			PAVEMENT
									PAVEMENT: Silty Gravelly SAND; fine to coarse grained, light brown, fine to coarse sub-rounded to sub-angular	D - M		
									0.26m: becoming brown, with cobbles			
									0.40m SPRAY SEAL			
					25	0.5			0.50m			
					25/75 HB				PAVEMENT: Gravelly SAND; fine to coarse grained, brown-grey, fine to medium rounded to sub-angular gravel, with clay	M		
				ES 0.60 - 0.70 m								
									0.90-1.00m: hard fill layer / band	D		
				B 1.00 - 1.30 m		1.0			1.00m Sandy SILT; low plasticity, brown, fine to medium grained sand, with fine sub-rounded gravel			ALLUVIUM
									1.35m: becoming dark brown, fine grained sand, no gravel inclusions	M (>PL)		
						1.5						
						2.0			2.00m TERMINATED AT 2.00 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
HP - 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=Resdual (uncorrected kPa)

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ES - Environmental sample
U - Thin wall tube 'undisturbed'

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PL - Plastic limit
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w - Moisture content

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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

STANTEC AUSTRALIA PTY LTD

Stantec

TEST BORE LOG SHEET

Client: Maitland City Council
Project: Pavement Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: TB505

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 200m **Angle from Horizontal:** 90° **Surface Elevation:**
Machine Type: 3.5 tonne Excavator **Excavation Method:** 300mm AS
Excavation Dimensions: **Contractor:** Stantec
Date Excavated: 5/12/22 **Logged By:** BC **Checked By:** TB

Drilling				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Stability	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		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
300mm AS		Stable	Not Encountered	B 0.00 - 0.30 m		0.5			0.02m SPRAY SEAL PAVEMENT: Silty Gravelly SAND; fine to coarse grained, light brown, fine to coarse sub-rounded to sub-angular gravel	D - M		PAVEMENT
					47				0.30m 0.32m SPRAY SEAL PAVEMENT: Silty Gravelly SAND; fine to coarse grained, brown, fine to coarse sub-rounded to sub-angular gravel, with cobbles	D - M		
					30				0.63m 0.60-0.63m hard fill layer / band FILL: Silty Gravelly SAND; fine to coarse grained, brown-grey, fine to coarse sub-rounded to sub-angular gravel	D - M		FILL
				B 0.70 - 1.00 m	30/100 VR	1.0			0.90m: becoming light brown, with cobbles			
						1.5			1.10m Sandy SILT; low plasticity, dark brown, fine grained sand	M (<PL)		ALLUVIUM
				ES 1.60 - 1.70 m								
						2.0			2.00m TERMINATED AT 2.00 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
HP - 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=Resdual (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

STANTEC AUSTRALIA PTY LTD

Stantec

BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH01

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 435m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Edson Versadrill MRA 260 **Mounting:** 4wd Ute **Driller:** MH
Casing Diameter: Uncased **Contractor:** Stantec
Date Started: 24/11/22 **Date Completed:** 24/11/22 **Logged By:** GE **Checked By:** TB

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Sampling & Testing: DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)	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/V		Uncased	Not Observed		6	0.0			TOPSOIL: Sandy SILT; dark brown, fine to coarse grained sand	M (<PL)		TOPSOIL
					12	0.10m			Silty CLAY; medium to high plasticity, dark brown, with fine to medium grained sand	M (<PL)	VSt	ALLUVIUM
					12	0.40m			Sandy SILT; low plasticity, dark brown, fine to coarse grained sand, lenses of clay	D - M	St	
					6	0.5						
					3							
					2				0.90m: with clay		F	
					2	1.0						
					2	1.20m			Silty SAND; fine to coarse grained, brown, trace clay	M	MD	
				SPT 1.40 - 1.85 m 3, 1, 1 N*=2	5							1.40 m: SPT from 1.40 to target depth 1.40 m: SPT Recovery: 0.45 m
					5	1.5						
					1						L - VL	
					0							
				SPT 1.85 - 2.30 m 1, 2, 2 N*=4	2	1.90m			Silty CLAY; medium to high plasticity, grey-black mottled orange			1.85 m: SPT Recovery: 0.45 m
					3	2.0						
					5						F	
				SPT 2.30 - 2.75 m 2, 3, 4 N*=7	8					M (>PL)		2.30 m: SPT Recovery: 0.45 m
					10	2.5						
					12							
				SPT 2.75 - 3.20 m 3, 4, 6 N*=10	16						St	2.75 m: SPT Recovery: 0.45 m
					20	3.00m						
					20	3.0			TERMINATED AT 3.00 m Target depth			
					22							

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

MOISTURE
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W - Wet
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LL - Liquid limit
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SOIL CONSISTENCY
VS - Very Soft
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RELATIVE DENSITY
VL - Very Loose
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MD - Medium Dense
D - Dense
VD - Very Dense

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STANTEC AUSTRALIA PTY LTD

Stantec

BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH02

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 485m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Edson Versadrill MRA 260 **Mounting:** 4wd Ute **Driller:** MH
Casing Diameter: Uncased **Contractor:** Stantec
Date Started: 5/12/22 **Date Completed:** 5/12/22 **Logged By:** JE **Checked By:** TB

Drilling				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		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/V		Uncased			3 4 4 4 3	0.5			TOPSOIL FILL: Clayey SILT; dark brown, trace fine grained sand	M (≈PL) to M (<PL)		FILL
				ES 0.45 m					0.30m FILL: Silty CLAY; low to medium plasticity, dark brown-black, trace fine grained sand, trace fine to medium angular to sub-rounded gravel	M (≈PL) to M (<PL)	F - St	
									0.80m Clayey SILT; low to medium plasticity, brown, trace fine grained sand	M (>PL) to M (<LL)	F	ALLUVIUM 0.90 m: Possible Groundwater inflow
	E			ES 0.95 m	3 2 3 2	1.0						
				ES 1.40 m	2 1 2 1	1.5				M (<LL) to M (≈ LL)		1.60 m: Groundwater at 1.6m BGL after 1 hour
				ES 1.95 m	3 5 7	2.0			1.85m Silty CLAY; medium to high plasticity, grey-brown mottled red, trace fine grained sand	M (>PL)	F	1.80 m: Groundwater at 1.8m BGL after 10 minutes
	E-F			ES 2.40 m	11 11	2.5						
	F			ES 2.90 m	17	3.0			3.00m TERMINATED AT 3.00 m Target depth		St - VSt	

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
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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
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F Firm
H Hard
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WATER
Water Level on Date shown
water inflow
water outflow

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STANTEC AUSTRALIA PTY LTD

Stantec

BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH03

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 310m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Edson Versadrill MRA 260 **Mounting:** 4wd Ute **Driller:** MH
Casing Diameter: Uncased **Contractor:** Stantec
Date Started: 5/12/22 **Date Completed:** 5/12/22 **Logged By:** JE **Checked By:** TB

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Sampling & Testing: DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)	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/V		Uncased	Not Observed		3	0			TOPSOIL FILL: Clayey SILT; dark brown, trace fine grained sand	M (<PL)		FILL
				B 0.15 - 0.50 m	3				0.15m CLAY; medium to high plasticity, grey-brown mottled red, trace fine grained sand	M (≈PL)		ALLUVIUM
					3							
				ES 0.45 m	4	0.5					St	
					3							
					4							
				ES 0.95 m	4	1.0						
					7					M (>PL)		
					9							
				ES 1.45 m	13	1.5						
					16							
					20							
					24							
				ES 1.95 m	14	2.0					St - VSt	
					14/50 VR				2.20m: becoming brown mottled grey and orange, with fine to medium grained sand, trace fine to medium sub-angular gravel	M (≈PL)		
				ES 2.45 m		2.5						
				SPT 2.50 - 2.95 m 2, 5, 8 N*=13					2.50m: becoming grey-brown mottled orange	M (>PL)		2.50 m: SPT Recovery: 0.45 m
						3.0			3.00m 2.95m: becoming pale grey mottled orange-brown and black TERMINATED AT 3.00 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
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WATER
Water Level on Date shown
water inflow
water outflow

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STANTEC AUSTRALIA PTY LTD

Stantec

BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH04

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 25m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Edson Versadrill MRA 260 **Mounting:** 4wd Ute **Driller:** MH
Casing Diameter: Uncased **Contractor:** Stantec
Date Started: 5/12/22 **Date Completed:** 5/12/22 **Logged By:** JE **Checked By:** TB

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Sampling & Testing: DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)	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/V		Uncased	Not Encountered		7 7 7 6	0.5			TOPSOIL FILL: Clayey SILT; dark brown, trace fine grained sand	M (<PL)		FILL
				B 0.30 - 0.65 m					0.20m FILL: Sandy CLAY; low plasticity, brown, fine to medium grained sand, with occasional sand lenses	M (<PL)	VSt	
				ES 0.45 m					0.50m Silty CLAY; low to medium plasticity, grey-brown, with fine to medium grained sand	M (<PL)	St	ALLUVIUM
				ES 0.95 m	5 5 4	1.0						
				ES 1.45 m	3 4 4	1.5			1.65m	M (≈PL)		
				D 1.70 - 2.00 m	5				Sandy Silty CLAY; low plasticity, dark grey-brown, fine to medium grained sand			
				ES 1.95 m	7 7	2.0				M (≈PL)	St - VSt	
				ES 2.45 m	8 8 8	2.5			2.60m Silty CLAY; medium plasticity, grey-brown, with fine to medium grained sand	M (≈PL)	St - VSt	
				ES 2.95 m	8 10	3.0			3.00m TERMINATED AT 3.00 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
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HFA Hollow flight auger
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RR Rock roller

PENETRATION
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WATER
Water Level on Date shown
water inflow
water outflow

FIELD TESTS
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STANTEC AUSTRALIA PTY LTD

Stantec

BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH05

Job No: 304100979-005 **Sheet:** 1 of 2

Position: Refer to Site Plan - Ch 140m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Edson Versadrill MRA 260 **Mounting:** 4wd Ute **Driller:** MH
Casing Diameter: Uncased **Contractor:** Stantec
Date Started: 5/12/22 **Date Completed:** 5/12/22 **Logged By:** JE **Checked By:** TB

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Sampling & Testing: DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)	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/V		Uncased			7	0			TOPSOIL FILL: Clayey SILT; dark brown, trace fine grained sand			FILL
						0.15m						
				ES 0.45 m	9 5 7	0.5			Clayey SILT; low to medium plasticity, brown, trace fine grained sand, trace fine angular to sub-rounded gravel	M (<PL)	St - VSt	ALLUVIUM
						0.65m						
				D 0.70 - 1.00 m	5 4				SAND; fine to medium grained, brown, with clay	M (<PL)	L - MD	
				ES 0.95 m	2	1.0						
					3							
				D 1.20 - 1.50 m	4				Silty SAND; fine to medium grained, brown	D	L - MD	
				ES 1.45 m	4	1.5						
				D 1.60 - 1.90 m	3 2							
					2							
						1.90m						
				D 2.00 - 2.20 m ES 2.00 m	3	2.0			Clayey SAND; fine to medium grained, brown, low plasticity clay	M	L	
					2							
						2.30m						
				ES 2.45 m	3 4	2.5			Silty SAND; fine to medium grained, brown 2.40m: with clay	M	L - MD	
					6 4							
				SPT 3.00 - 3.45 m 1, 2, 1 N*=3		3.0			3.10m: no clay	M	VL - L	3.00 m: SPT Recovery: 0.45 m

METHOD
EX Excavator bucket
R Ripper
HA Hand auger
PT Push tube
SON Sonic drilling
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AD/V Solid flight auger: V-Bit
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STANTEC AUSTRALIA PTY LTD

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BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH05

Job No: 304100979-005 **Sheet:** 2 of 2

Position: Refer to Site Plan - Ch 140m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Edson Versadrill MRA 260 **Mounting:** 4wd Ute **Driller:** MH
Casing Diameter: Uncased **Contractor:** Stantec
Date Started: 5/12/22 **Date Completed:** 5/12/22 **Logged By:** JE **Checked By:** TB

Drilling				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		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/V		Uncased							Silty SAND; fine to medium grained, brown *(continued)*	M	VL - L	ALLUVIUM 3.50 m: Groundwater inflow 3.60 m: Groundwater level after 10 minutes
				D 3.70 - 4.00 m ES 3.95 m				3.65m	Silty CLAY; medium plasticity, grey mottled brown-orange, with fine grained sand			
				SPT 4.00 - 4.45 m 1, 3, 4 N*=7		4.0			4.00m: medium to high plasticity	M (≈PL)	F - St	4.00 m: SPT Recovery: 0.45 m
						4.5						
				SPT 5.00 - 5.45 m 3, 5, 6 N*=11		5.0		5.00m				
								5.40m	Silty SAND; fine to medium grained, dark grey-brown, with clay (clay pockets/lenses throughout)	W	L - MD	5.00 m: SPT Recovery: 0.45 m
						5.5			Silty CLAY; high plasticity, grey mottled brown and orange, with fine grained sand, trace fine sub-rounded gravel	M (>PL)	St	
						6.0		6.00m	TERMINATED AT 6.00 m Target depth			
						6.5						

METHOD
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VD - Very Dense

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

STANTEC AUSTRALIA PTY LTD

Stantec

BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH06

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 662m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Edson Versadrill MRA 260 **Mounting:** 4wd Ute **Driller:** MH
Casing Diameter: Uncased **Contractor:** Stantec
Date Started: 8/12/22 **Date Completed:** 8/12/22 **Logged By:** MH **Checked By:** TB

Drilling				Sampling & Testing		Depth (m)	Material Description					
Method	Resistance	Casing	Water	Sample or Field Test	DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)		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
300mm AS		Uncased	Not Encountered	D 0.08 - 0.45 m ES 0.08 - 0.18 m	15 5 7 5	0.5			FILL: Silty SAND; fine to coarse grained, dark brown, with organics 0.15m: with fine to coarse gravel	D - M	MD	Possibly FILL 0.00 m: 50mm fine to coarse, anglular gravel surfacing
				B 0.60 - 0.80 m 16kg D 0.60 - 0.80 m 15kg ES 0.60 - 0.70 m	2 3			0.52m	FILL: Silty CLAY; medium to high plasticity, mottled brown, grey and orange, with fine to coarse angular to sub-angular gravel, with organics	M (≈PL) - M (>PL)	St	
				ES 0.95 m	6	1.0		1.00m	Silty CLAY; medium to high plasticity, brown-orange and grey, with fine to coarse angular to sub-angular gravel, with organics	M (≈PL) - M (>PL)	St	RESIDUAL SOIL
				ES 1.30 m	18 21			1.20m	Silty Sandy CLAY; medium plasticity, yellow-brown, fine to coarse grained sand	M (<PL) - M (≈PL)	H	
				ES 1.50 m	19 10 VR 10/50mm	1.5		1.40m	Sandy CLAY; low plasticity, yellow-brown and grey-white, fine to coarse grained sand	M (<PL)	H	EXTREMELY WEATHERED
				ES 1.95 m				1.70m	Clayey SAND; fine to coarse grained, yellow-brown and orange, lenses of sandy clay	M	D - VD	
						2.0		2.00m	TERMINATED AT 2.00 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
HP - 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=Resdual (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

STANTEC AUSTRALIA PTY LTD

Stantec

BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH07

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 548m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Edson Versadrill MRA 260 **Mounting:** 4wd Ute **Driller:** MH
Casing Diameter: Uncased **Contractor:** Stantec
Date Started: 8/12/22 **Date Completed:** 8/12/22 **Logged By:** MH **Checked By:** TB

Drilling: Method	Drilling: Resistance	Drilling: Casing	Water	Sampling & Testing: Sample or Field Test	Sampling & Testing: DCP TEST (AS 1289.6.3.2-1997) Blows/150 mm (3 6 9 12)	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
300mm AS		Uncased	Not Encountered		33				TOPSOIL FILL: Silty SAND; fine to coarse grained, brown, with fine to coarse gravel	D		FILL
				D 0.15 - 0.25 m 10kg	32			0.10m	FILL: Sandy GRAVEL; fine to coarse angular to sub-angular, brown, fine to coarse grained sand, with chunks of asphalt/coal chitter	D - M	VD	
					8			0.30m	Silty CLAY; medium to high plasticity, dark brown mottled orange-brown and red			RESIDUAL SOIL
				B 0.40 - 0.70 m 20kg ES 0.40 - 0.50 m	5	0.5				M (>PL)	St	
				ES 0.60 m	5							
				ES 0.85 m	10			0.80m	Silty CLAY; low to medium plasticity, brown mottled grey, orange and yellow-orange	M (<PL)	VSt	
					14	1.0		1.00m	Silty CLAY; low plasticity, grey mottled yellow-orange			EXTREMELY WEATHERED
				ES 1.10 m	30					M (<PL)	H	
					30				1.20m: becoming grey			
					R; HB 30/125mm	1.5		1.30m	TERMINATED AT 1.30 m Refusal on Weathered Rock			
						2.0						

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
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Water Level on Date shown
water inflow
water outflow

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VS - Vane Shear; P=Peak, R=Resdual (uncorrected kPa)

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

STANTEC AUSTRALIA PTY LTD

Stantec

BOREHOLE LOG SHEET

Client: Maitland City Council
Project: Geotechnical Investigation - Proposed Flood Access Road
Location: Scobies Lane, Oakhampton Heights

Hole No: BH101

Job No: 304100979-005 **Sheet:** 1 of 1

Position: Refer to Site Plan - Ch 600m **Angle from Horizontal:** 90° **Surface Elevation:**
Rig Type: Geoprobe 6625 CPT Rig **Mounting:** Track **Driller:** MG
Casing Diameter: **Contractor:** Stratacore Drilling
Date Started: 8/2/23 **Date Completed:** 8/2/23 **Logged By:** TB **Checked By:**

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			Not Encountered		0.5			FILL: Silty Gravelly SAND, fine to coarse grained, brown, fine to coarse gravel, trace organics	D		FILL 0.00 m: Approx. observed material during anchoring of CPT rig. No CPT undertaken due to shallow weathered rock.
								0.50m Silty CLAY, medium plasticity, grey	M (≈PL)		RESIDUAL SOIL
					1.0			0.80m SILTSTONE/SANDSTONE, grey-brown, highly weathered 1.00m TERMINATED AT 1.00 m Target depth			WEATHERED ROCK
					1.5						
					2.0						

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
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E Easy
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H Hard
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Water Level on Date shown
water inflow
water outflow

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

STANTEC AUSTRALIA PTY LTD

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

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

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

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)

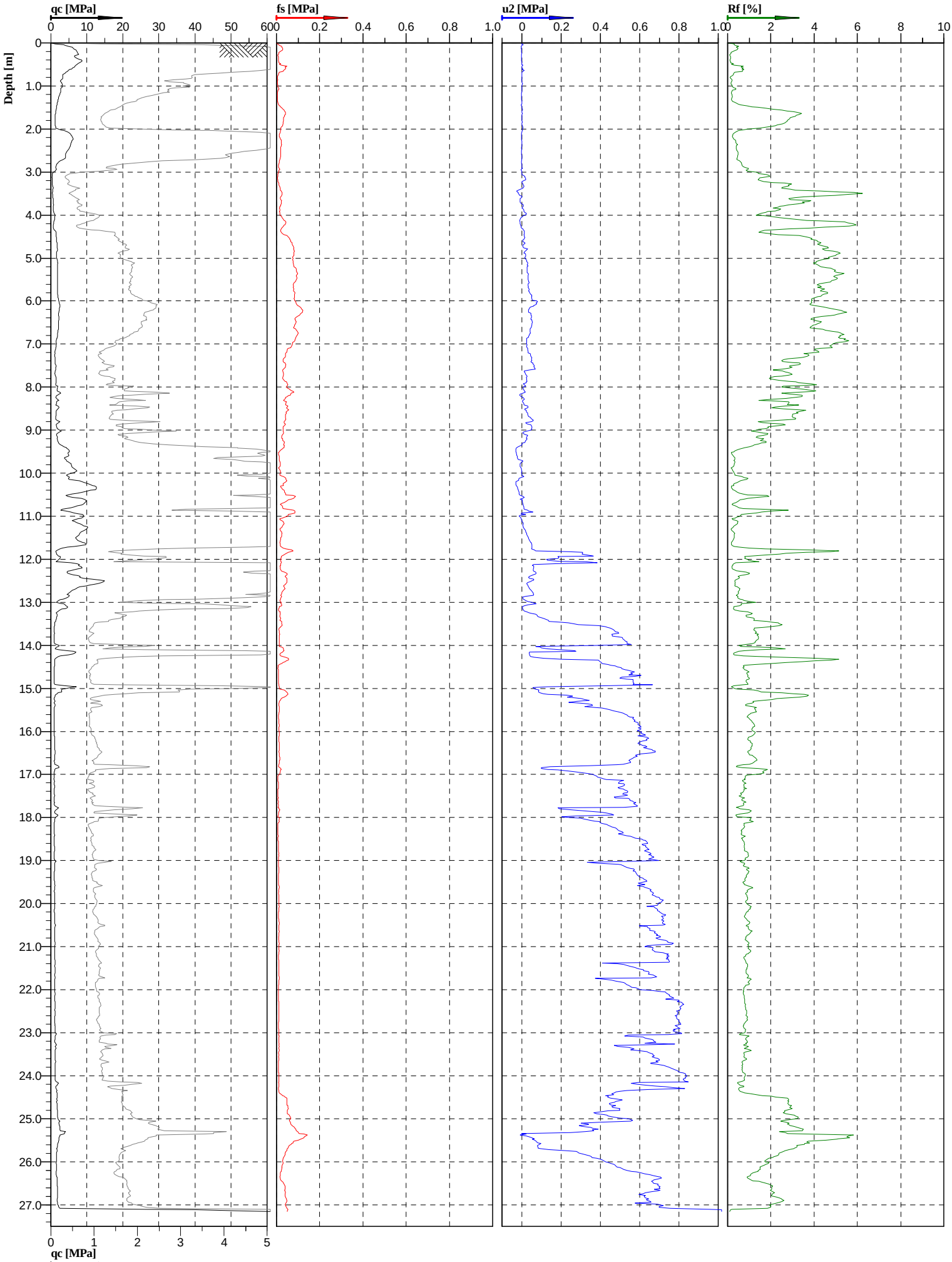
Igneous rock: Mafic, fine to medium (BASALT, DOLERITE)

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)

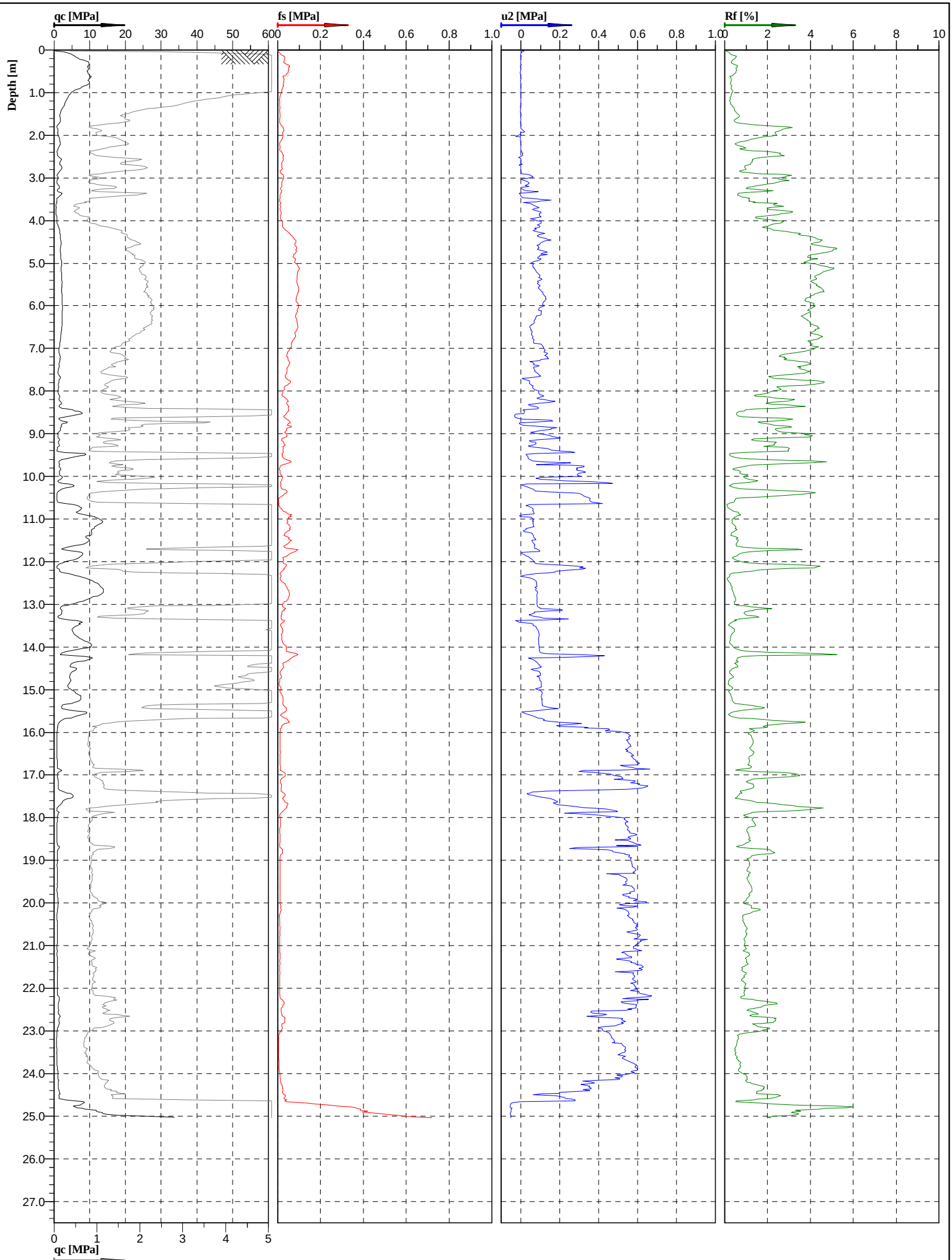


U2

stratacore

Cone No: 4254
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: South Willards Lane, Oakhampton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: CPT01
Project ID: 304100979	Client: Stantec	Date: 8/02/2023	Scale: 1 : 110
Project: Geotechnical Investigation		Page: 1/1	Fig:
		File: CPT01.cpt	



Cone No: 4254
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: South Willards Lane, Oakhampton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: CPT02
Project ID: 304100979	Client: Stantec	Date: 8/02/2023	Scale: 1 : 110
Project: Geotechnical Investigation		Page: 1/1	Fig:
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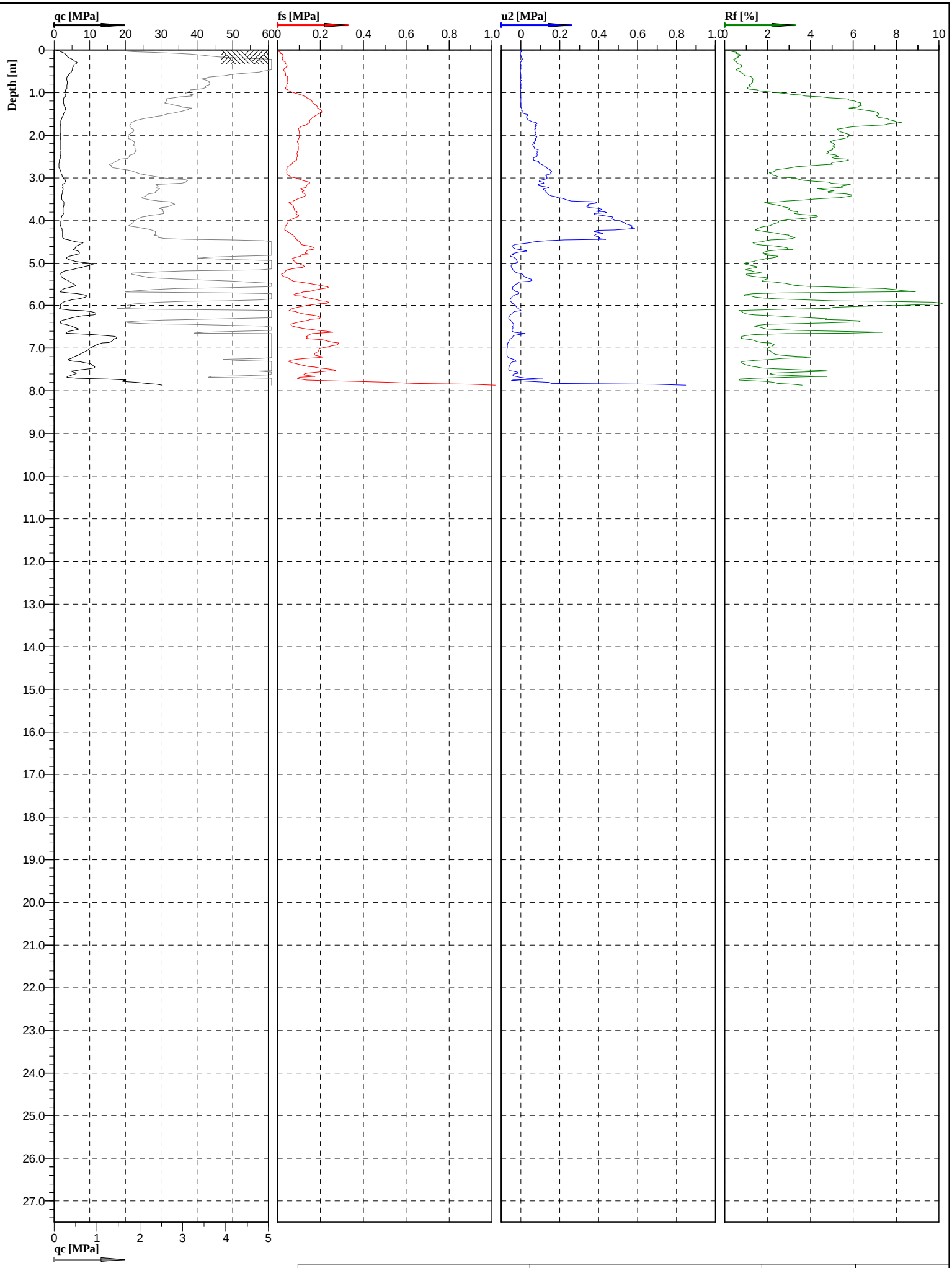
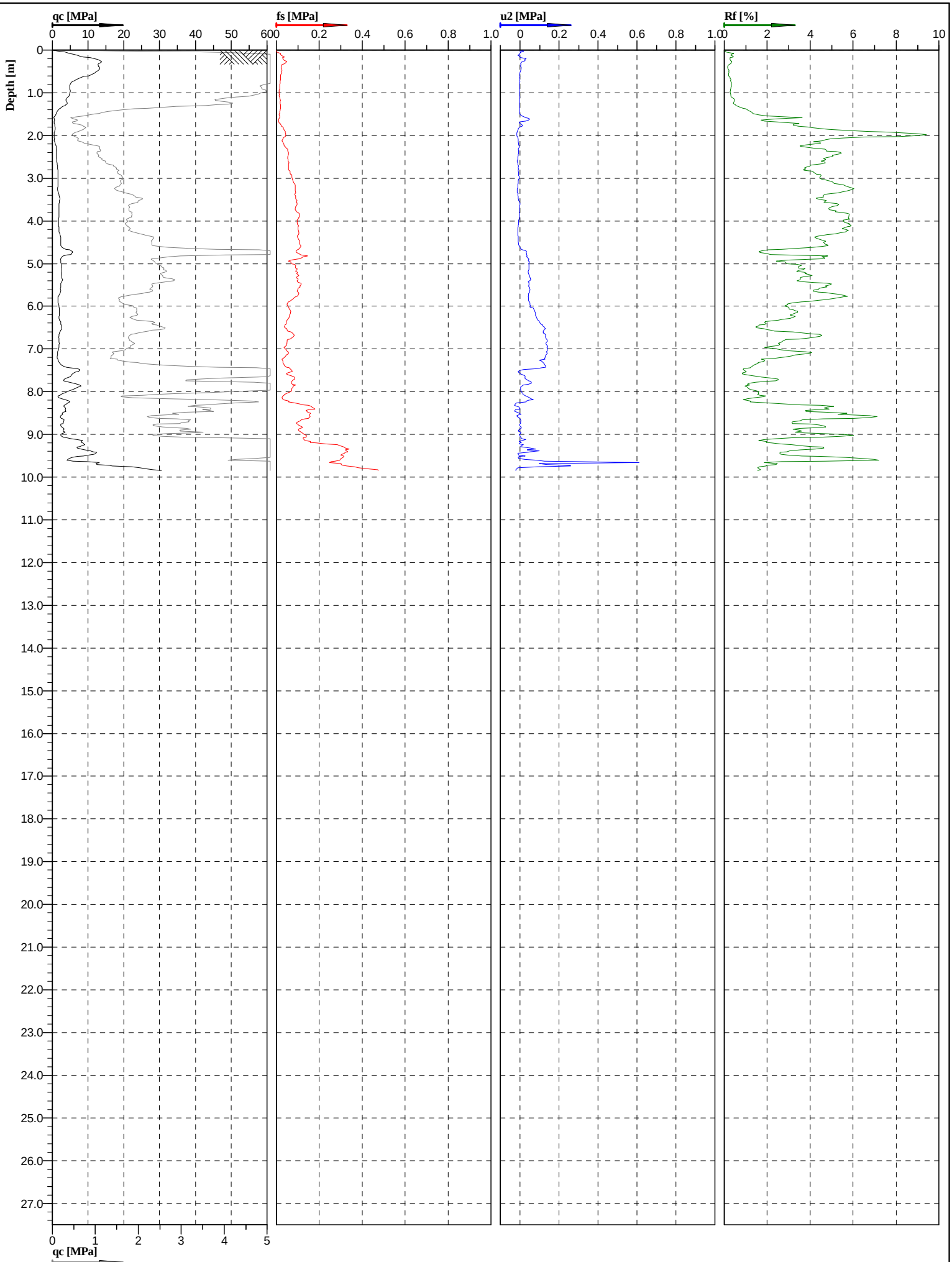


U2

stratacore

Cone No: 4254
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: South Willards Lane, Oakhampton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: CPT03
Project ID: 304100979	Client: Stantec	Date: 8/02/2023	Scale: 1 : 110
Project: Geotechnical Investigation		Page: 1/1	Fig:
		File: CPT03.cpt	

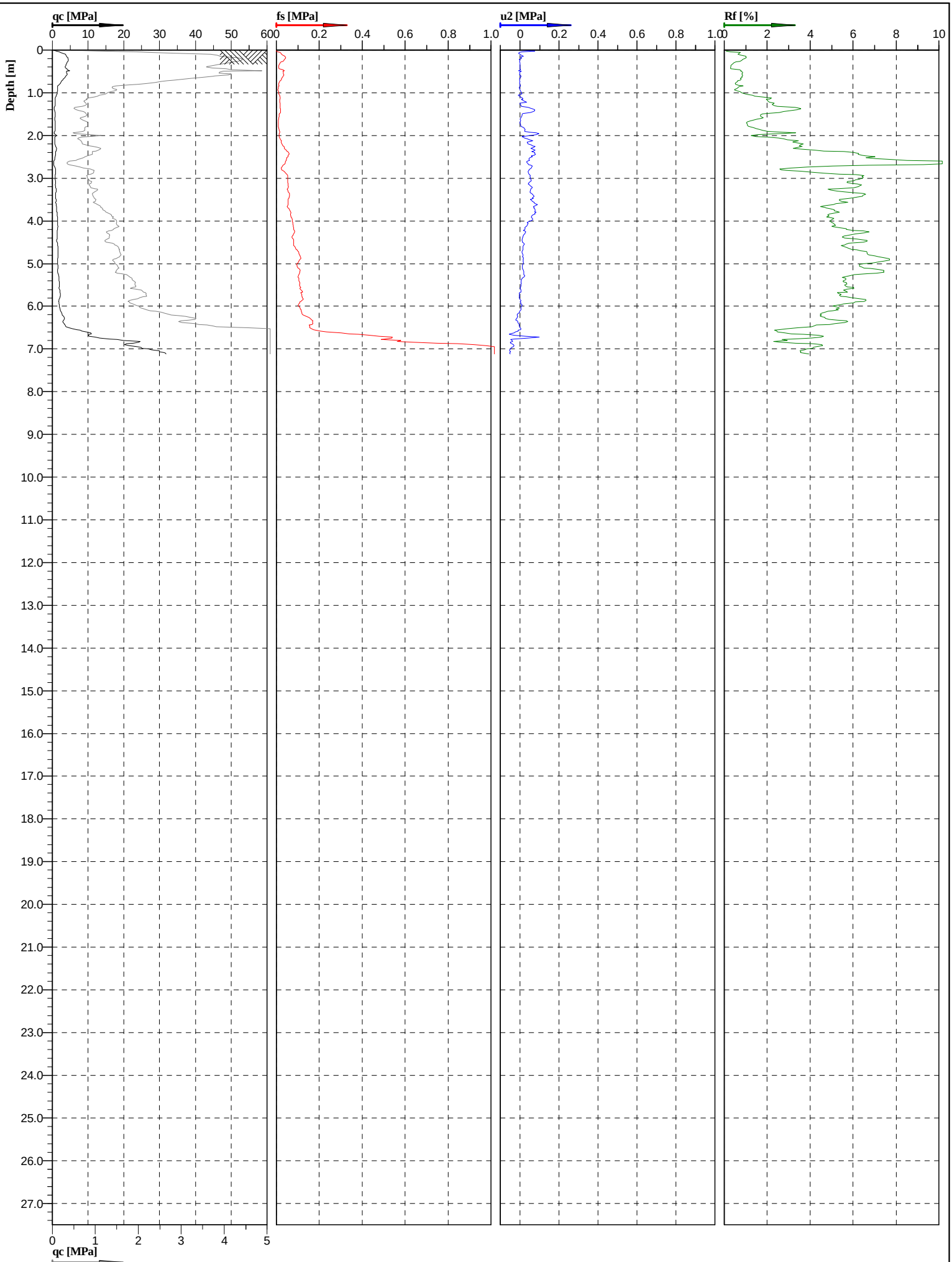


U2

stratacore

Cone No: 4254
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: South Willards Lane, Oakhampton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: CPT04
Project ID: 304100979	Client: Stantec	Date: 8/02/2023	Scale: 1 : 110
Project: Geotechnical Investigation		Page: 1/1	Fig:
		File: CPT04.cpt	



stratacore

Cone No: 4254
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: South Willards Lane, Oakhampton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: CPT05
Project ID: 304100979	Client: Stantec	Date: 8/02/2023	Scale: 1 : 110
Project: Geotechnical Investigation		Page: 1/1	Fig:
		File: CPT05.cpt	

APPENDIX

C

LABORATORY TEST RESULTS

Cardno

now

Stantec

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

California Bearing Ratio Test Report

Report No: CBR:NEWC22S-10766
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

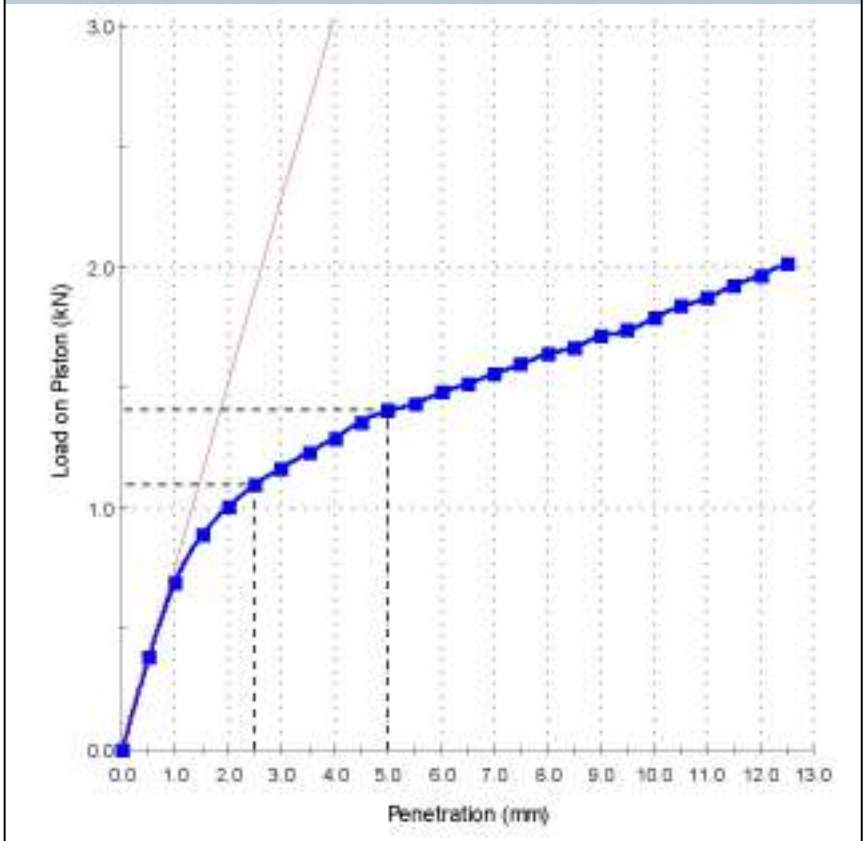
Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 6/02/2023

Sample Details

Sample ID:	NEWC22S-10766	**Sampling Method:**	Submitted by client*
Client ID:		**Material:**	Existing Ground
Date Sampled:	6/12/2022	**Source:**	On-Site
Date Submitted:	13/12/2022	**Specification:**	No Specification
Date Tested:	31/01/2023		
Project Location:	Various Locations		
Sample Location:	Scoobies Lane, NSW, TB02 - 0.5 - 1.0m		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 2.5mm (%):	**8**
Dry Density before Soaking (t/m³):	1.78
Density Ratio before Soaking (%):	100.0
Moisture Content before Soaking (%):	15.5
Moisture Ratio before Soaking (%):	100.5
Dry Density after Soaking (t/m³):	1.79
Density Ratio after Soaking (%):	100.0
Swell (%):	0.0
Moisture Content of Top 30mm (%):	19.3
Moisture Content of Remaining Depth (%):	17.2
Compaction Hammer Used:	Standard
	AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	5
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	33
Plasticity Determination Method:	Visual/Tactile
——— AS 1289.2.1.1 ———	
In Situ (Field) Moisture Content (%):	15.1

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Maximum Dry Density Report

Report No: MDD:NEWC22S-10766
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

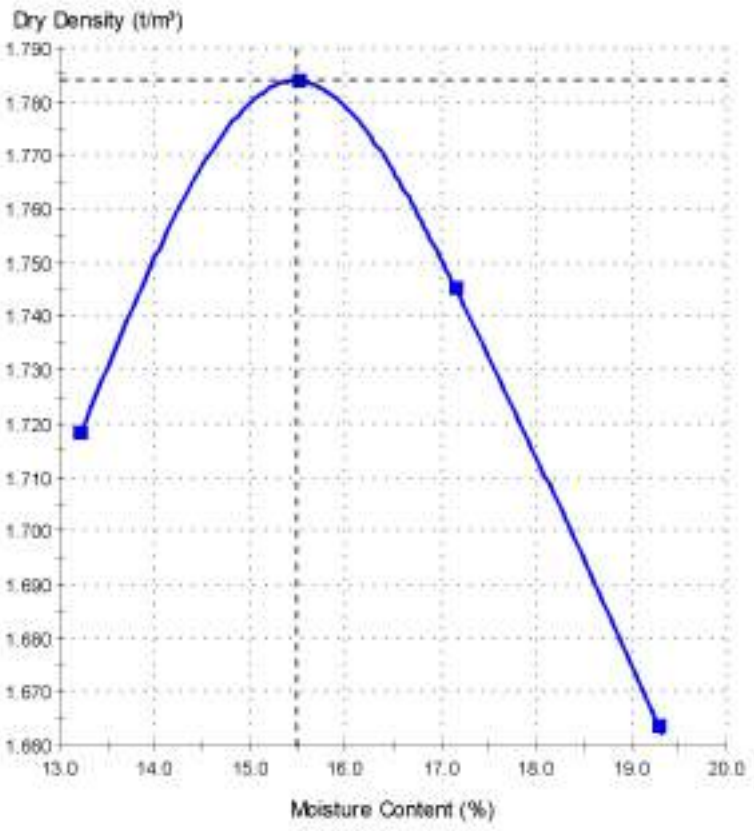
Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 2/02/2023

Sample Details

Sample ID: NEWC22S-10766
Date Sampled: 6/12/2022
Date Submitted: 13/12/2022
Date Tested: 31/01/2023
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW, TB02 - 0.5 - 1.0m

Sampling Method: Submitted by client*
Material: Existing Ground
Source: On-Site
Specification: No Specification

Dry Density - Moisture Content Relationship



Test Results

	AS 1289.5.1.1
Standard MDD (t/m³):	**1.78**
Standard OMC (%):	**15.5**
Retained Sieve (mm):	19.0
Oversize Material (%):	5
Curing Time (h):	72
LL Method:	Visual / Tactile

Comments

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

California Bearing Ratio Test Report

Report No: CBR:NEWC22S-10767
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

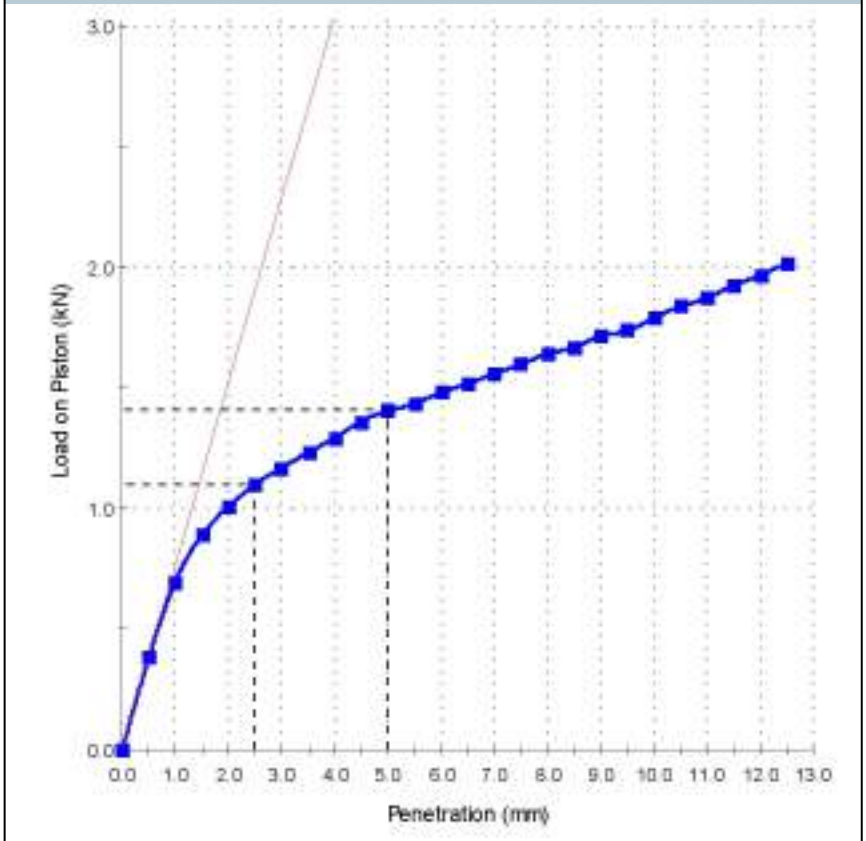
Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 6/02/2023

Sample Details

Sample ID: NEWC22S-10767
Client ID:
Date Sampled: 6/12/2022
Date Submitted: 13/12/2022
Date Tested: 31/01/2023
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW, TB04 - 0.7 - 1.0m

Sampling Method: Submitted by client*
Material: Existing Ground
Source: On-Site
Specification: No Specification

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 2.5mm (%):	**8**
Dry Density before Soaking (t/m³):	1.88
Density Ratio before Soaking (%):	99.0
Moisture Content before Soaking (%):	5.7
Moisture Ratio before Soaking (%):	99.0
Dry Density after Soaking (t/m³):	1.87
Density Ratio after Soaking (%):	98.5
Swell (%):	0.5
Moisture Content of Top 30mm (%):	13.8
Moisture Content of Remaining Depth (%):	13.1
Compaction Hammer Used:	Standard AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	2
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	29
Plasticity Determination Method:	Visual/Tactile
———— AS 1289.2.1.1 ————	
In Situ (Field) Moisture Content (%):	7.8

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Maximum Dry Density Report

Report No: MDD:NEWC22S-10767
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

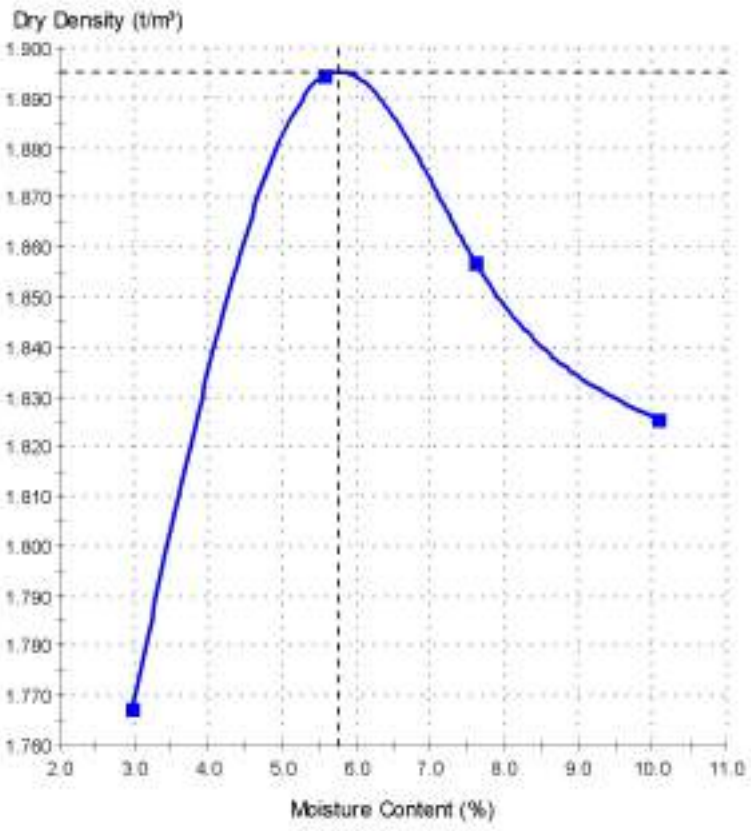
Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 6/02/2023

Sample Details

Sample ID:	NEWC22S-10767	**Sampling Method:**	Submitted by client*
Date Sampled:	6/12/2022	**Material:**	Existing Ground
Date Submitted:	13/12/2022	**Source:**	On-Site
Date Tested:	31/01/2023	**Specification:**	No Specification
Project Location:	Various Locations		
Sample Location:	Scoobies Lane, NSW, TB04 - 0.7 - 1.0m		

Dry Density - Moisture Content Relationship



Test Results

	AS 1289.5.1.1
Standard MDD (t/m³):	**1.90**
Standard OMC (%):	**6.0**
Retained Sieve (mm):	19.0
Oversize Material (%):	2
Curing Time (h):	25
LL Method:	Visual / Tactile

Comments

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

California Bearing Ratio Test Report

Report No: CBR:NEWC22S-10768
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

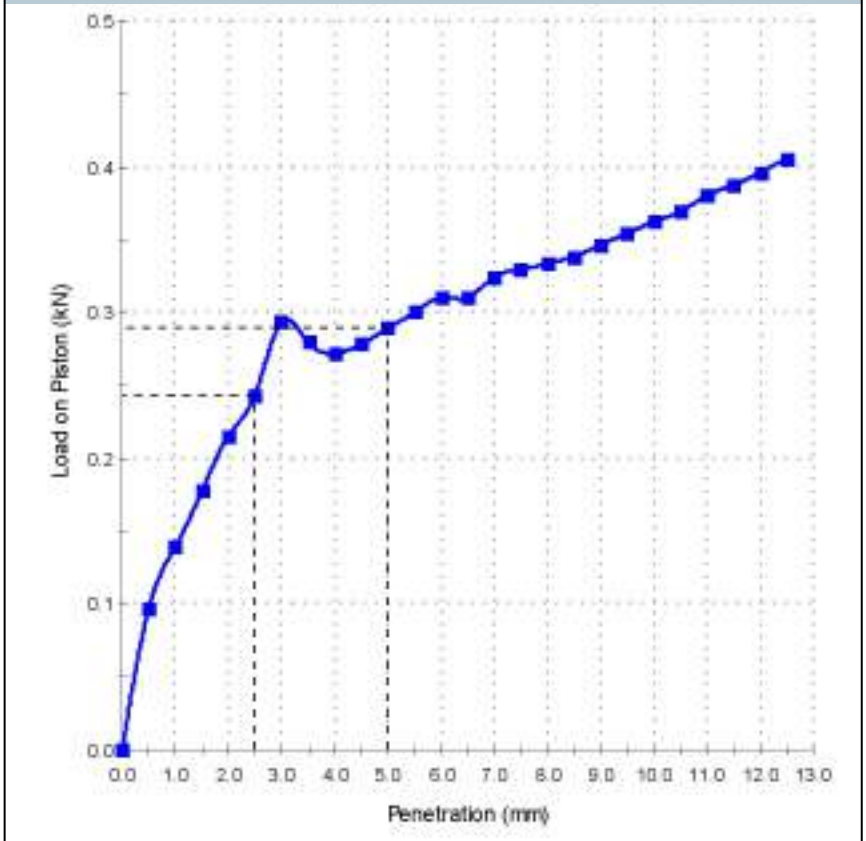
Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 30/01/2023

Sample Details

Sample ID: NEWC22S-10768
Client ID: -
Date Sampled: 6/12/2022
Date Submitted: 13/12/2022
Date Tested: 16/12/2022
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW, BH03 - 0.15 - 0.5m

Sampling Method: Submitted by client*
Material: Existing Ground
Source: On-Site
Specification: No Specification

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 2.5mm (%):	**2.0**
Dry Density before Soaking (t/m³):	1.41
Density Ratio before Soaking (%):	101.0
Moisture Content before Soaking (%):	30.0
Moisture Ratio before Soaking (%):	96.0
Dry Density after Soaking (t/m³):	1.40
Density Ratio after Soaking (%):	100.5
Swell (%):	0.5
Moisture Content of Top 30mm (%):	31.3
Moisture Content of Remaining Depth (%):	31.5
Compaction Hammer Used:	Standard AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	28
Plasticity Determination Method:	AS 1289.3.1.1
——— AS 1289.2.1.1 ———	
In Situ (Field) Moisture Content (%):	29.0

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Maximum Dry Density Report

Report No: MDD:NEWC22S-10768
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

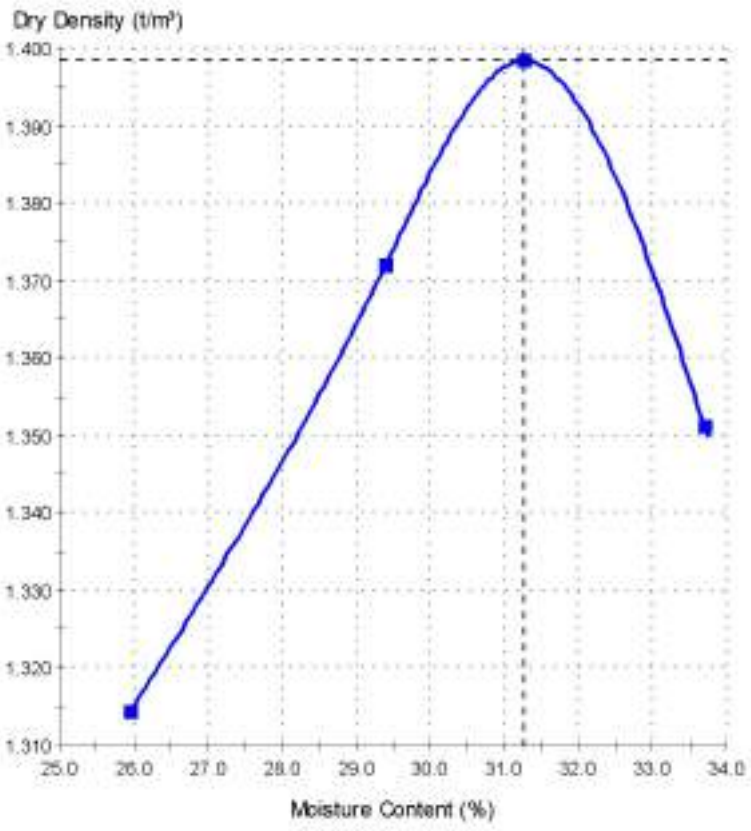
Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 21/12/2022

Sample Details

Sample ID: NEWC22S-10768
Date Sampled: 6/12/2022
Date Submitted: 13/12/2022
Date Tested: 14/12/2022
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW, BH03 - 0.15 - 0.5m

Sampling Method: Submitted by client*
Material: Existing Ground
Source: On-Site
Specification: No Specification

Dry Density - Moisture Content Relationship



Test Results

	AS 1289.5.1.1
Standard MDD (t/m³):	**1.40**
Standard OMC (%):	**31.5**
Retained Sieve (mm):	19.0
Oversize Material (%):	0
Curing Time (h):	144
LL Method:	Visual / Tactile

Comments

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

California Bearing Ratio Test Report

Report No: CBR:NEWC22S-10769
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

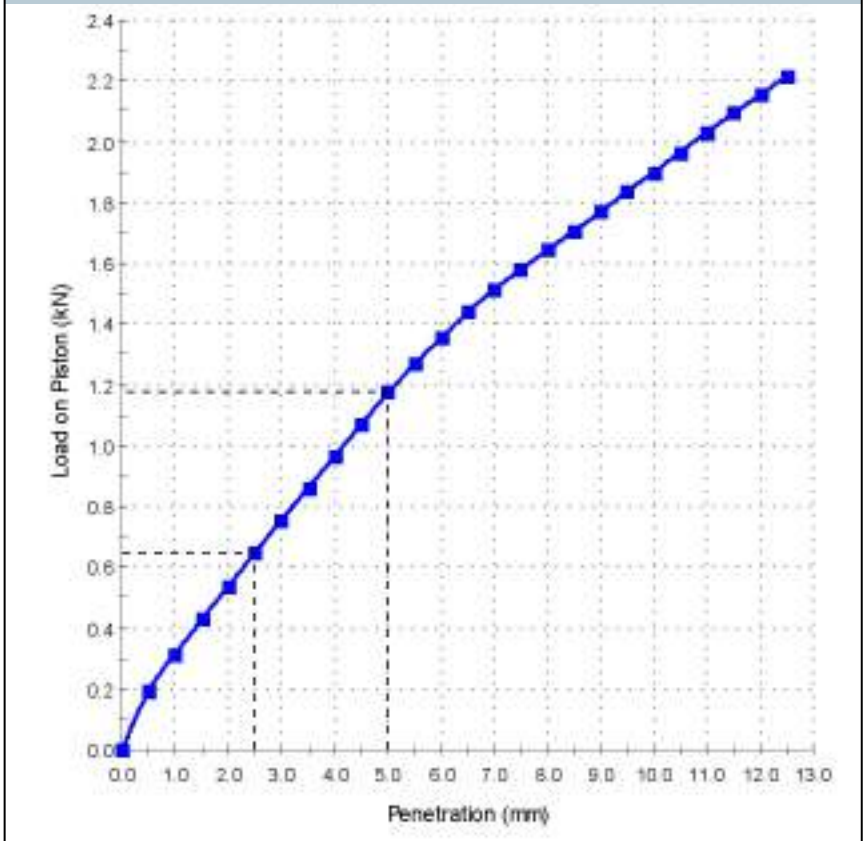
Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 30/01/2023

Sample Details

Sample ID: NEWC22S-10769
Client ID: -
Date Sampled: 6/12/2022
Date Submitted: 13/12/2022
Date Tested: 16/12/2022
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW, BH04 - 0.3 - 0.65m

Sampling Method: Submitted by client*
Material: Existing Ground
Source: On-Site
Specification: No Specification

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 5.0mm (%):	**6**
Dry Density before Soaking (t/m³):	1.63
Density Ratio before Soaking (%):	100.0
Moisture Content before Soaking (%):	20.0
Moisture Ratio before Soaking (%):	99.5
Dry Density after Soaking (t/m³):	1.62
Density Ratio after Soaking (%):	99.5
Swell (%):	0.5
Moisture Content of Top 30mm (%):	24.9
Moisture Content of Remaining Depth (%):	20.7
Compaction Hammer Used:	Standard AS 1289.5.1.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	31
Plasticity Determination Method:	AS 1289.3.1.1
———— AS 1289.2.1.1 ————	
In Situ (Field) Moisture Content (%):	16.7

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC22S-10768-1
Issue No: 1

Material Test Report

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 30/01/2023

Sample Details

Sample ID / Client ID: NEWC22S-10768 / -
Date Sampled: 06/12/2022
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW
BH03 - 0.15 - 0.5m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	29.0	
Date Tested		14/12/2022	
Sample History	AS 1289.1.1	Oven-Dried	
Preparation	AS 1289.1.1	Dry-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	12.0	
Mould Length (mm)		254	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	46	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	25	
Plasticity Index (%)	AS 1289.3.3.1	21	
Date Tested		29/01/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC22S-10769-1
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 30/01/2023

Sample Details

Sample ID / Client ID: NEWC22S-10769 / -
Date Sampled: 06/12/2022
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW
BH04 - 0.3 - 0.65m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	16.7	
Date Tested		14/12/2022	
Sample History	AS 1289.1.1	Oven-Dried	
Preparation	AS 1289.1.1	Dry-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.5	
Mould Length (mm)		254	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	33	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	21	
Plasticity Index (%)	AS 1289.3.3.1	12	
Date Tested		28/01/2023	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.62**	
Standard OMC (%)		**20.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		171	
LL Method	Visual / Tactile Assessment		
Date Tested		15/12/2022	
CBR at 5.0mm (%)	AS 1289.6.1.1	**6**	
Dry Density before Soaking (t/m³)		1.63	
Density Ratio before Soaking (%)		100.0	
Moisture Content before Soaking (%)		20.0	
Moisture Ratio before Soaking (%)		99.5	
Dry Density after Soaking (t/m³)		1.62	
Density Ratio after Soaking (%)		99.5	
Swell (%)		0.5	
Moisture Content of Top 30mm (%)		24.9	

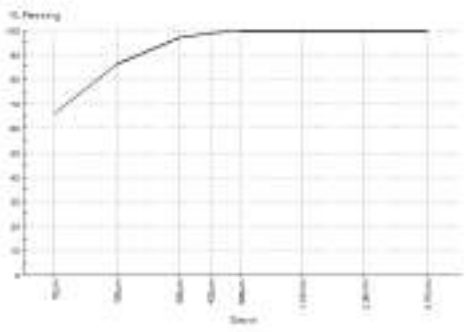
Particle Size Distribution

Method: AS 1289.3.6.1
Drying By: Oven
Date Tested: 19/12/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	100	
1.18mm	100	
600µm	100	
425µm	99	
300µm	97	
150µm	86	
75µm	66	

Chart



Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC22S-10769-1
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 30/01/2023

Sample Details

Sample ID / Client ID:	NEWC22S-10769 / -
Date Sampled:	06/12/2022
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	Various Locations
Sample Location:	Scoobies Lane, NSW BH04 - 0.3 - 0.65m

Other Test Results

Description	Method	Result	Limits
Moisture Content of Remaining Depth (%)		20.7	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		31	
Plasticity Method		AS 1289.3.1.1	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		16/12/2022	

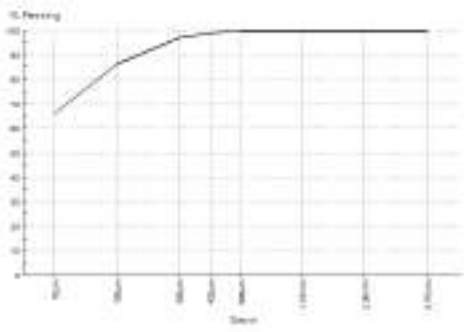
Particle Size Distribution

Method: AS 1289.3.6.1
Drying By: Oven
Date Tested: 19/12/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	100	
1.18mm	100	
600µm	100	
425µm	99	
300µm	97	
150µm	86	
75µm	66	

Chart



Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC22S-10770-1
Issue No: 1

Material Test Report

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 30/01/2023

Sample Details

Sample ID: NEWC22S-10770
Date Sampled: 06/12/2022
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW
BH04 - 1.7 - 2.0m

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-Dried	
Preparation	AS 1289.1.1	Dry-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	6.0	
Mould Length (mm)		250.05	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	31	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	12	
Date Tested		28/01/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC22S-10771-1
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

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Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 30/01/2023

Sample Details

Sample ID:	NEWC22S-10771
Date Sampled:	06/12/2022
Source:	On-Site
Material:	Existing Ground
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	Various Locations
Sample Location:	Scoobies Lane, NSW
	BH05 - 0.7 - 1.0m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-Dried	
Preparation	AS 1289.1.1	Dry-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	30	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	11	
Date Tested		28/01/2023	

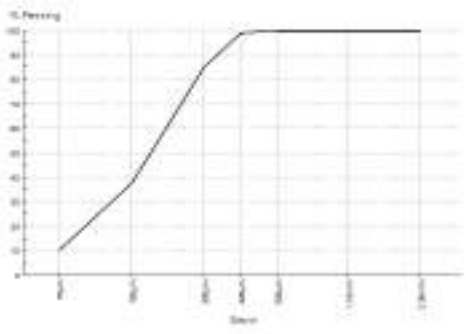
Particle Size Distribution

Method: AS 1289.3.6.1
Drying By: Oven
Date Tested: 20/12/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	100	
600µm	100	
425µm	99	
300µm	85	
150µm	38	
75µm	10	

Chart



Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
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Material Test Report

Report No: NEWC22S-10772-1
Issue No: 1

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: - **TRN:** -

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Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 30/01/2023

Sample Details

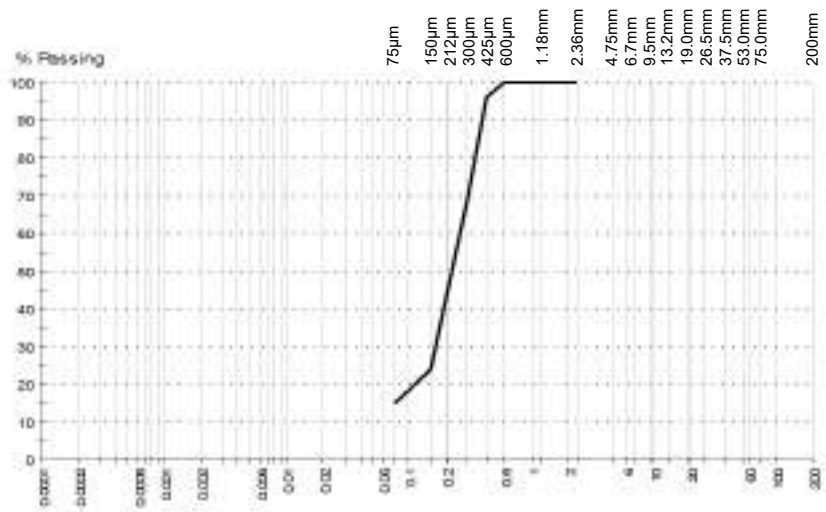
Sample ID: NEWC22S-10772
Date Sampled: 06/12/2022
Source: On-Site
Material: Existing Ground
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: Various Locations
Sample Location: Scoobies Lane, NSW
BH05 - 1.2 - 1.5m

Other Test Results

Description	Method	Result	Limits

Particle Size Distribution

AS 1289.3.6.1



CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

Particle Size (mm)

Drying By: Oven
Date Tested: 19/12/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	100	
600µm	100	
425µm	96	
300µm	69	
150µm	24	
75µm	15	

Comments

*Results relate only to the items tested or sampled.

COC rec'd: 13/12/22-C 1444

CHAIN OF CUSTODY RECORD

Cardno

now

Stantec

LAB Name	Envirolab
Address	12 Ashley St, Chatswood NSW 2067

Client	Stantec Australia Pty Ltd Suite 2, Level 2, 22 Honeysuckle Drive Newcastle NSW 2300	Contact Numbers Phone Fax	0249 654555 0249 654866
Contact	Dave Bashan	E-mail	brock.collinson@cardno.com.au; dave.bashan@cardno.com.au
Sampled by	Brock Collinson		
Project Ref:	304100979	Date Results Required	Standard TAT

Laboratory LIMS ID	Client Sample ID	Date Sampled	Matrix: Soil	Matrix: Water	Containers/Preservation: Soil Jar (T) Nat. Orange	Purple JAR	Orange Jar	40mL VOA Vial (G) H_2SO_4 Maroon	0.1-1.0 dm (P) H_2SO_4 Maroon	0.2-1.0 dm (G) H_2SO_4 Maroon	0.1-0.2 (P) Filtered (Y-Yes, N-No) (HNO3) Red	0.2l (P) NaOH Blue	Other - Zip Lock Bag	Analysis Required: Acid Sulfate Field Screen	SC Suite	ENM Suite excluding foreign materials	Hold	All samples chilled immediately after sampling event.
1	BH06 0.05-0.1	5/12/2022	x		x											x		
2	BH06 0.6-0.7	5/12/2022	x										x	x				
3	BH07 0.4-0.5	5/12/2022	x		x									x				
4	TB5C1 0.7-0.75	5/12/2022	x		x									x		x		
5	TB5C2 0.4-0.5	5/12/2022	x		x											x		
6	TB5C3 0.6-0.7	5/12/2022	x		x											x		
7	TB5C4 0.6-0.7	5/12/2022	x		x												x	
8	TB5C5 1.6-1.7	5/12/2022	x		x									x				
			x															
			x															
			x															
			x															
			x															
			x															
			x															

Relinquished by: Brock Collinson — Signature — Date/Time

Received by — Signature — Date/Time — Custody Seals Intact? / Samples Received Chilled?

312836 13/12/22 C 1444

Internal Laboratory Chain of Custody

Client Name	Stantec	**Sampler**	BC/JE
Client Address		**Method**	Drill rig with auger/ Excavator w auger
Project Ref	304100979	**Dispatch by**	BC/JE
Project Name	Pavement Investigation	**Date**	9/12/2022
Site Location	Scobies Lane	**Request by**	BC
Component/Stage	Stage 5	**Date**	9/12/2022

ENVIROLAB — Envirolab Services, 12 Ashley St, Chatswood NSW 2067, Ph: (02) 9910 6200

Job No: 312836

Date Received: 12/12/22

Time Received: 1000

Received By:

Temp: Cool/Ambient

Cooling: Ice/Icepack

Security: Intact/Broken/None

Location		Depth	Date	Type	Material Description
BH06	1	0.08-0.1	08/12/22	Enviro	Silty SAND; dark brown
BH06	2	0.6-0.7	08/12/22	Enviro	Silty CLAY; brown, grey and orange
BH07	3	0.4-0.5	08/12/22	Enviro	Silty CLAY; dark brown, orange brown and red
TB501	4	0.7-0.75	05/12/22	Enviro	Sandy SILT; dark brown
TB502	5	0.4-0.5	05/12/22	Enviro	Silty Gravelly SAND; dark grey
TB503	6	0.6-0.7	05/12/22	Enviro	Gravelly Silty SAND; brown
TB504	7	0.6-0.7	05/12/22	Enviro	Gravelly SAND; brown-grey
TB505	8	1.6-1.7	05/12/22	Enviro	SILT; dark brown

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 312836

Client Details

Client	Cardno (NSW/ACT) Pty Ltd
Attention	Brock Collinson
Address	PO Box 19, St Leonards, NSW, 1590

Sample Details

Your Reference	**304100979**
Number of Samples	8 Soil
Date samples received	12/12/2022
Date completed instructions received	13/12/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	20/12/2022
Date of Issue	20/12/2022

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

Results Approved By
Diego Bigolin, Inorganics Supervisor
Hannah Nguyen, Metals Supervisor
Jenny He, Senior Chemist
Josh Williams, Organics and LC Supervisor
Liam Timmins, Organic Instruments Team Leader

Authorised By

Nancy Zhang, Laboratory Manager

vTRH(C6-C10)/BTEXN in Soil					
Our Reference		312836-1	312836-4	312836-5	312836-6
Your Reference	UNITS	BH06	TB501	TB502	TB503
Depth		0.08-0.1	0.7-0.75	0.4-0.5	0.6-0.7
Date Sampled		08/12/2022	05/12/2022	05/12/2022	05/12/2022
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Date analysed	-	19/12/2022	19/12/2022	19/12/2022	19/12/2022
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	<1	<1	<1	<1
m+p-xylene	mg/kg	<2	<2	<2	<2
o-Xylene	mg/kg	<1	<1	<1	<1
Naphthalene	mg/kg	<1	<1	<1	<1
Total +ve Xylenes	mg/kg	<1	<1	<1	<1
Surrogate aaa-Trifluorotoluene	%	124	103	101	109

svTRH (C10-C40) in Soil					
Our Reference		312836-1	312836-4	312836-5	312836-6
Your Reference	UNITS	BH06	TB501	TB502	TB503
Depth		0.08-0.1	0.7-0.75	0.4-0.5	0.6-0.7
Date Sampled		08/12/2022	05/12/2022	05/12/2022	05/12/2022
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Date analysed	-	16/12/2022	16/12/2022	16/12/2022	16/12/2022
TRH C_{10} - C_{14}	mg/kg	<50	<50	<50	<50
TRH C_{15} - C_{28}	mg/kg	<100	<100	160	<100
TRH C_{29} - C_{36}	mg/kg	<100	<100	100	<100
Total +ve TRH (C10-C36)	mg/kg	<50	<50	260	<50
TRH >C_{10} -C_{16}	mg/kg	<50	<50	<50	<50
TRH >C_{10} - C_{16} less Naphthalene (F2)	mg/kg	<50	<50	<50	<50
TRH >C_{16} -C_{34}	mg/kg	<100	<100	230	<100
TRH >C_{34} -C_{40}	mg/kg	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	230	<50
Surrogate o-Terphenyl	%	80	83	87	84

PAHs in Soil					
Our Reference		312836-1	312836-4	312836-5	312836-6
Your Reference	UNITS	BH06	TB501	TB502	TB503
Depth		0.08-0.1	0.7-0.75	0.4-0.5	0.6-0.7
Date Sampled		08/12/2022	05/12/2022	05/12/2022	05/12/2022
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Date analysed	-	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Naphthalene	mg/kg	<0.1	<0.1	0.3	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	0.3	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	0.3	<0.1
Anthracene	mg/kg	<0.1	<0.1	0.3	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	0.3	<0.1
Pyrene	mg/kg	<0.1	<0.1	0.3	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	0.2	<0.1
Chrysene	mg/kg	<0.1	<0.1	0.3	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	1	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	1.0	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	0.6	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	0.4	<0.1
Total +ve PAH's	mg/kg	<0.05	<0.05	5.6	<0.05
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	1.2	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	1.3	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	1.3	<0.5
Surrogate p-Terphenyl-d14	%	82	89	91	83

Acid Extractable metals in soil					
Our Reference		312836-1	312836-4	312836-5	312836-6
Your Reference	UNITS	BH06	TB501	TB502	TB503
Depth		0.08-0.1	0.7-0.75	0.4-0.5	0.6-0.7
Date Sampled		08/12/2022	05/12/2022	05/12/2022	05/12/2022
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	16/12/2022	16/12/2022	16/12/2022	16/12/2022
Date analysed	-	19/12/2022	19/12/2022	19/12/2022	19/12/2022
Arsenic	mg/kg	<4	<4	5	<4
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	8	7	13	9
Copper	mg/kg	2	<1	8	11
Lead	mg/kg	7	4	18	250
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	3	3	12	8
Zinc	mg/kg	15	3	36	17

Misc Inorg - Soil					
Our Reference		312836-1	312836-4	312836-5	312836-6
Your Reference	UNITS	BH06	TB501	TB502	TB503
Depth		0.08-0.1	0.7-0.75	0.4-0.5	0.6-0.7
Date Sampled		08/12/2022	05/12/2022	05/12/2022	05/12/2022
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	19/12/2022	19/12/2022	19/12/2022	19/12/2022
Date analysed	-	19/12/2022	19/12/2022	19/12/2022	19/12/2022
pH 1:5 soil:water	pH Units	4.6	5.8	6.2	6.8
Electrical Conductivity 1:5 soil:water	µS/cm	280	160	200	130

Moisture					
Our Reference		312836-1	312836-4	312836-5	312836-6
Your Reference	UNITS	BH06	TB501	TB502	TB503
Depth		0.08-0.1	0.7-0.75	0.4-0.5	0.6-0.7
Date Sampled		08/12/2022	05/12/2022	05/12/2022	05/12/2022
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	14/12/2022	14/12/2022	14/12/2022	14/12/2022
Date analysed	-	15/12/2022	15/12/2022	15/12/2022	15/12/2022
Moisture	%	11	13	14	5.7

sPOCAS field test					
Our Reference		312836-2	312836-3	312836-4	312836-8
Your Reference	UNITS	BH06	BH07	TB501	TB505
Depth		0.6-0.7	0.4-0.5	0.7-0.75	1.6-1.7
Date Sampled		08/12/2022	08/12/2022	05/12/2022	05/12/2022
Type of sample		Soil	Soil	Soil	Soil
Date prepared	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022
Date analysed	-	20/12/2022	20/12/2022	20/12/2022	20/12/2022
pH_F (field pH test)	pH Units	6.7	7.0	7.1	6.7
pH_{FOX} (field peroxide test)	pH Units	4.1	6.0	3.2	5.1
Reaction Rate*	-	Low reaction	Low reaction	Low reaction	Medium reaction

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-020	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).

Method ID	Methodology Summary
Org-022/025	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS and/or GC-MS/MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'EQ PQL'values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'EQ zero'values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'EQ half PQL'values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore "Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-023	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.

QUALITY CONTROL: vTRH(C6-C10)/BTEXN in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	312836-4
Date extracted	-			14/12/2022	1	14/12/2022	14/12/2022		14/12/2022	14/12/2022
Date analysed	-			19/12/2022	1	19/12/2022	19/12/2022		19/12/2022	19/12/2022
TRH C_6 - C_9	mg/kg	25	Org-023	<25	1	<25	<25	0	117	106
TRH C_6 - C_{10}	mg/kg	25	Org-023	<25	1	<25	<25	0	117	106
Benzene	mg/kg	0.2	Org-023	<0.2	1	<0.2	<0.2	0	109	99
Toluene	mg/kg	0.5	Org-023	<0.5	1	<0.5	<0.5	0	113	102
Ethylbenzene	mg/kg	1	Org-023	<1	1	<1	<1	0	112	101
m+p-xylene	mg/kg	2	Org-023	<2	1	<2	<2	0	125	114
o-Xylene	mg/kg	1	Org-023	<1	1	<1	<1	0	122	110
Naphthalene	mg/kg	1	Org-023	<1	1	<1	<1	0	[NT]	[NT]
Surrogate aaa-Trifluorotoluene	%		Org-023	116	1	124	124	0	117	103

QUALITY CONTROL: svTRH (C10-C40) in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	312836-4
Date extracted	-			14/12/2022	1	14/12/2022	14/12/2022		14/12/2022	14/12/2022
Date analysed	-			16/12/2022	1	16/12/2022	16/12/2022		16/12/2022	16/12/2022
TRH C_{10} - C_{14}	mg/kg	50	Org-020	<50	1	<50	<50	0	88	89
TRH C_{15} - C_{28}	mg/kg	100	Org-020	<100	1	<100	<100	0	88	83
TRH C_{29} - C_{36}	mg/kg	100	Org-020	<100	1	<100	<100	0	100	101
TRH >C_{10} -C_{16}	mg/kg	50	Org-020	<50	1	<50	<50	0	88	89
TRH >C_{16} -C_{34}	mg/kg	100	Org-020	<100	1	<100	<100	0	88	83
TRH >C_{34} -C_{40}	mg/kg	100	Org-020	<100	1	<100	<100	0	100	101
Surrogate o-Terphenyl	%		Org-020	80	1	80	89	11	78	78

QUALITY CONTROL: PAHs in Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	312836-4
Date extracted	-			14/12/2022	1	14/12/2022	14/12/2022		14/12/2022	14/12/2022
Date analysed	-			14/12/2022	1	14/12/2022	14/12/2022		14/12/2022	14/12/2022
Naphthalene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	97	92
Acenaphthylene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Acenaphthene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	91	83
Fluorene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	95	86
Phenanthrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	102	94
Anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Fluoranthene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	94	88
Pyrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	97	87
Benzo(a)anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Chrysene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	73	65
Benzo(b,j+k)fluoranthene	mg/kg	0.2	Org-022/025	<0.2	1	<0.2	<0.2	0	[NT]	[NT]
Benzo(a)pyrene	mg/kg	0.05	Org-022/025	<0.05	1	<0.05	<0.05	0	74	70
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-022/025	<0.1	1	<0.1	<0.1	0	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	80	1	82	82	0	85	79

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	312836-4
Date prepared	-			16/12/2022	1	16/12/2022	16/12/2022		16/12/2022	16/12/2022
Date analysed	-			19/12/2022	1	19/12/2022	19/12/2022		19/12/2022	19/12/2022
Arsenic	mg/kg	4	Metals-020	<4	1	<4	7	55	95	86
Cadmium	mg/kg	0.4	Metals-020	<0.4	1	<0.4	<0.4	0	99	88
Chromium	mg/kg	1	Metals-020	<1	1	8	10	22	104	88
Copper	mg/kg	1	Metals-020	<1	1	2	1	67	99	97
Lead	mg/kg	1	Metals-020	<1	1	7	7	0	100	87
Mercury	mg/kg	0.1	Metals-021	<0.1	1	<0.1	<0.1	0	89	94
Nickel	mg/kg	1	Metals-020	<1	1	3	3	0	100	89
Zinc	mg/kg	1	Metals-020	<1	1	15	14	7	101	85

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-4	[NT]
Date prepared	-			19/12/2022	1	19/12/2022	19/12/2022		19/12/2022	[NT]
Date analysed	-			19/12/2022	1	19/12/2022	19/12/2022		19/12/2022	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	4.6	4.6	0	101	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	280	290	4	108	[NT]

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			20/12/2022	[NT]	[NT]	[NT]	[NT]	20/12/2022	[NT]
Date analysed	-			20/12/2022	[NT]	[NT]	[NT]	[NT]	20/12/2022	[NT]
pH_F (field pH test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]
pH_{FOX} (field peroxide test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]

Result Definitions

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

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

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

Spikes for Physical and Aggregate Tests are not applicable.

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

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Samples were out of the recommended holding time for this analysis pH in soil.

CHAIN OF CUSTODY RECORD

Cardno now Stantec

LAB Name	Envirolab
Address	12 Ashley St, Chatswood NSW 2067

Client	Stantec Australia Pty Ltd Suite 2, Level 2, 22 Honeysuckle Drive Newcastle NSW 2300
Contact	Dave Beslian
Sampled by	Josh Edmunds
Project Ref:	304100979

Contact Numbers		
Phone	0249 654655	
Fax	0249 654656	
E-mail	brock.collinson1@cardno.com.au	david.beslian@cardno.com.au

Date Results Required: Standard TAT

Laboratory LIMS ID	Client Sample ID	Date Sampled	Matrix: Soil	Matrix: Water	Containers/Preservation: Soil Jar (G) NaL Orange	Purple JAR	Orange Jar	60mL VOA Vial (G) H_2SO_4 Maroon	0.1-1.0 litre (P) H_2SO_4 Maroon	0.2-1.0 litre (G) H_2SO_4 Maroon	0.1-1.2 (P) Filtered?? (Y=Yes, N=No (HNO3) Red	0.2l (P) NaOH Blue	Other - Zip Lock Bag	Analysis Required: Acid Sulfate Field Screen	8Cr Suite	ENM Suite excluding foreign materials			
1	BH02 0.45	5/12/2022	x										x	x					
2	BH02 0.95	5/12/2022	x										x	x					
	BH02 1.45	5/12/2022	x										x						
	BH02 1.95	5/12/2022	x										x						
	BH02 2.45	5/12/2022	x										x						
	BH02 2.95	5/12/2022	x										x						
3	BH03 0.45	5/12/2022	x										x	x					
	BH03 0.95	5/12/2022	x										x						
	BH03 1.45	5/12/2022	x										x						
	BH03 1.95	5/12/2022	x										x						
	BH03 2.45	5/12/2022	x										x						
4	BH04 0.45	5/12/2022	x										x	x					
	BH04 0.95	5/12/2022	x										x						
	BH04 1.45	5/12/2022	x										x						
	BH04 1.95	5/12/2022	x										x						
	BH04 2.45	5/12/2022	x										x						
	BH04 2.95	5/12/2022	x										x						
	BH05 0.45	5/12/2022	x										x						
5	BH05 0.95	5/12/2022	x										x	x					
6	BH06 1.45	5/12/2022	x										x	x					
	BH06 2.0	5/12/2022	x										x						
	BH06 2.45	5/12/2022	x										x						
	BH06 3.95	5/12/2022	x										x						

All samples chilled immediately after sampling event.

Environmental Division
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 221124
Date Received: 15/12/22
Time Received: 10:45
Temperature: 14.1
Cooling: Ice/Icepack
Security: Intact/Broken/None

Relinquished by: Brock Collinson — Signature — Date/Time: 14/12/2022

Received by: — Signature — Date/Time: 15/12/2022 — Custody Seals Intact? / Samples Received Chilled?

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 313195

Client Details

Client	Cardno (NSW/ACT) Pty Ltd
Attention	David Bastian
Address	PO Box 19, St Leonards, NSW, 1590

Sample Details

Your Reference	**304100979**
Number of Samples	6 Soil
Date samples received	15/12/2022
Date completed instructions received	15/12/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	22/12/2022
Date of Issue	22/12/2022

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Results Approved By
Nick Sarlamis, Assistant Operation Manager

Authorised By

Nancy Zhang, Laboratory Manager

sPOCAS field test						
Our Reference		313195-1	313195-2	313195-3	313195-4	313195-5
Your Reference	UNITS	BH02 0.45	BH02 0.95	BH03 0.45	BH04 0.45	BH05 0.95
Date Sampled		05/12/2022	05/12/2022	05/12/2022	05/12/2022	05/12/2022
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/12/2022	21/12/2022	21/12/2022	21/12/2022	21/12/2022
Date analysed	-	21/12/2022	21/12/2022	21/12/2022	21/12/2022	21/12/2022
pH_F (field pH test)	pH Units	7.1	7.2	7.2	7.2	7.2
pH_{FOX} (field peroxide test)	pH Units	4.5	5.8	6.2	5.1	6.1
Reaction Rate*	-	Low reaction	High reaction	Extreme reaction	Extreme reaction	High reaction

sPOCAS field test		
Our Reference		313195-6
Your Reference	UNITS	BH05 1.45
Date Sampled		05/12/2022
Type of sample		Soil
Date prepared	-	21/12/2022
Date analysed	-	21/12/2022
pH_F (field pH test)	pH Units	7.2
pH_{FOX} (field peroxide test)	pH Units	5.6
Reaction Rate*	-	High reaction

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.

QUALITY CONTROL: sPOCAS field test						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			21/12/2022	[NT]	[NT]	[NT]	[NT]	21/12/2022	[NT]
Date analysed	-			21/12/2022	[NT]	[NT]	[NT]	[NT]	21/12/2022	[NT]
pH_F (field pH test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	100	[NT]
pH_{FOX} (field peroxide test)	pH Units		Inorg-063	[NT]	[NT]	[NT]	[NT]	[NT]	101	[NT]

Result Definitions

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PQL	Practical Quantitation Limit
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Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: ASM:NEWC23W00585
Issue No: 1

Material Test Report

Client: Stantec Australia Pty Ltd
Level 22, 570 Bourke Street
Melbourne VIC 3000

Principal:
Project No.: 757-NEWC00160AA
Project Name: CMT Services
Lot No.: NA **TRN:** NA

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Approved Signatory: Jason Condran (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 17/02/2023

Material Details

Location	Scoobies Lane, NSW		
Source	On-Site	**Sampled From**	
Description	Existing Ground	**Specification**	No Specification
Sampling Method	Submitted by client*		

Sample Details

Sample ID	NEWC23S-01270	NEWC23S-01271	NEWC23S-01272	NEWC23S-01273
Field Sample ID	01265	01266	01267	01268
Date Sampled	6/12/2022	6/12/2022	6/12/2022	6/12/2022
Date Submitted:	17/02/2023	17/02/2023	17/02/2023	17/02/2023
Sample Location:	BH06	TB501	TB502	TB503
	Depth:0.08 - 0.1m	Depth:0.7 - 0.75	Depth:0.4 - 0.5m	Depth:0.6 - 0.7m

Other Test Results

Description	Method	Results				Limits
Foreign Materials Content	RMS T276					
Retained on 4.75mm sieve (%)		56.3	65.3	87.0	49.0	
Type I (%)		0.0	0.0	0.0	0.0	
Metal.Glass.Asphalt.Stone.Ceramics and Slag						
Type II (%)		0.0	0.0	0.0	0.0	
Plaster.Clay lumps and other Friable Material						
Type III (%)		0.0	0.0	1.7	19.1	
Rubber.Plastic.Bitumen.Paper.Cloth.Wood and other Vegetable Matter						

Comments

N/A

Ming To

From: Greta Petzold
Sent: Wednesday, 15 February 2023 10:24 AM
To: Ted Bartlett, Samplereceipt
Cc: Josh Edmunds; Brock Collinson; Dave Bastian
Subject: RE: Acid Sulphate Testing

Ref: 312836-A
TAT: Standard.
Due: 22/02/2023
MT

Categories: Additional

Hi Ted,

No worries, we'll get that organised for you.

Cheers

Kind Regards,

Greta Petzold | Operations Manager | Envirolab Services

Great Science. Great Service.

12 Ashley Street Chatswood NSW 2067
T 612 9910 6200
E GPetzold@enviro.lab.com.au W www.enviro.lab.com.au

Follow us on: LinkedIn | Facebook | Twitter

Samples will be analysed per our T&C's.

From: Ted Bartlett <edward.bartlett@cardno.com.au>
Sent: Tuesday, 14 February 2023 7:45 PM
To: Greta Petzold <GPetzold@enviro.lab.com.au>
Cc: Josh Edmunds <Joshua.Edmunds@cardno.com.au>, Brock Collinson <brock.collinson@cardno.com.au>; Dave Bastian <David.Bastian@cardno.com.au>
Subject: RE: Acid Sulphate Testing

Thanks for chasing these up Greta.

Could we please run the detailed chromium ASS suite on the following samples.

4 • TB501: 0.7-0.75m (312836-4)
• BH04: 0.45m (313195-4)
2 • BH06: 0.6-0.7m (312836-2)

Cheers.

Ted Bartlett
Geotechnical Engineer

Phone: +61 2 4940 6523

edward.bartlett@cardno.com.au

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 312836-A

Client Details

Client	Cardno (NSW/ACT) Pty Ltd
Attention	Edward Bartlett
Address	PO Box 19, St Leonards, NSW, 1590

Sample Details

Your Reference	**304100979**
Number of Samples	additional analysis
Date samples received	12/12/2022
Date completed instructions received	14/02/2023

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	21/02/2023
Date of Issue	21/02/2023

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

Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Chromium Suite			
Our Reference		312836-A-2	312836-A-4
Your Reference	UNITS	BH06	TB501
Depth		0.6-0.7	0.7-0.75
Date Sampled		08/12/2022	05/12/2022
Type of sample		Soil	Soil
Date prepared	-	21/02/2023	21/02/2023
Date analysed	-	21/02/2023	21/02/2023
pH $_{kcl}$	pH units	4.0	5.5
s-TAA pH 6.5	%w/w S	0.12	<0.01
TAA pH 6.5	moles H^+ /t	74	<5
Chromium Reducible Sulfur	%w/w	0.01	0.02
a-Chromium Reducible Sulfur	moles H^+ /t	7	10
S_{HCl}	%w/w S	0.018	[NT]
S_{KCl}	%w/w S	0.018	[NT]
S_{NAS}	%w/w S	<0.005	[NT]
ANC_{BT}	% $CaCO_3$	[NT]	[NT]
s-ANC_{BT}	%w/w S	[NT]	[NT]
s-Net Acidity	%w/w S	0.13	0.020
a-Net Acidity	moles H^+ /t	81	13
Liming rate	kg $CaCO_3$ /t	6	1
a-Net Acidity without ANCE	moles H^+ /t	81	13
Liming rate without ANCE	kg $CaCO_3$ /t	6.1	0.96
s-Net Acidity without ANCE	%w/w S	0.13	0.020

Method ID	Methodology Summary
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Net acidity including ANC has a safety factor of 1.5 applied. Neutralising value (NV) of 100% is assumed for liming rate. Based on National acid sulfate soils identification and laboratory methods manual June 2018. The recommendation that the SHCL concentration be multiplied by a factor of 2 to ensure retained acidity is not underestimated, has not been applied in the SHCL results reported.

QUALITY CONTROL: Chromium Suite						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			21/02/2023	[NT]	[NT]	[NT]	[NT]	21/02/2023	[NT]
Date analysed	-			21/02/2023	[NT]	[NT]	[NT]	[NT]	21/02/2023	[NT]
pH $_{kcl}$	pH units		Inorg-068	[NT]	[NT]	[NT]	[NT]	[NT]	99	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
TAA pH 6.5	moles H^+ /t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	127	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	114	[NT]
a-Chromium Reducible Sulfur	moles H^+ /t	3	Inorg-068	<3	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	0.05	Inorg-068	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-ANC_{BT}	%w/w S	0.05	Inorg-068	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Net Acidity	moles H^+ /t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate	kg $CaCO_3$ /t	0.75	Inorg-068	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+ /t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$ /t	0.75	Inorg-068	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity without ANCE	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

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

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

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

Spikes for Physical and Aggregate Tests are not applicable.

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

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Ming To

From: Greta Petzold
Sent: Wednesday, 15 February 2023 10:24 AM
To: Ted Bartlett; Samplereceipt
Cc: Josh Edmunds; Brock Collinson; Dave Bastian
Subject: RE: Acid Sulphate Testing

Categories: Additional

Ref: 313195-A
TAT: Standard.
Due: 22/02/2023
MT

Hi Ted,

No worries, we'll get that organised for you.

Cheers

Kind Regards,

Greta Petzold | Operations Manager ; Envirolab Services

Great Science. Great Service.

12 Ashley Street Chatswood NSW 2067
T 612 9910 6200
E GPetzold@envirolab.com.au | W www.envirolab.com.au

Follow us on: LinkedIn | Facebook Twitter

Samples will be analysed per our T&C's.

From: Ted Bartlett <edward.bartlett@cardno.com.au>
Sent: Tuesday, 14 February 2023 7:45 PM
To: Greta Petzold <GPetzold@envirolab.com.au>
Cc: Josh Edmunds <Joshua.Edmunds@cardno.com.au>, Brock Collinson <brock.collinson@cardno.com.au>; Dave Bastian <Dave.Bastian@cardno.com.au>
Subject: RE: Acid Sulphate Testing

Thanks for chasing these up Greta.

Could we please run the potential chromium ASS suite on the following samples:

- TB501: 0.7-0.75m (312836-1)
- BH04: 0.45m (313195-4)
- BH06: 0.6-0.7m (312836-2)

Cheers,

Ted Bartlett
Geotechnical Engineer

Phone: +61 7 4940 5523

edward.bartlett@cardno.com.au

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ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 313195-A

Client Details

Client	Cardno (NSW/ACT) Pty Ltd
Attention	Edward Bartlett
Address	PO Box 19, St Leonards, NSW, 1590

Sample Details

Your Reference	**304100979**
Number of Samples	additional analysis
Date samples received	15/12/2022
Date completed instructions received	14/02/2022

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	21/02/2023
Date of Issue	21/02/2023

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Results Approved By
Priya Samarawickrama, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

Chromium Suite		
Our Reference		313195-A-4
Your Reference	UNITS	BH04 0.45
Date Sampled		05/12/2022
Type of sample		Soil
Date prepared	-	21/02/2023
Date analysed	-	21/02/2023
pH $_{kcl}$	pH units	6.1
s-TAA pH 6.5	%w/w S	<0.01
TAA pH 6.5	moles H^+ /t	<5
Chromium Reducible Sulfur	%w/w	0.009
a-Chromium Reducible Sulfur	moles H^+ /t	6
S_{HCl}	%w/w S	[NT]
S_{KCl}	%w/w S	[NT]
S_{NAS}	%w/w S	[NT]
ANC_{BT}	% $CaCO_3$	[NT]
s-ANC_{BT}	%w/w S	[NT]
s-Net Acidity	%w/w S	0.0090
a-Net Acidity	moles H^+ /t	5.5
Liming rate	kg $CaCO_3$ /t	<0.75
a-Net Acidity without ANCE	moles H^+ /t	5.5
Liming rate without ANCE	kg $CaCO_3$ /t	<0.75
s-Net Acidity without ANCE	%w/w S	0.0090

Method ID	Methodology Summary
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Net acidity including ANC has a safety factor of 1.5 applied. Neutralising value (NV) of 100% is assumed for liming rate. Based on National acid sulfate soils identification and laboratory methods manual June 2018. The recommendation that the SHCL concentration be multiplied by a factor of 2 to ensure retained acidity is not underestimated, has not been applied in the SHCL results reported.

QUALITY CONTROL: Chromium Suite						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	[NT]
Date prepared	-			21/02/2023	[NT]	[NT]	[NT]	[NT]	21/02/2023	[NT]
Date analysed	-			21/02/2023	[NT]	[NT]	[NT]	[NT]	21/02/2023	[NT]
pH $_{kcl}$	pH units		Inorg-068	[NT]	[NT]	[NT]	[NT]	[NT]	97	[NT]
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	<0.01	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
TAA pH 6.5	moles H^+ /t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	119	[NT]
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	110	[NT]
a-Chromium Reducible Sulfur	moles H^+ /t	3	Inorg-068	<3	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{HCl}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{KCl}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
S_{NAS}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	0.05	Inorg-068	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-ANC_{BT}	%w/w S	0.05	Inorg-068	<0.05	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Net Acidity	moles H^+ /t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate	kg $CaCO_3$ /t	0.75	Inorg-068	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
a-Net Acidity without ANCE	moles H^+ /t	5	Inorg-068	<5	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Liming rate without ANCE	kg $CaCO_3$ /t	0.75	Inorg-068	<0.75	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
s-Net Acidity without ANCE	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]

Result Definitions

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

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

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

Spikes for Physical and Aggregate Tests are not applicable.

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

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Ming To

From: Greta Petzold
Sent: Monday, 20 February 2023 1:52 PM
To: Ted Bartlett; Samplereceipt
Cc: Dave Bastian; SydneyMailbox
Subject: RE: Acid Sulphate Testing

Categories: Additional

Ref: 312836-A
TAT: 1 day.
Due: 21/02/2023 pm

Hi Ted,

No worries, we'll get that organised for you.

@Samplereceipt, A job please

Kind Regards,

Greta Petzold | Operations Manager | Envirolab Services

Great Science. Great Service.

12 Ashley Street Chatswood NSW 2067
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E GPetzold@envirolab.com.au W www.envirolab.com.au

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Samples will be analysed per our T&C's.

From: Ted Bartlett <edward.bartlett@cardno.com.au>
Sent: Monday, February 20, 2023 1:36 PM
To: Greta Petzold <GPetzold@envirolab.com.au>
Cc: Dave Bastian <David.Bastian@cardno.com.au>; SydneyMailbox <Sydney@envirolab.com.au>
Subject: RE: Acid Sulphate Testing

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Hi Greta,

We're chasing up some additional TCLP testing for the same work order as below – hoping the samples are still in storage.

Provided the lab still has them could we please action the following testing.

- TB502: 0.4-0.5m – TCLP for B(a)P (envirolab ID: 312836-5)
- TB503: 0.5-0.7m – TCLP for Lead (envirolab ID: 312836-6)

Thanks!

Ted Bartlett
Geotechnical Engineer

Phone: +61 2 4940 5523

edward.bartlett@cardno.com.au

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www.envirolab.com.au

CERTIFICATE OF ANALYSIS 312836-B

Client Details

Client	Cardno (NSW/ACT) Pty Ltd
Attention	Edward Bartlett
Address	PO Box 19, St Leonards, NSW, 1590

Sample Details

Your Reference	**304100979**
Number of Samples	additional analysis
Date samples received	12/12/2022
Date completed instructions received	20/02/2023

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	21/02/2023
Date of Issue	21/02/2023

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Results Approved By
Hannah Nguyen, Metals Supervisor
Josh Williams, Organics Supervisor
Kyle Gavrily, Senior Chemist

Authorised By

Nancy Zhang, Laboratory Manager

TCLP Preparation - Acid			
Our Reference		312836-B-5	312836-B-6
Your Reference	UNITS	TB502	TB503
Depth		0.4-0.5	0.6-0.7
Date Sampled		05/12/2022	05/12/2022
Type of sample		Soil	Soil
pH of soil for fluid# determ.	pH units	7.2	7.2
pH of soil TCLP (after HCl)	pH units	1.6	1.6
Extraction fluid used		1	1
pH of final Leachate	pH units	4.9	4.9

PAHs in TCLP (USEPA 1311)		
Our Reference		312836-B-5
Your Reference	UNITS	TB502
Depth		0.4-0.5
Date Sampled		05/12/2022
Type of sample		Soil
Date extracted	-	21/02/2023
Date analysed	-	21/02/2023
Naphthalene in TCLP	mg/L	<0.001
Acenaphthylene in TCLP	mg/L	<0.001
Acenaphthene in TCLP	mg/L	<0.001
Fluorene in TCLP	mg/L	<0.001
Phenanthrene in TCLP	mg/L	<0.001
Anthracene in TCLP	mg/L	<0.001
Fluoranthene in TCLP	mg/L	<0.001
Pyrene in TCLP	mg/L	<0.001
Benzo(a)anthracene in TCLP	mg/L	<0.001
Chrysene in TCLP	mg/L	<0.001
Benzo(bjk)fluoranthene in TCLP	mg/L	<0.002
Benzo(a)pyrene in TCLP	mg/L	<0.001
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	<0.001
Dibenzo(a,h)anthracene in TCLP	mg/L	<0.001
Benzo(g,h,i)perylene in TCLP	mg/L	<0.001
Total +ve PAH's	mg/L	NIL (+)VE
Surrogate p-Terphenyl-d14	%	96

Metals from Leaching Fluid pH 2.9 or 5		
Our Reference		312836-B-6
Your Reference	UNITS	TB503
Depth		0.6-0.7
Date Sampled		05/12/2022
Type of sample		Soil
Date extracted	-	21/02/2023
Date analysed	-	21/02/2023
Lead	mg/L	0.2

Method ID	Methodology Summary
Inorg-004	Toxicity Characteristic Leaching Procedure (TCLP) using AS 4439 and USEPA 1311. Please note that the mass used may be scaled down from default based on sample mass available. Samples are stored at 2-6oC before and after leachate preparation.
Metals-020	Determination of various metals by ICP-AES following buffer determination as per USEPA 1311 and hence AS 4439.3. Extraction Fluid 1 refers to the pH 5.0 buffer and Extraction Fluid 2 is the pH 2.9 buffer.
Org-022/025	Leachates are extracted with Dichloromethane and analysed by GC-MS/GC-MSMS.

QUALITY CONTROL: PAHs in TCLP (USEPA 1311)					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			21/02/2023	[NT]	[NT]	[NT]	[NT]	21/02/2023	[NT]
Date analysed	-			21/02/2023	[NT]	[NT]	[NT]	[NT]	21/02/2023	[NT]
Naphthalene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	86	[NT]
Acenaphthylene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Acenaphthene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	84	[NT]
Fluorene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	90	[NT]
Phenanthrene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	96	[NT]
Anthracene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Fluoranthene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	100	[NT]
Pyrene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	108	[NT]
Benzo(a)anthracene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Chrysene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	66	[NT]
Benzo(bjk)fluoranthene in TCLP	mg/L	0.002	Org-022/025	<0.002	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(a)pyrene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	96	[NT]
Indeno(1,2,3-c,d)pyrene - TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Dibenzo(a,h)anthracene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Benzo(g,h,i)perylene in TCLP	mg/L	0.001	Org-022/025	<0.001	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate p-Terphenyl-d14	%		Org-022/025	90	[NT]	[NT]	[NT]	[NT]	100	[NT]

QUALITY CONTROL: Metals from Leaching Fluid pH 2.9 or 5					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	[NT]
Date extracted	-			21/02/2023	[NT]	[NT]	[NT]	[NT]	21/02/2023	[NT]
Date analysed	-			21/02/2023	[NT]	[NT]	[NT]	[NT]	21/02/2023	[NT]
Lead	mg/L	0.03	Metals-020	<0.03	[NT]	[NT]	[NT]	[NT]	95	[NT]

Result Definitions

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

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

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

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

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

Spikes for Physical and Aggregate Tests are not applicable.

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

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

				Acid Extractable metals in soil								Misc Inorg - Soil			Moisture	PAHs in Soil																					
				Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	pH 1:5 soil:water1:5 soil:water	Electrical Conductivity 1:5 soil:water	Foreign Materials	Moisture Content	Naphthalene	Total PAH (NEPM/WHO 16)	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	Benzo(a)pyrene TEQ (Zero LOR)	Benzo(a)pyrene TEQ (Half LOR)_1	Benzo(a)pyrene TEQ (Full LOR)				
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pH Units	µS/cm	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				
EQL				4	0.4	1	1	1	0.1	1	1		1		0.1	0.1	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.5	0.5	0.5				
NSW 2014 Excavated Natural Material (Absolute Max)				40	1	150	200	100	1	60	300	4.5 to 10	3000	0.1			40										1										
NSW 2014 Excavated Natural Material (Max Average)				20	0.5	75	100	50	0.5	30	150	5 to 9	1500	0.05			20										0.5										
Borehole	**Depth**	**Date**	**Matrix_Description**																																		
BH06	0.08-0.1	8/12/2022	FILL: Silty SAND	<4	<0.4	8	2	7	<0.1	3	15	4.6	280	0	11	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5				
TB501	0.7-0.75	5/12/2022	Sandy SILT	<4	<0.4	7	<1	4	<0.1	3	3	5.8	160	0	13	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5				
TB502	0.4-0.5	5/12/2022	FILL: Gravelly Silty SAND/Silty SAND	5	<0.4	13	8	18	<0.1	12	36	6.2	200	1.7	14	0.3	5.6	0.3	<0.1	<0.1	0.3	0.3	0.3	0.3	0.2	0.3	1	0.6	<0.1	0.4	1.2	1.3	1.3				
TB503	0.6-0.7	5/12/2022	FILL: Gravelly Silty SAND	<4	<0.4	9	11	250	<0.1	8	17	6.8	130	19.1	5.7	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5				
Statistical Summary																																					
Number of Results				4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4				
Number of Detects				1	0	4	3	4	0	4	4	4	4	4	4	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1				
Minimum Concentration				<4	<0.4	7	<1	4	<0.1	3	3	4.6	130	0	5.7	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5				
Minimum Detect				5	ND	7	2	4	ND	3	3	4.6	130	1.7	5.7	0.3	5.6	0.3	ND	ND	0.3	0.3	0.3	0.3	0.2	0.3	1	0.6	ND	0.4	1.2	1.3	1.3				
Maximum Concentration				5	<0.4	13	11	250	<0.1	12	36	6.8	280	19.1	14	0.3	5.6	0.3	<0.1	<0.1	0.3	0.3	0.3	0.3	0.2	0.3	1	0.6	<0.1	0.4	1.2	1.3	1.3				
Maximum Detect				5	ND	13	11	250	ND	12	36	6.8	280	19.1	14	0.3	5.6	0.3	ND	ND	0.3	0.3	0.3	0.3	0.2	0.3	1	0.6	ND	0.4	1.2	1.3	1.3				
Average Concentration				2.8	0.2	9.3	5.4	70	0.05	6.5	18	5.9	193	5.2	11	0.11	1.4	0.11	0.05	0.05	0.11	0.11	0.11	0.11	0.088	0.11	0.27	0.19	0.05	0.14	0.49	0.51	0.51				
Median Concentration				2	0.2	8.5	5	12.5	0.05	5.5	16	6	180	0.85	12	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.25	0.25	0.25				
Standard Deviation				1.5	0	2.6	5	120	0	4.4	14	0.93	65	9.3	3.7	0.13	2.8	0.13	0	0	0.13	0.13	0.13	0.13	0.075	0.13	0.49	0.28	0	0.18	0.48	0.53	0.53				
Number of Guideline Exceedances				0	0	0	0	1	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0				
Number of Guideline Exceedances(Detects Only)				0	0	0	0	1	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0				

				svTRH (C10-C40) in Soil									vTRH(C6-C10)/BTEXN in Soil									
				C10-C16	C16-C34	C34-C40	C10 - C40 (Sum of total)	F2: >C10-C16 less NAPHTHALENE	C10 - C14	C15 - C28	C29-C36	+C10 - C36 (Sum of total)	Naphthalene (VOC)	C6-C10	F1: C6-C10 less BTEX	Benzene	Toluene	Ethylbenzene	C6 - C9	Xylene (m & p)	Xylene (o)	Xylene Total
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				50	100	100	50	50	50	100	100	50	1	25	25	0.2	0.5	1	25	2	1	1
NSW 2014 Excavated Natural Material (Absolute Max)												500				0.5	65	25				15
NSW 2014 Excavated Natural Material (Max Average)												250										
Borehole	**Depth**	**Date**	**Matrix_Description**																			
BH06	0.08-0.1	8/12/2022	FILL: Silty SAND	<50	<100	<100	<50	<50	<50	<100	<100	<50	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
TB501	0.7-0.75	5/12/2022	Sandy SILT	<50	<100	<100	<50	<50	<50	<100	<100	<50	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
TB502	0.4-0.5	5/12/2022	FILL: Gravelly Silty SAND/Silty SAND	<50	230	<100	230	<50	<50	160	100	260	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
TB503	0.6-0.7	5/12/2022	FILL: Gravelly Silty SAND	<50	<100	<100	<50	<50	<50	<100	<100	<50	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
Statistical Summary																						
Number of Results				4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Number of Detects				0	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
Minimum Concentration				<50	<100	<100	<50	<50	<50	<100	<100	<50	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
Minimum Detect				ND	230	ND	ND	ND	ND	160	100	260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				<50	230	<100	230	<50	<50	160	100	260	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
Maximum Detect				ND	230	ND	230	ND	ND	160	100	260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration				25	95	50	76	25	25	78	63	84	0.5	13	13	0.1	0.25	0.5	13	1	0.5	0.5
Median Concentration				25	50	50	25	25	25	50	50	25	0.5	12.5	12.5	0.1	0.25	0.5	12.5	1	0.5	0.5
Standard Deviation				0	90	0	103	0	0	55	25	118	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances				0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

				Acid Extractable metals in soil								Misc Inorg - Soil		Moisture	PAHs in Soil																	
				Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	pH 1:5 soil:water	Electrical Conductivity 1:5 soil:water	Moisture Content	Naphthalene	Total PAH (NEPM/WHO 16)	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene	Benzo(a)pyrene TEQ (Zero LOR)	Benzo(a)pyrene TEQ (Half LOR)_1	Benzo(a)pyrene TEQ (Full LOR)
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	pH Units	µS/cm	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				4	0.4	1	1	1	0.1	1	1		1	0.1	0.1	0.05	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.1	0.1	0.1	0.5	0.5	0.5
NSW 2014 General Solid Waste CT1 (No Leaching)				100	20	100		100	4	40																0.8						
NSW 2014 General Solid Waste SCC1 (with leached)				500	100	1900		1500	50	1050																10						
NSW 2014 Restricted Solid Waste CT2 (No Leaching)				400	80	400		400	16	160																3.2						
NSW 2014 Restricted Solid Waste SCC2 (with leached)				2000	400	7600		6000	200	4200																23						
Borehole	**Depth**	**Date**	**Matrix_Description**																													
BH06	0.08-0.1	8/12/2022	FILL: Silty SAND	<4	<0.4	8	2	7	<0.1	3	15	4.6	280	11	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5
TB501	0.7-0.75	5/12/2022	Sandy SILT	<4	<0.4	7	<1	4	<0.1	3	3	5.8	160	13	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5
TB502	0.4-0.5	5/12/2022	FILL: Gravelly Silty SAND/Silty SAND	5	<0.4	13	8	18	<0.1	12	36	6.2	200	14	0.3	5.6	0.3	<0.1	<0.1	0.3	0.3	0.3	0.3	0.2	0.3	1	0.6	<0.1	0.4	1.2	1.3	1.3
TB503	0.6-0.7	5/12/2022	FILL: Gravelly Silty SAND	<4	<0.4	9	11	250	<0.1	8	17	6.8	130	5.7	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5
Statistical Summary																																
Number of Results				4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Number of Detects				1	0	4	3	4	0	4	4	4	4	4	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1
Minimum Concentration				<4	<0.4	7	<1	4	<0.1	3	3	4.6	130	5.7	<0.1	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5
Minimum Detect				5	ND	7	2	4	ND	3	3	4.6	130	5.7	0.3	5.6	0.3	ND	ND	0.3	0.3	0.3	0.3	0.2	0.3	1	0.6	ND	0.4	1.2	1.3	1.3
Maximum Concentration				5	<0.4	13	11	250	<0.1	12	36	6.8	280	14	0.3	5.6	0.3	<0.1	<0.1	0.3	0.3	0.3	0.3	0.2	0.3	1	0.6	<0.1	0.4	1.2	1.3	1.3
Maximum Detect				5	ND	13	11	250	ND	12	36	6.8	280	14	0.3	5.6	0.3	ND	ND	0.3	0.3	0.3	0.3	0.2	0.3	1	0.6	ND	0.4	1.2	1.3	1.3
Average Concentration				2.8	0.2	9.3	5.4	70	0.05	6.5	18	5.9	193	11	0.11	1.4	0.11	0.05	0.05	0.11	0.11	0.11	0.11	0.088	0.11	0.27	0.19	0.05	0.14	0.49	0.51	0.51
Median Concentration				2	0.2	8.5	5	12.5	0.05	5.5	16	6	180	12	0.05	0.025	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.025	0.05	0.05	0.05	0.25	0.25	0.25
Standard Deviation				1.5	0	2.6	5	120	0	4.4	14	0.93	65	3.7	0.13	2.8	0.13	0	0	0.13	0.13	0.13	0.13	0.075	0.13	0.49	0.28	0	0.18	0.48	0.53	0.53
Number of Guideline Exceedances				0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

				svTRH (C10-C40) in Soil								vTRH(C6-C10)/BTEXN in Soil									
				C10-C16	C16-C34	C34-C40	C10 - C40 (Sum of total)	F2: >C10-C16 less NAPHTHALENE	C10 - C14	C15 - C28	C29-C36	>C10 - C36 (Sum of total)	Naphthalene (VOC)	C6-C10	F1: C6-C10 less BTEX	Benzene	Toluene	Ethylbenzene	C6 - C9	Xylene (m & p)	Xylene (o)	Xylene Total
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL				50	100	100	50	50	50	100	100	50	1	25	25	0.2	0.5	1	25	2	1	1
NSW 2014 General Solid Waste CT1 (No Leaching)												10000				10	288	600	650			1000
NSW 2014 General Solid Waste SCC1 (with leached)												10000				18	518	1080	650|6500			1800
NSW 2014 Restricted Solid Waste CT2 (No Leaching)												40000				40	1152	2400	2600			4000
NSW 2014 Restricted Solid Waste SCC2 (with leached)												40000				72	2073	4320	2600			7200
Borehole	**Depth**	**Date**	**Matrix_Description**																			
BH06	0.08-0.1	8/12/2022	FILL: Silty SAND	<50	<100	<100	<50	<50	<50	<100	<100	<50	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
TB501	0.7-0.75	5/12/2022	Sandy SILT	<50	<100	<100	<50	<50	<50	<100	<100	<50	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
TB502	0.4-0.5	5/12/2022	FILL: Gravelly Silty SAND/Silty SAND	<50	230	<100	230	<50	<50	160	100	260	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
TB503	0.6-0.7	5/12/2022	FILL: Gravelly Silty SAND	<50	<100	<100	<50	<50	<50	<100	<100	<50	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
Statistical Summary																						
Number of Results				4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Number of Detects				0	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
Minimum Concentration				<50	<100	<100	<50	<50	<50	<100	<100	<50	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
Minimum Detect				ND	230	ND	230	ND	ND	160	100	260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				<50	230	<100	230	<50	<50	160	100	260	<1	<25	<25	<0.2	<0.5	<1	<25	<2	<1	<1
Maximum Detect				ND	230	ND	230	ND	ND	160	100	260	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration				25	95	50	76	25	25	78	63	84	0.5	13	13	0.1	0.25	0.5	13	1	0.5	0.5
Median Concentration				25	50	50	25	25	25	50	50	25	0.5	12.5	12.5	0.1	0.25	0.5	12.5	1	0.5	0.5
Standard Deviation				0	90	0	103	0	0	55	25	118	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

		Metals from Leaching Fluid pH 2.9 or 5	PAHs in TCLP (USEPA 1311)																
		Lead	Naphthalene	Total PAH (NEPM/WHO 16)	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benz(a)anthracene	Chrysene	Benzo(b+j) & Benzo(k)fluoranthene	Benzo(a)pyrene	Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	µg/L	µg/L	µg/L
EQL		30	1		1	1	1	1	1	1	1	1	1	2	0.001	1	1	1
NSW 2014 General Solid Waste TCLP1 (leached)		5000													0.04			
NSW 2014 Restricted Solid Waste TCLP2 (leached)		20000													0.16			
Field_ID	**Sample_Depth_Range**																	
TB502	0.4-0.5	5/12/2022	FILL: Silty Sandy CLAY	-	<1	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.001	<1	<1	<1
TB503	0.6-0.7	5/12/2022	FILL: Gravelly Silty SAND	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical Summary																			
Number of Results		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Number of Detects		1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration		200	<1	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.001	<1	<1	<1	<1
Minimum Detect		200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration		200	<1	0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<0.001	<1	<1	<1	<1
Maximum Detect		200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration																			
Median Concentration		200	0.5	0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	0.0005	0.5	0.5	0.5	0.5
Standard Deviation																			
Number of Guideline Exceedances		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX

D

DESIGN OUTPUTS

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Design Traffic Calculation

Client: Maitland City Council
Project Reference: 304100929-005
Project Name: MCC Capital Works Program
Road Section: Scobies Lane & S Willards Lane
Location: Oakhampton Heights

Traffic Information	
Annual Average Daily Traffic (AADT)	780 vehicles/day
Direction Factor	0.5
Percentage Heavy Vehicles	3.0 %
Lane Distribution Factor	1.00
Traffic Loading	
Number of Axle Groups per Heavy Vehicle (N_{HVAG})	2.5
Traffic Load Distribution	AGPT02-12 Example TLD
Design Life	
Design Period	20 years
Heavy Vehicle Growth Rate	2.0% p.a.

Design Traffic	
Cumulative Heavy Vehicle Axle Groups (HVAG)	**5.16E+05**
Average number of ESA per Heavy Vehicle Axle Group (ESA/HVAG)	0.70
Design number of Equivalent Standard Axles (DESA)	**3.63E+05**
Standard Axle Repetitions per ESA for damage type k (SARk/ESA)	
Fatigue of asphalt: SAR_a/ESA	1.1
Rutting and shape loss (subgrade strain): SAR_s/ESA	1.6
Fatigue of cemented materials: SAR_c/ESA	12
Design number of Standard Axle Repetitions for damage type k (DSARk)	
Fatigue of asphalt: $DSAR_a$	4.00E+05
Rutting and shape loss (subgrade strain): $DSAR_s$	5.81E+05
Fatigue of cemented materials: $DSAR_c$	4.36E+06

Calculated by: DGB
Checked by:
Date: 1/03/2023

Notes: Supplied ADT value 679 projected from September 2016 using assumed growth rate of 2%

Design Traffic Calculation

Client: Maitland City Council
Project Reference: 304100929-005
Project Name: MCC Capital Works Program
Road Section: Scobies Lane & S Willards Lane
Location: Oakhampton Heights

Traffic Information	
Annual Average Daily Traffic (AADT)	780 vehicles/day
Direction Factor	0.5
Percentage Heavy Vehicles	3.0 %
Lane Distribution Factor	1.00
Traffic Loading	
Number of Axle Groups per Heavy Vehicle (N_{HVAG})	2.5
Traffic Load Distribution	AGPT02-12 Example TLD
Design Life	
Design Period	30 years
Heavy Vehicle Growth Rate	2.0% p.a.

Design Traffic	
Cumulative Heavy Vehicle Axle Groups (HVAG)	**8.62E+05**
Average number of ESA per Heavy Vehicle Axle Group (ESA/HVAG)	0.70
Design number of Equivalent Standard Axles (DESA)	**6.07E+05**
Standard Axle Repetitions per ESA for damage type k (SARk/ESA)	
Fatigue of asphalt: SAR_a/ESA	1.1
Rutting and shape loss (subgrade strain): SAR_s/ESA	1.6
Fatigue of cemented materials: SAR_c/ESA	12
Design number of Standard Axle Repetitions for damage type k (DSARk)	
Fatigue of asphalt: $DSAR_a$	6.67E+05
Rutting and shape loss (subgrade strain): $DSAR_s$	9.71E+05
Fatigue of cemented materials: $DSAR_c$	7.28E+06

Calculated by: DGB
Checked by:
Date: 1/03/2023

Notes: Supplied ADT value 679 projected from September 2016 using assumed growth rate of 2%

Design Traffic Calculation

Client: Maitland City Council
Project Reference: 304100929-005
Project Name: MCC Capital Works Program
Road Section: Oakhampton Road
Location: Oakhampton Heights

Traffic Information	
Annual Average Daily Traffic (AADT)	1596 vehicles/day
Direction Factor	0.5
Percentage Heavy Vehicles	5.5 %
Lane Distribution Factor	1.00
Traffic Loading	
Number of Axle Groups per Heavy Vehicle (N_{HVAG})	2.5
Traffic Load Distribution	AGPT02-12 Example TLD
Design Life	
Design Period	20 years
Heavy Vehicle Growth Rate	2.0% p.a.

Design Traffic	
Cumulative Heavy Vehicle Axle Groups (HVAG)	**1.95E+06**
Average number of ESA per Heavy Vehicle Axle Group (ESA/HVAG)	0.70
Design number of Equivalent Standard Axles (DESA)	**1.37E+06**
Standard Axle Repetitions per ESA for damage type k (SARk/ESA)	
Fatigue of asphalt: SAR_a/ESA	1.1
Rutting and shape loss (subgrade strain): SAR_s/ESA	1.6
Fatigue of cemented materials: SAR_c/ESA	12
Design number of Standard Axle Repetitions for damage type k (DSARk)	
Fatigue of asphalt: $DSAR_a$	1.51E+06
Rutting and shape loss (subgrade strain): $DSAR_s$	2.19E+06
Fatigue of cemented materials: $DSAR_c$	1.64E+07

Calculated by: DGB
Checked by:
Date: 1/03/2023

Notes: Supplied ADT value 1417 projected from August 2017 using assumed growth rate of 2%

Design Traffic Calculation

Client: Maitland City Council
Project Reference: 304100929-005
Project Name: MCC Capital Works Program
Road Section: Oakhampton Road
Location: Oakhampton Heights

Traffic Information	
Annual Average Daily Traffic (AADT)	1596 vehicles/day
Direction Factor	0.5
Percentage Heavy Vehicles	5.5 %
Lane Distribution Factor	1.00
Traffic Loading	
Number of Axle Groups per Heavy Vehicle (N_{HVAG})	2.5
Traffic Load Distribution	AGPT02-12 Example TLD
Design Life	
Design Period	30 years
Heavy Vehicle Growth Rate	2.0% p.a.

Design Traffic	
Cumulative Heavy Vehicle Axle Groups (HVAG)	**3.25E+06**
Average number of ESA per Heavy Vehicle Axle Group (ESA/HVAG)	0.70
Design number of Equivalent Standard Axles (DESA)	**2.29E+06**
Standard Axle Repetitions per ESA for damage type k (SARk/ESA)	
Fatigue of asphalt: SAR_a/ESA	1.1
Rutting and shape loss (subgrade strain): SAR_s/ESA	1.6
Fatigue of cemented materials: SAR_c/ESA	12
Design number of Standard Axle Repetitions for damage type k (DSARk)	
Fatigue of asphalt: $DSAR_a$	2.52E+06
Rutting and shape loss (subgrade strain): $DSAR_s$	3.66E+06
Fatigue of cemented materials: $DSAR_c$	2.75E+07

Calculated by: DGB
Checked by:
Date: 1/03/2023

Notes: Supplied ADT value 1417 projected from August 2017 using assumed growth rate of 2%

Design Traffic Calculation

Client: Maitland City Council
Project Reference: 304100929-005
Project Name: MCC Capital Works Program
Road Section: Proposed Flood Access Road
Location: Oakhampton Heights

Traffic Information	
Annual Average Daily Traffic (AADT)	1430 vehicles/day
Direction Factor	0.5
Percentage Heavy Vehicles	3.0 %
Lane Distribution Factor	1.00
Traffic Loading	
Number of Axle Groups per Heavy Vehicle (N_{HVAG})	2.5
Traffic Load Distribution	AGPT02-12 Example TLD
Design Life	
Design Period	30 years
Heavy Vehicle Growth Rate	2.0% p.a.

Design Traffic	
Cumulative Heavy Vehicle Axle Groups (HVAG)	**1.58E+06**
Average number of ESA per Heavy Vehicle Axle Group (ESA/HVAG)	0.70
Design number of Equivalent Standard Axles (DESA)	**1.11E+06**
Standard Axle Repetitions per ESA for damage type k (SARk/ESA)	
Fatigue of asphalt: SAR_a/ESA	1.1
Rutting and shape loss (subgrade strain): SAR_s/ESA	1.6
Fatigue of cemented materials: SAR_c/ESA	12
Design number of Standard Axle Repetitions for damage type k (DSARk)	
Fatigue of asphalt: $DSAR_a$	1.22E+06
Rutting and shape loss (subgrade strain): $DSAR_s$	1.78E+06
Fatigue of cemented materials: $DSAR_c$	1.33E+07

Calculated by: DGB
Checked by:
Date: 1/03/2023

Notes: Supplied ADT 1430 and assumed HV 3% used

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	6.10E+05

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Flex Title: Flexible unbound

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.59E+02	1.75E+02	0.35
2	rough	Gran_250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
3	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
3	top	Sub_CBR3	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
3	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 1: Austroads (2004) sublayering
Layer no. 2: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID		Critical Strain	CDF
1	130.00	Gran_350		n/a		n/a
2	380.00	Gran_250		n/a		n/a
3	0.00	Sub_CBR3	ESA750-Full		1.28E-03	9.14E-01

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	1.10E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Flex Title: Flexible unbound

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.59E+02	1.75E+02	0.35
2	rough	Gran_250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
3	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
3	top	Sub_CBR3	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
3	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 1: Austroads (2004) sublayering
Layer no. 2: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID		Critical Strain	CDF
1	135.00	Gran_350		n/a		n/a
2	400.00	Gran_250		n/a		n/a
3	0.00	Sub_CBR3	ESA750-Full		1.18E-03	9.55E-01

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	2.30E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Flex Title: Flexible unbound

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.59E+02	1.75E+02	0.35
2	rough	Gran_250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
3	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
3	top	Sub_CBR3	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
3	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 1: Austroads (2004) sublayering
Layer no. 2: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID		Critical Strain	CDF
1	145.00	Gran_350		n/a		n/a
2	425.00	Gran_250		n/a		n/a
3	0.00	Sub_CBR3	ESA750-Full		1.07E-03	9.63E-01

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	2.30E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Flex w select Title: Flexible unbound with select

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.59E+02	1.75E+02	0.35
2	rough	Gran_250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
3	rough	subsltCB15	Aniso.	1.50E+02	0.45	1.03E+02	7.50E+01	0.45
4	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
3	top	subsltCB15	EZZ	0.009300	7.000	1.600
4	top	Sub_CBR3	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
3	1.00	Subgrade (Selected Material)
4	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 1: Austroads (2004) sublayering
Layer no. 2: Austroads (2004) sublayering
Layer no. 3: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	145.00	Gran_350		n/a	n/a
2	135.00	Gran_250		n/a	n/a
3	300.00	subsltCB15	ESA750-Full	9.08E-04	3.11E-01
4	0.00	Sub_CBR3	ESA750-Full	1.06E-03	8.90E-01

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	1.10E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: Flex Title: Flexible unbound

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Gran_350	Aniso.	3.50E+02	0.35	2.59E+02	1.75E+02	0.35
2	rough	Gran_250	Aniso.	2.50E+02	0.35	1.85E+02	1.25E+02	0.35
3	rough	Sub_CBR8	Aniso.	8.00E+01	0.45	5.52E+01	4.00E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
3	top	Sub_CBR8	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
3	1.00	Subgrade (Austroads 2004)

Details of Layers to be sublayered:
Layer no. 1: Austroads (2004) sublayering
Layer no. 2: Austroads (2004) sublayering

Results:

Layer No.	Thickness	Material ID	Load ID		Critical Strain	CDF
1	135.00	Gran_350		n/a		n/a
2	165.00	Gran_250		n/a		n/a
3	0.00	Sub_CBR8	ESA750-Full		1.18E-03	9.12E-01

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	6.10E+05

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: HBB Title: Heavily bound base - new construction

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Cement5000	Iso.	5.00E+03	0.20			
2	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Cement5000	ETH	0.000310	12.000	12.000
2	top	Sub_CBR3	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Cement Stabilised
2	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	335.00	Cement5000	ESA750-Full	-8.26E-05	9.36E-01
2	0.00	Sub_CBR3	ESA750-Full	2.45E-04	8.65E-06

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	1.10E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: HBB Title: Heavily bound base - new construction

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Cement5000	Iso.	5.00E+03	0.20			
2	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Cement5000	ETH	0.000310	12.000	12.000
2	top	Sub_CBR3	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Cement Stabilised
2	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	345.00	Cement5000	ESA750-Full	-7.90E-05	9.89E-01
2	0.00	Sub_CBR3	ESA750-Full	2.35E-04	1.15E-05

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	2.30E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: HBB Title: Heavily bound base - new construction

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Cement5000	Iso.	5.00E+03	0.20			
2	rough	Sub_CBR3	Aniso.	3.00E+01	0.45	2.07E+01	1.50E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Cement5000	ETH	0.000310	12.000	12.000
2	top	Sub_CBR3	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Cement Stabilised
2	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	360.00	Cement5000	ESA750-Full	-7.40E-05	9.48E-01
2	0.00	Sub_CBR3	ESA750-Full	2.20E-04	1.54E-05

CIRCLY - Version 6.0 (24 August 2021)

Job Title: Scobies

Damage Factor Calculation

Assumed number of damage pulses per movement:
Combined pulse for gear (i.e. ignore NROWS)

Traffic Spectrum Details:

Load No.	Load ID	Movements
1	ESA750-Full	1.10E+06

Details of Load Groups:

Load No.	Load ID	Load Category	Load Type	Radius	Pressure/ Ref. stress	Exponent
1	ESA750-Full	ESA750-Full	Vertical Force	92.1	0.75	0.00

Load Locations:

Location No.	Load ID	Gear No.	X	Y	Scaling Factor	Theta
1	ESA750-Full	1	-165.0	0.0	1.00E+00	0.00
2	ESA750-Full	1	165.0	0.0	1.00E+00	0.00
3	ESA750-Full	1	1635.0	0.0	1.00E+00	0.00
4	ESA750-Full	1	1965.0	0.0	1.00E+00	0.00

Layout of result points on horizontal plane:
Xmin: 0 Xmax: 165 Xdel: 165
Y: 0

Details of Layered System:

ID: HBB Title: Heavily bound base - new construction

Layer No.	Lower i/face	Material ID	Isotropy	Modulus (or Ev)	P.Ratio (or vvh)	F	Eh	vh
1	rough	Cement5000	Iso.	5.00E+03	0.20			
2	rough	Sub_CBR8	Aniso.	8.00E+01	0.45	5.52E+01	4.00E+01	0.45

Performance Relationships:

Layer No.	Location	Material ID	Component	Perform. Constant	Perform. Exponent	Traffic Multiplier
1	bottom	Cement5000	ETH	0.000310	12.000	12.000
2	top	Sub_CBR8	EZZ	0.009300	7.000	1.600

Reliability Factors:
Project Reliability: Austroads 95%

Layer No.	Reliability Factor	Material Type
1	1.00	Cement Stabilised
2	1.00	Subgrade (Austroads 2004)

Results:

Layer No.	Thickness	Material ID	Load ID	Critical Strain	CDF
1	300.00	Cement5000	ESA750-Full	-7.71E-05	7.42E-01
2	0.00	Sub_CBR8	ESA750-Full	1.94E-04	3.05E-06