Geotechnical Investigation for Catherine McAuley Catholic College 507 Medowie Road, Medowie NSW

Ref: P1292 - R – 001 – Rev.0

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Client: Catholic Diocese of Maitland

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Attention: Geoff Whitwall

RE: Geotechnical Investigation for Catherine McAuley Catholic College
507 Medowie Road, Medowie NSW

Dear Geoff,

As requested by the Catholic Diocese of Maitland, Valley Civilab Pty Ltd have undertaken a geotechnical site investigation for the purpose of a Site Classification to AS 2870-2011 with Foundation Parameter Recommendations and Pavement Design to Austroads Guidelines. The following report (Ref: P1292 - R – 001 – Rev.0) summarises the geotechnical conditions that were encountered at 507 Medowie Road, Medowie NSW, including site classification, pavement design and the presence of acid sulfate soils.

If you have further questions or queries regarding the attached report, please contact the signatory below.

For and on behalf of
Valley Civilab Pty Ltd

Nathan Roberts
Geotechnical Engineering Manager
Bachelor of Engineering (Civil)

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1. Introduction

At the request of the Catholic Diocese of Maitland, Valley Civilab Pty Ltd (VC) have carried out a geotechnical investigation for the purpose of a site classification and pavement design for proposed Catholic College.

The purpose of the investigation was to provide recommendations on the following:

- Surface and Sub-surface conditions;
- Laboratory testing results;
- Site preparation;
- Excavation conditions;
- Suitability of site soils for fill and founding conditions;
- Site Classification to AS 2870-2011;
- Alternative footing types and foundation design parameters;
- Recommendations on the presence of Acid Sulfate Soils;
- Recommendations on the presence of Soil Aggressively towards Concrete and Steel Structures;
- Subgrade strength and rigid and flexible pavement design.

2. Site Description

The site was located at 507 Medowie Road, Medowie NSW. The site is surrounded by Medowie Road to the east, an existing substation to the north east, rural residential lots to the north and low lying bushland / wetlands to the south and west. Development existing at the site consisted of a house and industrial sized shed, tennis court, windmill and paved / unpaved access tracks. A power line easement also existed to be running north to south within the lot immediately adjacent to the east boundary.

Site slopes were generally to the south / south west at 5 to 10°, reducing to 0 to 3° in the lower western and southern portions of the site. Site drainage was generally by overland flow towards the south and west, a contour drainage line existed within the south east portion of the site and ran to the south. The southern and western most portions of the site were understood to flood during times of long duration storm events.

In general vegetation at the site consisted of short grass at the time of investigation with some sparse medium to large trees; large to medium sized trees also lined the north, south and western boundaries of the site.

No outcropping of rock was observed at the site.

3. Preliminary Site Investigation

3.1 Geological Setting

Reference to the 1:250,000 Newcastle Geological Map indicates that the majority of the site is underlain by the Permian Tomago Coal Measures consisting of shale, mudstone, sandstone, tuff and coal. The lower lying southern and western most portions of the site indicated to be underlain by Quaternary Alluvium consisting of gravel, sand, silt, clay, “Waterloo Rock”, Marine and freshwater deposits.

3.2 Mine Subsidence

Reference to the Mine Subsidence District Maps indicates that the site is not undermined.

3.3 Acid Sulfate Soils Risk Maps

In reference to the Acid Sulfate Soils Management Advisory Committee (ASSMAC) risk maps the southern portion of the site lies within an area in which Acid Sulfate Soils are known or expected to occur.

Refer to **Annex A** for site plan showing the approximate extent of the site that lies within the Acid Sulfate Soil Risk area.

4. Methodology

Fieldwork was undertaken on 9th of May 2017 and consisted of:

- a visual assessment of the existing surface of the site and surrounding area;
- the drilling of twenty five (25) boreholes (BH-1 – BH-25) to depths of between 1.8m and 3.0m for site classification;
- the drilling of thirteen (13) boreholes (BHP-1 – BHP-13) up to depths of between 1.4m and 2.0m for pavement investigation;
- the driving of Dynamic Cone Penetrometer probes at BH locations;
- recovery of disturbed and undisturbed soil samples for laboratory testing.

Laboratory testing consisted of:

- eight (8) Shrink Swell Index Tests;
- seven (7) California Bearing Ratio Tests;
- seven (7) Soil Aggressivity tests towards steel and concrete;
- twelve (12) Acid Sulfate Soil pH screening tests;
- three (3) Acid Sulfate Soil pH screening tests.

5. Subsurface Conditions

The subsurface conditions encountered have been divided into five (5) units as follows:

UNIT 1 – TOPSOIL:

- Silty SAND, with grass root fibres, loose

UNIT 2 – FILL:

- Silty Gravelly SAND / SAND, Silty Sandy CLAY, medium dense to dense / stiff

UNIT 3 – ALLUVIUM:

- Silty SAND / SAND / Clayey SAND, Clayey SAND/Sandy CLAY, Sandy CLAY, medium dense to dense / stiff

UNIT 4A – RESIDUAL:

- Silty CLAY, stiff to very stiff

UNIT 4B – RESIDUAL

- Silty CLAY, high plasticity, pale grey/red with weathered inclusions (ironstone/ sandstone bands) very stiff to hard

A summary of the soil subsurface unit profiles encountered in each borehole can be seen below in **Table 5.1**.

***Table 5.1** – Summary of soil and subsurface profile for site classification*

Borehole	Borehole Depth (m)	UNIT Depth (m)				
		UNIT 1	UNIT 2	UNIT 3	UNIT 4A	UNIT 4B
Site Classification Boreholes						
BH-1*	2.0**	0.0-0.2	-	0.2-2.0	-	-
BH-2*	1.8**	0.0-0.2	-	0.2-1.8	-	-
BH-3*	2.0**	0.0-0.1	-	0.1-2.0	-	-
BH-4*	2.0**	0.0-0.1	-	0.1-2.0	-	-
BH-5*	2.0**	0.0-0.1	-	0.1-2.0	-	-
BH-6*	3.0	0.0-0.05	-	0.05-3.0	-	-
BH-7*	3.0	0.0-0.05	-	0.05-3.0	-	-
BH-8*	3.0	0.0-0.05	-	0.05-3.0	-	-
BH-9	1.8	0.0-0.15	-	-	-	0.15-1.8
BH-10	3.0	0.0-0.2	-	-	0.2-1.0	1.0-3.0
BH-11	3.0	0.0-0.2	-	-	0.2-1.0	1.0-3.0
BH-12	3.0	0.0-0.2	-	-	0.2-1.0	1.0-3.0
BH-13	2.0	0.0-0.2	-	-	0.2-1.0	1.0-2.0
BH-14	2.3	0.0-0.15	-	-	0.15-1.3	1.3-2.3
BH-15	3.0	0.0-0.2	-	-	0.2-1.0	1.0-3.0
BH-16	3.0	0.0-0.2	-	-	0.2-1.0	1.0-3.0
BH-17	3.0	0.0-0.2	-	-	0.2-0.7	0.7-3.0
BH-18	3.0	0.0-0.1	-	0.1-3.0	-	-
BH-19	3.0	0.0-0.1	-	0.1-3.0	-	-
BH-20	3.0	-	0.0-0.4	-	0.4-1.2	1.2-3.0
BH-21	3.0	-	0.0-0.4	-	0.4-1.4	1.4-3.0
BH-22	3.0	-	0.0-0.4	-	0.4-1.3	1.3-3.0
BH-23	3.0	0.0-0.5	-	-	0.5-1.5	1.5-3.0
BH-24	3.0	0.0-0.3	-	-	0.3-1.4	1.4-3.0
BH-25	3.0	0.0-0.4	-	-	0.4-1.2	1.2-3.0

Pavement Investigation Boreholes						
BHP-1	2.0	0.0-0.3	-	0.3-2.0	-	-
BHP-2	2.0	0.0-0.4	-	0.4-2.0	-	-
BHP-3	2.0	0.0-0.2	-	0.2-2.0	-	-
BHP-4	2.0	-	0.0-0.5	0.5-2.0	-	-
BHP-5	2.0	-	0.0-0.5	0.5-2.0	-	-
BHP-6	2.0	-	0.0-1.4	-	1.4-2.0	-
BHP-7	2.0	0.0-0.2	-	-	0.2-2.0	-
BHP-8	2.0	-	-	-	0.0-2.0	-
BHP-9	2.0	0.0-0.3	-	-	0.3-2.0	-
BHP-10	2.0	-	0.0-1.3	-	1.3-2.0	-
BHP-11	1.4	0.0-0.2	-	0.2-0.4	0.4-1.4	1.4**
BHP-12	2.0	0.0-0.2	-	0.2-0.5	0.5-2.0	-
BHP-13	2.0	0.0-0.2	-	0.2-0.4	0.4-2.0	-

Notes:

*Groundwater inflow was encountered within BH-1 at 1.8m, BH-2 at 1.2m, BH-3 at 1.1m, BH-4 at 1.0m, BH-5 at 1.0m, BH-6 at 1.5m, BH-7 at 1.5m, BH-8 at 1.8m, BH-18 at 1.5m, BH-19 at 1.5m, BHP-1 at 1.0m, BHP-2 at 0.6m, BHP-4 at 1.0m, BHP-5 at 1.2m.
**Borehole collapsing (sands in water table)
***BHP-11 refusal on inferred rock?

Refer to **Annex A** for the borehole location plan and **Annex B** for the detailed borelog report.

6. Laboratory Test Results

Four (4) undisturbed soil samples were recovered from the boreholes for the purpose of a site classification. Two (2) bulk disturbed soil samples were recovered from the boreholes for the purpose of a pavement investigation. The sample was transported to Valley Civilab's NATA accredited soil testing laboratory for analysis.

6.1 Laboratory Test Results for Site Classification

The laboratory test results are summarised below in **Table 6.1**.

***Table 6.1** – Summary of shrink swell laboratory test results*

Borehole	Depth (m)	Soil Description	Iss (%)
BH-9	0.8 – 1.0	UNIT 4B, RESIDUAL, Silty CLAY, very stiff	2.0
BH-10	0.4 – 0.6	UNIT 4A, RESIDUAL, Silty CLAY, very stiff	2.3
BH-12	0.8 – 1.0	UNIT 4A, RESIDUAL, Silty CLAY, very stiff	2.4
BH-16	0.8 – 1.0	UNIT 4A, RESIDUAL, Silty CLAY, stiff-very stiff	3.2
BH-17	1.3 – 1.5	UNIT 4B, RESIDUAL, Silty CLAY, very stiff-hard	2.7

BH-21	1.0 – 1.2	UNIT 4A, RESIDUAL, Silty CLAY, stiff-very stiff	3.1
BH-23	0.6 – 0.8	UNIT 4A, RESIDUAL, Silty CLAY, very stiff-hard	1.8
BH-25	0.6 – 0.8	UNIT 4A, RESIDUAL, Silty CLAY, stiff	3.0

6.2 Laboratory Test Results for Pavement Investigation

The laboratory test results are summarised below in **Table 6.2**.

***Table 6.2** – California Bearing Ratio Test Results*

Sample	**BHP-1 0.3 - 0.7m**	**BHP-3 0.4 - 1.0m**	**BHP-5 0.5 - 1.0m**	**BHP-6 0.5 - 1.0m**	**BHP-9 0.4 - 1.0m**	**BHP-10 1.3 - 1.8m**	**BHP-12 0.5 - 1.0m**
Soil Description	UNIT 3, ALLUVIUM, Silty SAND	UNIT 3, ALLUVIUM, SAND	UNIT 2, FILL, SAND w clay	UNIT 2, FILL, SAND w clay	UNIT 4A, RESIDUAL, Silty Sandy Gravelly CLAY	UNIT 4B, RESIDUAL, Silty CLAY	UNIT 4B, RESIDUAL, Silty CLAY
FMC (%)	14.4	18.9	14.7	21.3	22.1	29.4	23.7
OMC (%)	10.6	13.3	12.3	17.0	23.9	25.8	25.9
MDD (t/m^3)	1.817	1.627	1.768	1.678	1.532	1.439	1.462
CBR (%)	20	10	4.5	4	8	1.5	9

6.3 Laboratory Test Results for Soil Aggressivity

The laboratory test results are summarised below in **Table 6.3**

***Table 6.3** – Summary of Soil Aggressivity Results*

Sample / Depth (m)	**Soil Description**	**Chloride (%)**	**Sulphate SO4 (%)**	**pH**	**Conductivity (ohm.cm)**	**Exposure Classification to Concrete**	**Exposure Classification to Steel**
BH4 0.4-0.6m	UNIT 3, ALLUVIUM, SAND (indurated)	0.002	0.006	6.1	30	Mild	Non Aggressive
BH4 1.0-1.3m	UNIT 3, ALLUVIUM, SAND	0.003	0.002	6.5	30	Mild	Non Aggressive
BH4 1.5-1.8m	UNIT 3, ALLUVIUM, SAND	0.003	0.002	6.1	40	Mild	Non Aggressive

BH10 0.8-1.0	UNIT 4A, RESIDUAL, Silty CLAY	0.001	0.004	5.6	45	Non Aggressive	Non Aggressive
BH10 2.0-2.5	UNIT 4B, RESIDUAL, Silty CLAY	0.002	0.006	5.1	60	Non Aggressive	Non Aggressive
BH17 0.5-0.7	UNIT 4A, RESIDUAL, Silty CLAY	0.010	0.008	5.0	100	Mild	Non Aggressive
BH17 1.5-1.8	UNIT 4B, RESIDUAL, Silty CLAY	0.003	0.020	5.2	170	Non Aggressive	Non Aggressive

Laboratory test reports are attached in **Annex C**.

7. Site Classification

7.1 Background Information

Site classification is based off the characteristic surface movements encountered at the site due to the moisture variations within the soil profile. Characteristic surface movements are estimated in accordance with AS2870-2011 "Residential Slabs & Footings". Surface movement calculation take into consideration the depth of the soil profile layers, the soil reactivity and the soil suction depth.

The site classification based on characteristic surface movements are summarised below in **Table 7.1**.

***Table 7.1** – Summary of AS2870-2011 characteristic surface movement & site classification*

Characteristic surface movement (y_s) mm	**Site Classification AS 2870-2011**	**Underlying Soil / Geology**
0	Class A	SAND or ROCK site (non-reactive)
0 – 20mm	Class S	CLAY (slightly reactive)
20 – 40mm	Class M	CLAY (moderately reactive)
40 – 60mm	Class H1	CLAY (highly reactive)
60 – 75mm	Class H2	CLAY (highly reactive)
> 75mm	Class E	CLAY (extremely reactive)

Sites subjected to deep-seated moisture change are modified with the addition of "-D".

As defined by AS2870-2011 other sites should be classified as a Class P (Problem) site. These sites include sites with:

- inadequate bearing capacity
- expected excessive foundation settlement due to loading on the foundation
- significant moisture variations
- mine subsidence risk
- slope stability risk
- erosion issues
- greater than 0.8m of fill for sand sites and greater than 0.4m for other sites (in general)

7.2 Site Classification

The proposed development should be designed in accordance with AS2870-2011 "Residential Slabs and Footings". Based on the visual inspection, dynamic cone penetrometer tests and soil profile shown above in **Section 5**, the site classification is summarised below in **Table 7.2**.

***Table 7.2** – Site classification & characteristic surface movements*

Site Classification	Site Reactivity	Characteristic Surface Movement
Class P	Class H1	40 – 60mm

The site was classified as a Class P due to the depth of fill material encountered at the site and the presence of existing development.

Classification of the site has not taken into account the effects of abnormal moisture conditions. If the site undergoes any earthworks operations, the site shall be reclassified in accordance with AS2870-2011.

7.3 Abnormal Moisture Effects

Abnormal moisture conditions in the foundation can be caused by the following:

- Leaking water services
- Prolonged periods of draught or heavy rainfall
- Trenches or other man made water courses
- Poor roof plumbing or obstruction to the roof plumbing system
- Poor rainfall runoff control
- Corroded gutters or downpipes

Abnormal moisture conditions specified above can cause adverse effects to the development's foundation such as:

- Erosion significantly effecting the lateral and founding support of the structure's footing system
- Saturation of the founding material which can cause a significant decrease in the strength of the founding material
- Shrinkage creating subsidence of the founding material and causing additional stresses within the building structure
- Swelling which creates an upward force in the footings which causes additional stresses within the building structure

7.4 Effects from Trees

The existence of trees within or adjacent to the building footprint can cause significant soil movement due to the following:

- Roots growing within the foundation and causing an upward force on footings
- Roots drawing in and absorbing the moisture below a footing system causing subsidence due to shrinkage of the soil volume

The site should take into account the tree score effect in accordance with and designed to AS2870-2011.

7.5 Footing Recommendations

The site is suitable for the use of both shallow and deep footing systems dependant on the development and structural bearing pressure required. Refer to **Section 7.5.1** and **7.5.2** below for bearing pressure parameters.

7.5.1 Shallow Footings

The maximum allowable bearing capacity of **150kPa** for shallow level footings founded within stiff clay soils, medium dense sands or better below existing topsoil, fill or any other deleterious material is recommended at the site.

If weathered rock is exposed at the base of the excavation of footings it is recommended that the rest of the footing system be piered / taken to bedrock to reduce the risk of differential settlement.

The footing systems must be designed by a structural engineer in accordance with engineering principles and AS 2870 - 2011 “Residential Slabs and Footings” for no less than the minimum requirements for the site classification and soil reactivity given as per **Section 7.2** above.

7.5.2 Deep Footings

The site is suitable for bored piers in residual and alluvial clays, or cased bored / drive / screw piers within alluvial sands. Approximate Allowable End Bearing Pressures and Shaft Adhesion estimated below in **Table 7.3**.

Table 7.3 *– Summary of Allowable end bearing pressures and Shaft adhesion for piers*

Soil Strata	Allowable Shaft Adhesion (kPa)	Allowable End Bearing Pressure (kPa)
UNIT 1 TOPSOIL	-	-
UNIT 2 FILL (existing)	-	-
UNIT 3 ALLUVIUM	-	150
UNIT 4A – RESIDUAL	5	150
UNIT 4B – RESIDUAL	10	200

Notes:
(1) AS2159 requires that the contribution of the pile shaft from ground surface to 1.5 piles diameters or 1m (whichever greater) shall be ignored;
(2) Assumes minimum embedment depth of 1 x pile diameter into the founding stratum and a total pile depth of at least 5 x pile diameters;
(3) The depth of the founding stratum may vary across the building area;
(4) Assumes a clean socket with roughness category of R2 or better as defined by Walker and Pells (1998);
(5) Allowable bearing capacities are based on a limiting settlement of 1% of the pile diameter and shaft adhesion values include a FOS of 2.5.
(6) It should also be considered that for piles designed to resist uplift (tension) loads we recommend a shaft adhesion value of 50% of the tabulated value to be adopted.

The bearing pressures presented above have been correlated from Dynamic Cone Penetration tests and should be considered as estimates only. Bearing pressures of all exposed foundation areas should be confirmed at the time of earthworks and prior to concrete pour by a qualified Geotechnical Engineer.

7.6 Footing Construction

All excavations should be excavated, cleaned, inspected a qualified Geotechnical Engineer and poured with minimal delay. If delays in pouring mass concrete footings is anticipated, a concrete blinding layer should be provided to protect the foundation material.

Should softening of exposed foundation occur, the effected material should be over excavated and backfilled to design footing level by engineered fill or mass concrete.

7.7 Ongoing Footing Maintenance

Foundations including effective site drainage are required to be maintained over the life of the development to ensure footing performance. Refer to **Annex D** for the following:

- BTF 18-2011- CSIRO – Foundation Maintenance and Footing Performance – A Homeowner's Guide.

7.8 Soil Aggressivity towards Steel and Concrete

Based on the results from the chemical laboratory testing of the soil sample collected on the site, and with reference to Table 6.4.2 (A) & (C) and 6.5.2 (A) & (C) in AS2159-2009, the exposure classification for on structural elements falls into the **mildly aggressive classification towards concrete and non-aggressive classification towards steel**.

Concrete piles should be designed in accordance with AS 2159-2009 Table 6.4.3. A minimum concrete strength of 32MPa must be used for concrete piles. For a 50 year design life the minimum required cover to reinforcement is 20mm for precast and prestressed piles, and 60mm for cast-in-place piles. For a 100 year design life the minimum required cover to reinforcement is 30mm for precast and prestressed piles, and 75mm for cast-in-place piles.

Exposed steel should be designed in accordance with AS 2159-2009 Table 6.5.3. A minimum steel uniform corrosive allowance of <0.01mm/year should be allowed for.

8. Earthworks

Any earthworks conducted at the site should be controlled in accordance with AS3798-2007 and guided by the sections below.

8.1 Site Preparation

It is recommended that the following be undertaken were controlled filling is to be undertaken:

1) Remove all topsoil, root effected zones, material assessed as unsuitable and other deleterious zones (noting the stripped soil is not considered suitable as engineered fill but may be considered for landscaping purposes);
2) Exposed suitable foundation areas should then be ripped 300mm and re-compacted to 100% standard maximum dry density (SMDD) at ±2% of optimum moisture content (OMC);
3) The foundation area should then be proof rolled under the supervision of an experienced geotechnical consultant
4) any soft spots / heaving areas identified. If identified these areas should be over excavated under the direction of the geotechnical consultant and replaced with engineered fill

8.2 Controlled Fill

Any earthworks conducted at the site should be controlled in accordance with AS3798-2007. Based on the soil profile shown above in **Section 5**, visual observations and in-situ Dynamic Cone Penetrometer testing, the material encountered at the site is deemed suitable for controlled fill. If the sub-surface conditions encountered at the site during construction differ from those discussed in **Section 5**, VC should be consulted to determine if the material is suitable for controlled fill. Similarly, any won material imported from external sites should consult VC to determine if the fill is suitable for controlled fill.

8.2.1 Compaction Criteria

Fill material should be compacted in near-horizontal uniform layers with a maximum compacted thickness of 300mm. It is important to ensure layers are placed in such a way that provides adequate drainage and prevent ponding during construction. The thickness of fill placed during construction should take into account the compaction equipment available.

The moisture of the fill material should be controlled within a specified range of OMC in order to achieve the compaction criteria. In general, soils should be compacted within a moisture range of ±2% of OMC.

For residential developments the following compaction criteria applies:

- Cohesive Soils – 95% Minimum Density Ratio (Standard Compactive Effort)
- Non-cohesive Soils – 70% Minimum Density Index

For road developments the following compaction criteria applies:

- General Fill – 98% Standard Maximum Dry Density

- Subgrade – 100% ± 2 Standard Maximum Dry Density Density

Refer to council development guidelines for compaction criteria for different traffic loading.

A suitably qualified geotechnical professional must be consulted to determine that the specified compaction has been achieved.

8.3 Excavations Conditions

Excavations within the fill, natural soils and extremely low to very low strength rock that was encountered during the investigations is thought to be achievable with conventional earthmoving equipment such excavators, backhoes and dozers. Very low to low strength rock may also require ripper tynes attached to excavator arms or dozers for effective excavation. Rock of low strength or greater may possibly require a 12 tonne excavator (or greater) with rock ripper or hydraulic rock hammer, depending on the degree of strength and fracturing in the rock. Excavations in rock would require minimising vibration to neighbouring residences and structures, else other methods may be required (for example pre-drilling the rock, rock sawing using diamond wire saw equipment, grinding or engaging a rock breaking and removal specialist).

Bored piers could be drilled using a 12 tonne excavator or greater with an attached auger. It is recommended that the bottom of bored pier holes should be cleaned out with the excavator fitted with a bucket attachment.

Excavations should be conducted in accordance with The Safe Work Australia "Excavation Work" Code of Practice March 2015. (http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/704/ExcavationWork2.pdf)

Excavations can seriously affect the stability of adjacent buildings. Careful consideration must be taken in order to prevent the collapse of partial collapse of adjacent structures.

Construction material and equipment should not be placed within the zone of influence of an excavation unless a suitably qualified geotechnical engineer has designed ground support structures to withstand these loads. The zone of influence is dependent on the material encountered at the site and is the area in which possible failures can occur.

Refer to Maitland City Council's development guidelines before conducting any excavation works.

8.4 Batter Slopes

8.4.1 Temporary Batter Slopes

Temporary excavations in natural material or extremely low to very low strength rock may be near vertical provided that:

- The depth does not exceed 1.5m;
- They are open for no more than 24hrs;
- No surcharge loading is applied to the surface within 2.5m of the excavation;
- No one enters the excavation e.g. workers

All other temporary batter slopes during construction should not exceed 1H:1V in soils and 1H:4V in rock and benched, planned and managed in accordance with Safe Work Australia Excavation Work Code of Practice March 2015.

8.4.2 Permanent Batter Slopes

Recommended permanent batter slopes in general are as follows:

- 2H:1V in cohesive soils (e.g. clays) or extremely to very low weathered rock else retained by an engineered retaining wall;
- 3H:1V in non-cohesive soils (e.g. sands) else retained by an engineered retaining wall;
- 1H:1V in low strength rock or greater (permanent rock batters may be steepened to near vertical – subject to inspection by a qualified geotechnical engineer).

9. Pavement Thickness Design

Pavement design was completed in accordance with:

- Port Stephens Council Pavement Design Guidelines;
- APRG-21 A Guide to the Design of New Pavements for Light Traffic Roads, 2006; and
- Austroads Design Guide 2012.

CIRCLY 6 was utilised for forward calculations to determine critical strains and pavement damage.

Based on laboratory test results as described in **Table 6.2** – California Bearing Ratio Test Results**,** adopted sub-grade soaked CBR values are as follows:

- 4% for subgrades

As per Port Stephens Council Development Design Specifications D2 the following traffic loadings were adopted for design:

Flexible & Rigid Pavements:

- Urban Residential Access Street – 1 x 10^5 Design ESA's

9.1 Flexible Pavement Thickness Design

The recommended flexible pavement thickness, pavement material and compaction specification are presented in **Table 9.1** and **Table 9.2** below.

Table 9.1 – Summary of Flexible Pavement Minimum Thickness Design

Pavement	Min Thickness
AC10 Wearing course (to Council spec)***	30
Primer seal	10
Base course (DGB20 or equivalent)	100
Subbase (DGS40 or equivalent)	200
Total thickness (mm)	340

Subgrade CBR	4%

*A construction tolerance of 10mm should be allowed for above the minimum thickness
**Select layer is recommended to compensate the presence of highly reactive low strength clays that were encountered at the site; and to provide trafficability during construction.
***or primer seal + two coat flush seal (as per council guidelines).

Table 9.2 – Flexible Pavement Compaction Criteria

Pavement	Compaction Criteria
AC10 Wearing course (to Council spec)	NA
Primer seal	NA
Base course (DGB20 or equivalent)	98% Modified (AS 1289.5.2.1)
Subbase (DGS40 or equivalent)	95% Modified (AS 1289.5.2.1)
Subgrade	100% Standard (AS 1289.5.1.1)

The pavement thickness is dependent on the provision of adequate surface and subsurface drainage as specified by a qualified civil or pavement engineer. It is recommended that an intra pavement subsoil drain be installed at the interfaces between pavement types.

9.2 Rigid Pavement Thickness Design

The recommended rigid pavement thickness, pavement material and compaction specification are presented in **Table 9.3** and **Table 9.4** below.

Table 9.3 – Summary of Rigid Pavement Minimum Thickness Design

Pavement	Min Thickness
Base course (32 MPa concrete with SL72 reinforcement)	150
Subbase (Crushed Rock Subbase Min Soaked CBR 80%, Maxi PI = 6%, or equivalent)	150
Total thickness (mm)	300
Subgrade CBR	4%

*A construction tolerance of 10mm should be allowed for above the minimum thickness
**Or as specified by Council

Table 9.4 – Rigid Pavement Compaction Criteria

Pavement	Compaction Criteria
Base course (32 MPa concrete with SL72 reinforcement)	NA
Subbase (Crushed Rock Subbase Min Soaked CBR 80%, Max PI = 6%, or equivalent)	98% Modified (AS 1289.5.2.1)
Subgrade	100% Standard (AS 1289.5.1.1)

The pavement thickness is dependent on the provision of adequate surface and subsurface drainage as specified by a qualified civil or pavement engineer. It is recommended that an intra pavement subsoil drain be installed at the interfaces between pavement types.

10. Acid Sulfate Soils Assessment

Acid Sulfate Soils is the common name given to naturally occurring sediments and soils containing iron sulfides, iron disulfide or their precursors which, when exposed to oxygen generate sulfuric acid. Oxygen exposure to sulfides in acid sulfate soils by drainage or excavation can have detrimental effects to the environment and infrastructure. If acid sulfate soils are encountered a management plan must be followed during the excavation or dewatering of soil materials.

The term “acid sulfate soils” can refer to either “actual acid sulfate soils” or “potential acid sulfate soils”. “Actual acid sulfate soils” is the term given to highly acidic sediments and soil horizons that have resulted from the aeration of soil material with a concentrated sulfide content. “Potential Acid Sulfate Soils” is the term given to sediment and soil horizons that have not undergone exposure to oxygen, however, have the potential to becoming highly acidic when exposed to air and oxidise.

11. Laboratory Analysis

11.1 Field pH Screening

The Field pH Screening test method is a qualitative method used to assist in the identification of the iron sulphides in acid sulfate soils. The field pH ($\mathrm{pH_F}$)is used to indicate the likelihood and severity of “actual acid sulfate soils”. Peroxide is used to rapidly oxidise iron sulfides and can assist in the identification of “potential acid sulfate soils”. The pH reading after oxidation is known as $\mathrm{pH_{FOX}}$.

Actual acid sulfate soils tend to have a field pH reading of less than or equal to 4 while “potential” acid sulfate soils tend to have a non-acidic or neutral pH reading. $\mathrm{pH_{FOX}}$ values of less than 3 indicate a high level of certainty for potential acid sulfate soils whilst. $\mathrm{pH_{FOX}}$ readings greater than 3 are less positive and require further laboratory analysis to confirm the presence of iron sulfides.

The test method is used only to assist in identifying soil acidity. These methods are used to assist in selecting a soil sample for further detailed testing of acid sulfate soils but do not quantify the amount of acidity in the soil. Therefore, the method should not be used as a substitute for detailed testing and further analytical methods must be used to quantify the amount of acidity within the soil. The Suspension Peroxide Oxidation Combined Acidity and Sulfate (SPOCAS) test method is used for further detailed analysis of acid sulfate soils. Refer to **Section 6.2** for a discussion of the SPOCAS test and results.

11.1.1Laboratory Field pH Screening Test Results

Twelve (12) small disturbed soil samples were recovered from the fieldwork investigation. The samples were immediately placed in small jars and transported on ice to Valley Civilab's NATA accredited soil testing laboratory for analysis. The samples were analysed for field pH. Three (3) sample was further tested for the presence of acid sulfate soils using the SPOCAS method (Suspension Peroxide Oxidation Combined Acidity and Sulfate).

The laboratory test results are summarised below in **Table 11.1**.

***Table 11.1** – Summary of Acid Sulfate Soils pH and laboratory results*

Borehole	Depth (m)	pH (field)	pH (field oxidised)	Delta pH (field - field oxidised)
BH2	0.4 - 0.5	6.0	3.4	2.6
BH2	0.8 - 0.9	4.9	3.9	1
BH2	1.0 - 1.2	5.2	3.6	1.6
BH2	1.5 - 1.8	5.0	3.8	1.2
BH5	0.5 - 0.6	5.1	3.7	1.4
BH5	1.1 - 1.2	5.1	4.0	1.1
BH5	1.5 - 1.6	4.8	3.6	1.2
BH8	0.4 - 0.5	5.5	3.3	2.2
BH8	0.7 - 0.8	5.7	3.9	1.8
BH8	1.0 - 1.2	5.3	4.0	1.3
BH8	1.5 - 1.7	5.8	4.5	1.3
BH8	2.4 - 2.6	6.0	3.8	2.2

Refer to **Annex E** for the laboratory screening test results.

11.1.2Discussion of Field pH Screening Results

Field $\mathrm{pH_F}$ test results were generally between 4.8 and 6.0, and $\mathrm{pH_{FOX}}$ were generally between 3.4 and 4.5. These results indicate that Acid Sulfate Soils may exist at the site and further detailed testing is required to determine the presence and extent of iron sulphides. Samples BH2 0.4-0.5m, BH5 1.5-1.6 and BH8 2.4-2.6m were chosen for further analytical testing.

11.2 Analytical Testing

TOS – Total Oxidisable Sulfur (Method 20) and SPOCAS – Suspension Peroxide Oxidation Combined Acidity & Sulfate (Method 21) are analytical methods used for detailed analysis of acid sulfate soil samples. The TOS method is generally not suitable for quanitifying the actual acidity of a soil. For effective acid sulfate soil management strategies, the SPOCAS method is used to gain a better understanding of the sulfur content of a soil.

An Acid Sulfate Soil Management Plan is assessed based on the percentage of oxidisable sulfur or the acid trail results achieved from the SPOCAS test method. The action criteria for a management plan is summarised below in **Table 11.2.** Soils a split up into three broad texture categories known as coarse texture (Sands to Loamy Sands), medium texture (Sandy Loams to light clays) and fine texture (medium to heavy clays and silty clays).

***Table 11.2** – Action Criteria for Analysis of ASS based on soil texture*

Type of Material		Action Criteria 1 – 1000 Tonnes Disturbed		Action Criteria Greater than 1000 Tonnes Disturbed	
Texture	**Clay (%)**	**Sulfur Trail (% S)**	**Acid Trail (Mol H*/tonne) TPA or TSA**	**Sulfur Trail (% S)**	**Acid Trail (Mol H*/tonne) TPA or TSA**
Coarse	≤ 5	0.03	18	0.03	18
Medium	$5 - 40$	0.06	36	0.03	18
Fine	≥ 40	0.1	62	0.03	18

If the sulfur trail (%S) and the acid trail (TPA or TSA) results are above the action criteria specified above in **Table 11.2,** an acid sulfate soils management plan will be required for the disturbance of soil site.

11.2.1Analytical Test SPOCAS Results

The results for the SPOCAS test method for the site are shown below in **Table 11.3**

***Table 11.3** – SPOCAS Test Results*

Sample	Limit of Results	BH2 0.4-0.5m	BH5 1.5-1.6m	BH8 2.4-2.6m	Action Criteria
Texture	--	Coarse	Coarse	Medium	
pH-KCL	0.1	7	4.3	5.3	-
pH-OX	0.1	5.5	2.6	4.0	-
Titratable Peroxide Acidity (TPA)	2	< 2	**410**	< 2	**18**
Titratable Sulfidic Acidity (TSA)	2	< 2	**310**	-3	**18**
Sulfur Trail (%S)	0.02	< 0.02	**0.05**	< 0.02	**0.03**

Refer to **Annex F** for the SPOCAS test results.

11.3 Laboratory Analysis & Recommendations

The TPA and TSA Acid Trail limit for a coarse textured soil is 18 mol H*/tonne. For BH5 1.5-1.6m the TPA acid trail result of 410 and TSA acid trail result of 310 were both **above** the action criteria of 18 mol H*/tonne. The Sulfur Trail – percentage of oxidisable sulfur (%S) limit for a coarse textured soil is 0.05. The percetange of oxidisable sulfur (%S) of 0.05 for BH5 1.5-1.6m was also **above** the action criteria of 0.03. Therefore, an acid sulfate soils management plan is required.

The SPOCAS and pH screening results represented in this report indicate that Acid Sulfate Soils do exist at the site and an Acid Sulfate Soils Management Plan therefore must be followed during the disturbance of soil at the site.

12. Acid Sulfate Soils Management Plan

If possible, the disturbance of acid sulfate soils should be minimised. Disturbance of acid sulfate soils must follow the procedures outlined in the specific management plan. Based on the findings in this report highlighted above an acid sulfate soils management plan must be followed in accordance with the Port Stephens Council guidelines and the New South Wales Department of Environment, Climate Change and Water (DECCW).

12.1 Groundwater or Soilwater Leachate De-Watering

The disturbance of acid sulfate soils and works at the site has a potential for groundwater and soilwater leachate. To control groundwater or leachate de-watering may be required on the site. If de-watering is required, then the captured water must be disposed of in the Hunter Water Corporation sewage system only, or irrigated over the site (on site irrigation is only to be used if the flow of irrigated water can be controlled to prevent runoff from the site to the surrounding area). **Water must not be discharged to the stormwater system**. Approval for the discharge of water off site will be required from Hunter Water Corporation and additional approval may be required from Port Stephens Council.

Extracted groundwater or soilwater leachate must be tested and treated if required. If the pH of extracted water is below 6.5 then hydrated lime should be added and thoroughly mixed. Hydrated lime dosing rates are shown below in **Table 12.1**. The pH of any discharged must be between 6.5 and 8.5.

***Table 12.1** – Approximately dosing rate for extracted ground and soil water*

Water pH	kg of Lime Required per m^3 of Extracted Water
pH 2	5
pH 3	0.5
pH 4	0.05
pH 5	0.005
pH 6	0.0005

Details for monitoring and testing can be found in **Annex G.**

12.2 Soil Excavation and Removal

12.2.1Treating Acid Sulfate Soils

Excavation of acid sulfate soils must be treated with lime prior to removal from the site. Treatment must be undertaken on a bunded hardstand with a perimeter that is a minimum 300mm high. The hardstand must be constructed prior to any excavations and excavated material must be placed on the hardstand only. A maximum excavated material stockpile size of 15m^3 may be treated before removal from site.

Treatment is undertaken by placing the excavated material on the hardstand. The required lime dosing is then spread across the stockpile and thoroughly mixed into the excavated material. This should be undertaken as soon as practicable to prevent further oxidation of the soil. Only after completion of the lime treating is the material suitable to be stored off the hardstand or to be removed from site. Untreated acid sulfate soils must not be stored off the hardstands at any time.

Excavated soils are to be dosed with lime so that the pH is above 5.5 and below 8. A regular chemical testing regime of the soils must be undertaken by a suitably qualified geotechnical engineer during mixing to ensure adequate doses of lime have been applied. The management plan process should be documented by the geotechnical engineer and kept on record. Lime dosing rates are based off Table 4.5 of the ASSMAC Assessment Guidelines and estimated for this site using laboratory testing.

Site specific lime dosing rates can be seen below in **Table 12.2**.

***Table 12.2** – Approximate Dosing Required of Agricultural Lime ($CaCO_3$) per Tonne of Excavated Soil*

Tonne of Excavated Material	Total Lime Dosing Required (kg)
1 to 15	50
16 to 35	83
36 to 50	100
51 to 75	167
76 to 100	233
101 to 200	500
201 to 500	1,167
501 to 750	1,767
751 to 1,000	2,333
1,001 to 2,000	4667
2,000 to 5,000	11,667
5,001 to 10,000	23,400

Details for monitoring and testing can be found in **Annex G.**

12.2.2Removal of Treated Acid Sulfate Soils

Prior to the removal of treated acid sulfate soils, the client must determine a waste classification using a chemical assessment in accordance with Step 5 of Part 1 of the Waste Classification Guidelines. If the client does not chemically assess the treated acid sulfate soils, the soil must be classified as hazardous waste.

12.2.3General Acid Sulfate Soils Management Strategies

A detailed description of general acid sulfate soils management strategies for working with acid sulfate soils can be found in **Annex G** as well as additional details about testing and monitoring of acid sulfate soils.

13. Report Limitations

The geotechnical data and recommendations within the above report are subjected to the specific sampling and testing that was undertaken at the time of the current investigation. It should be noted that underlying site soil conditions can vary significantly across a site and the environment can change overtime. If conditions encountered during and construction are different to those contained in this report Valley Civilab should be contacted immediately for site reassessment.

If you have any further questions about this report, please contact the undersigned.

For and on behalf of

Valley Civilab Pty Ltd

Reported by

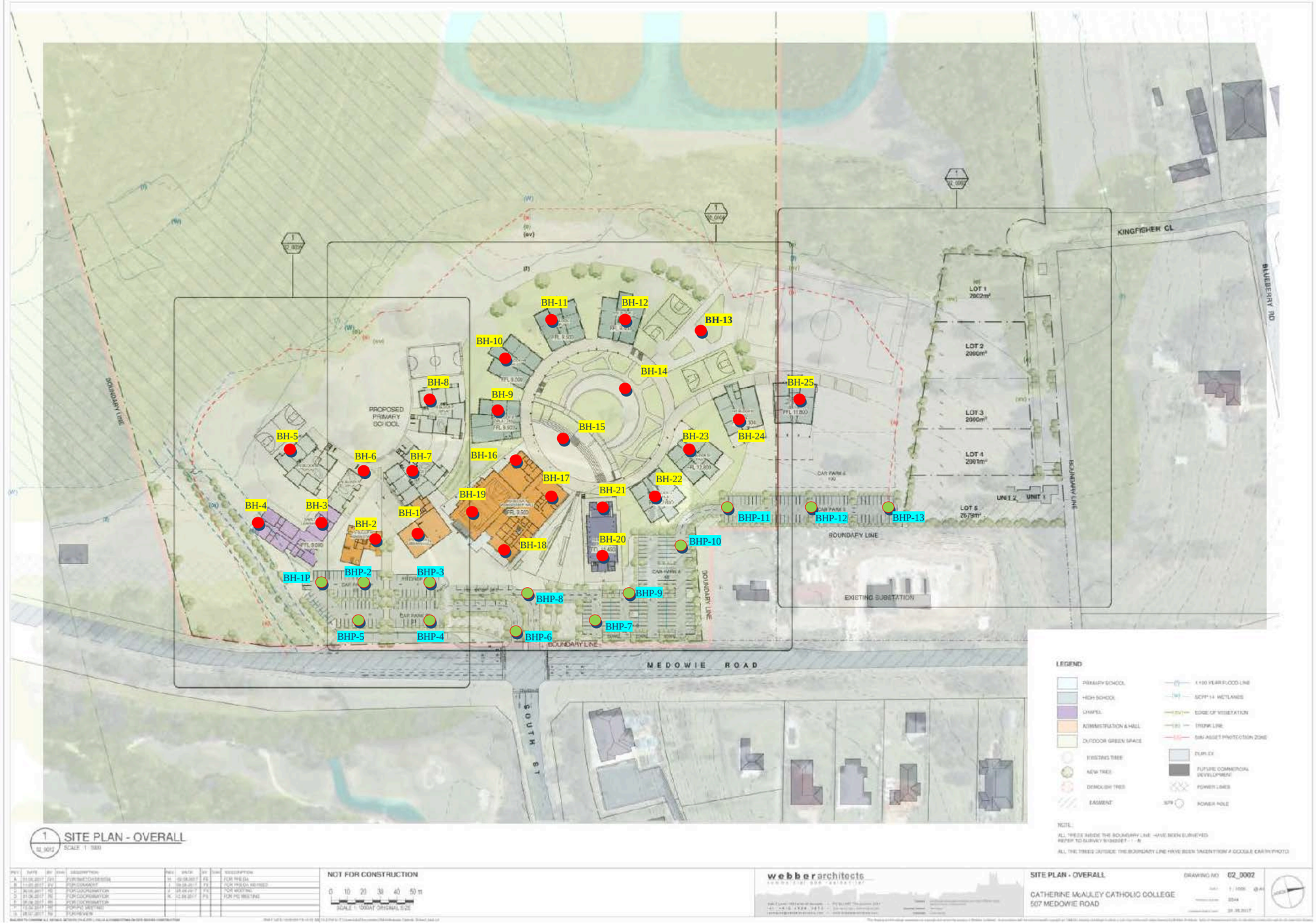
Nathan Roberts
Geotechnical Engineering Manager
Bachelor of Engineering (Civil)

Reviewed by

Matthew Lay
Senior Geotechnical Engineer
Bachelor of Engineering (Civil)

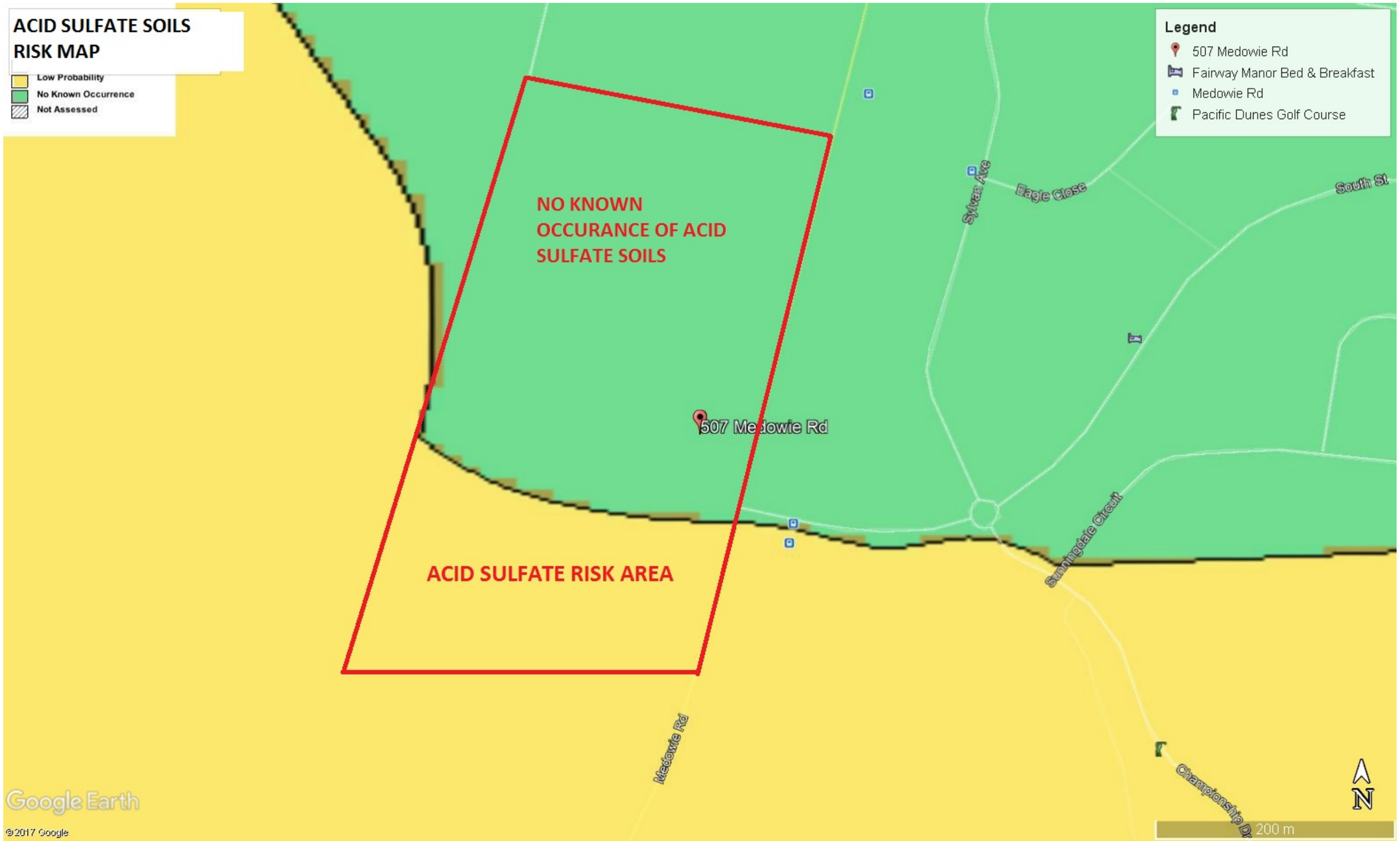
VALLEY CIVILAB
Geotechnical & Environmental Services

Annex A



APPROXIMATE BOREHOLE LOCATIONS: 507 Medowie Road, Medowie NSW (Site Classification boreholes BH1 to BH25; Pavement boreholes BHP-1 to BHP-13)

PO Box 3127 THORNTON NSW 2322 Ph: 02 4966 1844 Fax: 02 4966 1855
A.B.N. 50 103 355 531 A.C.N. 103 355 531
Email: office@valleycivilab.com.au



ACID SULFATE SOIL RISK MAP: 507 Medowie Road, Medowie NSW

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Email: office@valleycivilab.com.au

VALLEY CIVILAB
Geotechnical & Environmental Services

Annex B

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH1
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393581.0, N: 6374272.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	4			
	0.10 - 0.20	7			
	0.20 - 0.30	7			
	0.30 - 0.40	6			
	0.40 - 0.50	7			
	0.50 - 0.60	5			
	0.60 - 0.70	5			
	0.70 - 0.80	10			
	0.80 - 0.90	6			
	0.90 - 1.00	3			
	1.00 - 1.10	2			
	1.10 - 1.20	6			
	1.20 - 1.30	8			
	1.30 - 1.40	10			
	1.40 - 1.50	15			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	TOPSOIL: Silty SAND, fine grained with grass root fibres	M		TOPSOIL
0.20m						
			SAND, fine to medium grained, grey			ALLUVIUM
0.5		SP		M	D	
1.0						
1.20m						
		SP	Silty SAND, dark brown with indurated clay	M	VD	
1.40m						
			SAND, fine to medium grained, brown			
1.5		SP		M to W	D	
				W		1.80: collapsing
2.00m						
2.0			Hole Terminated at 2.00 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

VE E F H VH — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH2
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393581.0, N: 6374247.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / PENETRATION E F H	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	2				0.0
	0.10 - 0.20	2				
	0.20 - 0.30	2				
	0.30 - 0.40	6			0.40m	
	0.40 - 0.50	4			D 0.50m	
	0.50 - 0.60	6				0.5
	0.60 - 0.70	10				
	0.70 - 0.80	6			0.80m	
	0.80 - 0.90	5			D 0.90m	
	0.90 - 1.00	14			1.00m	
	1.00 - 1.10	8			D	1.0
	1.10 - 1.20	6			1.20m	
	1.20 - 1.30	7				
	1.30 - 1.40	15				
					1.50m	1.5
					D	
					1.80m	
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres	M		TOPSOIL
		0.20m			
	SP	SAND, fine to medium grained, pale grey	M		ALLUVIUM
		0.80m			
	SP	Clayey SAND, fine to medium grained, brown; medium plasticity clay		D	
		1.20m			
	SP	SAND, fine grained, dark brown	W		1.20: Groundwater Encountered
		1.80m			
		Hole Terminated at 1.80 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

VE E F H VH — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH3
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393573.0, N: 6374227.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	3			
	0.10 - 0.20	3			
	0.20 - 0.30	3			
	0.30 - 0.40	3			
	0.40 - 0.50	5			
	0.50 - 0.60	5			
	0.60 - 0.70	5			
	0.70 - 0.80	5			
	0.80 - 0.90	7			
	0.90 - 1.00	7			
	1.00 - 1.10	6			
	1.10 - 1.20	10			
	1.20 - 1.30	7			
	1.30 - 1.40	7			
	1.40 - 1.50	5			
	1.50 - 1.60	4			
	1.60 - 1.70	4			
	1.70 - 1.80	5			
	1.80 - 1.90	4			
	1.90 - 2.00	2			
	2.00 - 2.10	2			
	2.10 - 2.20	2			
	2.20 - 2.30	2			
	2.30 - 2.40	3			
	2.40 - 2.50	2			
	2.50 - 2.60	2			
	2.60 - 2.70	3			
	2.70 - 2.80	5			
	2.80 - 2.90	4			
	2.90 - 3.00	7			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION (Soil Type, Colour, Plasticity or Particle Characteristic, Secondary and Minor Components)	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres	M		TOPSOIL
0.10m			SAND, fine to medium grained, grey			ALLUVIUM
0.5		SP		M	D	
0.80m			Clayey SAND, fine to medium grained, grey; medium plasticity clay	M		
1.0		SP		W		1.10: Groundwater Encountered
1.50m			SAND, fine grained, brown			
1.5		SP		W		
2.00m			Hole Terminated at 2.00 m Terminated			
2.0						
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH4
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393577.0, N: 6374197.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

DCP AS 1289.6.3.2-1997

PENETRATION (VE / E / F / H)	Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	1			
	0.10 - 0.20	2			
	0.20 - 0.30	2			
	0.30 - 0.40	2			0.40m
	0.40 - 0.50	20			D
					0.60m
					1.00m
					D
					1.30m
					1.50m
					D
					1.80m

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	TOPSOIL: Silty SAND, fine grained with grass root fibres	M		TOPSOIL
			0.10m			
		SP	SAND, fine to medium grained, grey		L to MD	ALLUVIUM
			0.40m			
0.5		SP	SAND, (indurated, coffey, rock) fine to medium grained, orange	M	H	
			1.00m			
1.0		SP	SAND, fine grained, grey			1.00: Groundwater Encountered
			1.50m	W	D	
1.5		SP	SAND, fine grained, dark brown with clay			
			2.00m			
2.0			Hole Terminated at 2.00 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH5
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393528.0, N: 6374208.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / PENETRATION E F H	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	1				0.0
	0.10 - 0.20	2				
	0.20 - 0.30	4				
	0.30 - 0.40	3				
	0.40 - 0.50	4			0.50m	
	0.50 - 0.60	3			D 0.60m	0.5
	0.60 - 0.70	3				
	0.70 - 0.80	20				
					1.10m	1.0
					D 1.20m	
					1.50m	1.5
					D 1.60m	
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres 0.10m	M		TOPSOIL
	SP	SAND, fine to medium grained, grey 0.50m			ALLUVIUM
	SP	Clayey SAND (peat), fine grained, brown; medium plasticity clay 1.00m	M		
	SP	SAND, fine to medium grained, brown, trace silt/clay 2.00m	W	MD - D	1.00: Groundwater Encountered
		Hole Terminated at 2.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH6
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393525.0, N: 6374242.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	1			
	0.10 - 0.20	1			
	0.20 - 0.30	2			
	0.30 - 0.40	2			
	0.40 - 0.50	3			
	0.50 - 0.60	3			
	0.60 - 0.70	2			
	0.70 - 0.80	4			
	0.80 - 0.90	3			
	0.90 - 1.00	3			
	1.00 - 1.10	4			
	1.10 - 1.20	12			
	1.20 - 1.30	12			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	0.05m TOPSOIL: Silty SAND, fine to medium grained with grass root fibres	M		TOPSOIL
			SAND, fine to medium grained, grey			ALLUVIUM
0.5		SP	0.60m			
			Clayey SAND (peat), fine grained, brown; medium plasticity clay			
1.0		SP		M		
1.5			1.50m			
			SAND, fine grained, brown, trace silt/clay		MD - D	1.50: Groundwater Encountered
2.0		SP		W		
2.5						
3.0			3.00m			
			Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION

No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH7
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393539.0, N: 6374282.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / PENETRATION E F H	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	1			
	0.10 - 0.20	1			
	0.20 - 0.30	3			
	0.30 - 0.40	6			
	0.40 - 0.50	4			
	0.50 - 0.60	3			
	0.60 - 0.70	3			
	0.70 - 0.80	7			
	0.80 - 0.90	12			
	0.90 - 1.00	8			
	1.00 - 1.10	6			
	1.10 - 1.20	10			
	1.20 - 1.30	12			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	0.05m TOPSOIL: Silty SAND, fine to medium grained with grass root fibres	M		TOPSOIL
			SAND, fine to medium grained, grey			ALLUVIUM
0.5		SP		D	MD - D	
			0.90m Silty SAND, fine grained, dark brown, trace clay (partly indurated)			
1.0		SP		D	D	
1.5			1.50m SAND, fine grained, dark brown with silt and low plasticity clay			1.50: Groundwater Encountered
2.0		SP		W	D	
2.5						
3.0			3.00m Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

No Resistance

WATER


10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH8
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393496.0, N: 6374306.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / E / F / H PENETRATION	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	1				0.0
	0.10 - 0.20	4				
	0.20 - 0.30	4				
	0.30 - 0.40	5			0.40m	
	0.40 - 0.50	5			D 0.50m	0.5
	0.50 - 0.60	6				
	0.60 - 0.70	4			0.70m	
	0.70 - 0.80	4			D 0.80m	
	0.80 - 0.90	4				
	0.90 - 1.00	3			1.00m	1.0
	1.00 - 1.10	4			D	
	1.10 - 1.20	4			1.20m	
	1.20 - 1.30	7				
	1.30 - 1.40	10				
	1.40 - 1.50	12			1.50m	1.5
					D 1.70m	
					2.40m	2.0
					D 2.60m	2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL		MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	0.05m	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres	M		TOPSOIL
			SAND, fine grained, brown/grey			ALLUVIUM
	SP			M		
		0.50m			MD - D	
			Clayey SAND/Sandy CLAY, fine to medium grained, orange/brown; medium to high plasticity clay			
	SP			M		
		0.90m				
			Sandy CLAY, high plasticity, orange/brown, fine to medium grained sand			
	CH			M	VSt	
		1.50m				
			Clayey SAND, fine to medium grained, grey/pale brown; medium plasticity clay			
						1.80: Groundwater Encountered
	SP			W	D	
		3.00m				
			Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD
- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION


No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH9
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393505.0, N: 6374332.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / PENETRATION E F H	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	5				0.0
	0.10 - 0.20	7				
	0.20 - 0.30	5				
	0.30 - 0.40	5				
	0.40 - 0.50	5				0.5
	0.50 - 0.60	5				
	0.60 - 0.70	5				
	0.70 - 0.80	5			0.80m	
	0.80 - 0.90	6			U	
	0.90 - 1.00	7			1.00m	1.0
	1.00 - 1.10	8				
	1.10 - 1.20	6				
	1.20 - 1.30	5				
	1.30 - 1.40	10				
	1.40 - 1.50	10				1.5
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres	M		TOPSOIL
		0.15m			
		Silty CLAY, high plasticity, pale grey/red with ironstone bands and fine grained sand			RESIDUAL SOIL
					0.50: PP >400 kPa
	CH		D - M	VSt	1.00: PP >400 kPa
					1.50: PP >400 kPa
		1.80m			
		Hole Terminated at 1.80 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH10
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393489.0, N: 6374361.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / PENETRATION E F H	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	5				0.0
	0.10 - 0.20	6				
	0.20 - 0.30	3				
	0.30 - 0.40	7			0.40m	
	0.40 - 0.50	6			U	
	0.50 - 0.60	7			0.60m	0.5
	0.60 - 0.70	4				
	0.70 - 0.80	5			0.80m	
	0.80 - 0.90	5			D	
	0.90 - 1.00	4			1.00m	1.0
	1.00 - 1.10	5				
	1.10 - 1.20	5				
	1.20 - 1.30	6				1.5
	1.30 - 1.40	10				
					2.00m	2.0
					D	
					2.50m	2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres			TOPSOIL
		0.20m			
		Silty CLAY, high plasticity, pale brown/orange			RESIDUAL SOIL
	CH			VSt	
		1.00m			
		Silty CLAY, high plasticity, pale grey/red with ironstone/sandstone bands	D - M		
	CH			VSt - H	
		3.00m			
		Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH11
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393474.0, N: 6374396.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2011 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

DCP AS 1289.6.3.2-1997

VE / PENETRATION / E / F / H	Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	3			
	0.10 - 0.20	4			
	0.20 - 0.30	6			
	0.30 - 0.40	3			
	0.40 - 0.50	4			
	0.50 - 0.60	4			
	0.60 - 0.70	4			
	0.70 - 0.80	4			
	0.80 - 0.90	5			
	0.90 - 1.00	6			
	1.00 - 1.10	6			
	1.10 - 1.20	7			
	1.20 - 1.30	10			
	1.30 - 1.40	10			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres			TOPSOIL
0.20m						
			Silty CLAY, high plasticity, pale brown/orange			RESIDUAL SOIL
0.5		CH		D - M	St - VSt	
1.00m						
1.0			Silty CLAY, high plasticity, pale grey/red with ironstone/sandstone bands			
1.5						
2.0		CH			VSt - H	
2.5						
3.00m						
3.0			Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH12
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393509.0, N: 6374431.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / E / F / H PENETRATION	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	3				0.0
	0.10 - 0.20	4				
	0.20 - 0.30	5				
	0.30 - 0.40	8				
	0.40 - 0.50	6				0.5
	0.50 - 0.60	6				
	0.60 - 0.70	4				
	0.70 - 0.80	6			0.80m	
	0.80 - 0.90	6			U	
	0.90 - 0.00	6			1.00m	1.0
	1.00 - 1.10	6				
	1.10 - 1.20	7				
	1.20 - 1.30	8				1.5
	1.30 - 1.40	10				
	1.40 - 1.50	8				
	1.50 - 1.60	10				2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres			TOPSOIL
		0.20m			
		Silty CLAY, high plasticity, pale brown/orange			RESIDUAL SOIL
	CH		D - M	VSt	
		1.00m			
		Silty CLAY, high plasticity, pale grey/red with ironstone/sandstone bands			
	CH			VSt - H	
		3.00m			
		Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH13
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393534.0, N: 6374456.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	2			
	0.10 - 0.20	3			
	0.20 - 0.30	7			
	0.30 - 0.40	10			
	0.40 - 0.50	2			
	0.50 - 0.60	1			
	0.60 - 0.70	3			
	0.70 - 0.80	3			
	0.80 - 0.90	5			
	0.90 - 1.00	7			
	1.00 - 1.10	6			
	1.10 - 1.20	6			
	1.20 - 1.30	8			
	1.30 - 1.40	10			

MATERIAL

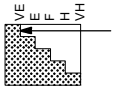
DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres			TOPSOIL
0.20m						
			Silty CLAY, high plasticity, pale brown/orange			RESIDUAL SOIL
0.5		CH			St - VSt	
1.00m						
1.0			Silty CLAY, high plasticity, pale grey/red with ironstone/sandstone bands	D - M		
1.5		CH			VSt - H	
2.00m						
2.0			Hole Terminated at 2.00 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION



WATER

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH14
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393544.0, N: 6374408.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	2			
	0.10 - 0.20	10			
	0.20 - 0.30	10			
	0.30 - 0.40	6			
	0.40 - 0.50	5			
	0.50 - 0.60	5			
	0.60 - 0.70	5			
	0.70 - 0.80	7			
	0.80 - 0.90	6			
	0.90 - 1.00	7			
	1.00 - 1.10	10			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres			TOPSOIL
0.15m						
			Silty CLAY, high plasticity, pale brown/orange			RESIDUAL SOIL
0.5		CH		D to M	VSt	
1.0						
1.30m						
			Silty CLAY, high plasticity, pale grey/red with ironstone and sandstone bands			
1.5		CH		D - M	VSt - H	
2.0						
2.30m						
			Hole Terminated at 2.30 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH15
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393549.0, N: 6374370.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

DCP AS 1289.6.3.2-1997

VE / PENETRATION E F H	Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	3			
	0.10 - 0.20	6			
	0.20 - 0.30	6			
	0.30 - 0.40	6			
	0.40 - 0.50	5			
	0.50 - 0.60	3			
	0.60 - 0.70	5			
	0.70 - 0.80	7			
	0.80 - 0.90	7			
	0.90 - 1.00	8			
	1.00 - 1.10	8			
	1.10 - 1.20	7			
	1.20 - 1.30	10			
	1.30 - 1.40	10			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres			TOPSOIL
0.20m						
			Silty CLAY, high plasticity, pale brown/orange			RESIDUAL SOIL
0.5		CH		D - M	VSt	
1.00m						
1.0			Silty CLAY, high plasticity, pale grey/red with ironstone/sandstone bands			
1.5						
2.0		CH		D - M	VSt - H	
2.5						
3.00m						
3.0			Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH16
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393550.0, N: 6374338.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / E / F / H PENETRATION	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	3				0.0
	0.10 - 0.20	8				
	0.20 - 0.30	6				
	0.30 - 0.40	4				
	0.40 - 0.50	4				
	0.50 - 0.60	7				0.5
	0.60 - 0.70	4				
	0.70 - 0.80	4			0.80m	
	0.80 - 0.90	3			U	
	0.90 - 0.90	4			1.00m	
	1.00 - 1.10	4				1.0
	1.10 - 1.20	3				
	1.20 - 1.30	4				
	1.30 - 1.40	3				
	1.40 - 1.50	6				1.5
	1.50 - 1.60	3				
	1.60 - 1.70	3				
	1.70 - 1.80	3				
	1.80 - 1.90	4				
	1.90 - 2.00	3				2.0
	2.00 - 2.10	5				
	2.10 - 2.20	5				
	2.20 - 2.30	10				
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres			TOPSOIL
		0.20m			
		Silty CLAY, high plasticity, pale brown/orange			RESIDUAL SOIL
	CH		M	St - VSt	
		1.00m			
		Silty CLAY, high plasticity, pale grey/red with ironstone/sandstone bands			
	CH		D - M	VSt - H	
		3.00m			
		Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION

No Resistance

WATER


10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH17
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393589.0, N: 6374343.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

PENETRATION	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
VE	0.00 - 0.10	2				0.0
E	0.10 - 0.20	4				
	0.20 - 0.30	8				
F	0.30 - 0.40	6				
	0.40 - 0.50	5			0.50m	
H	0.50 - 0.60	4			D	0.5
	0.60 - 0.70	4			0.70m	
	0.70 - 0.80	4				
	0.80 - 0.90	5				
	0.90 - 1.00	7				1.0
	1.00 - 1.10	5				
	1.10 - 1.20	4				
	1.20 - 1.30	4			1.30m	
	1.30 - 1.40	3			U	
	1.40 - 1.50	3			1.50m	1.5
	1.50 - 1.60	3			D	
	1.60 - 1.70	3				
	1.70 - 1.80	3			1.80m	
	1.80 - 1.90	3				
	1.90 - 2.00	3				2.0
	2.00 - 2.10	4				
	2.10 - 2.20	5				
	2.20 - 2.30	10				
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres			TOPSOIL
		0.20m			
	CH	Silty CLAY, high plasticity, pale brown/orange	M	St - VSt	RESIDUAL SOIL
		0.70m			
	CH	Silty CLAY, high plasticity, pale grey/red with ironstone/sandstone bands	D - M	VSt - H	
		3.00m			
		Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION

VE E F H VH — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH18
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393604.0, N: 6374313.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

VE / PENETRATION E F H	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	2				0.0
	0.10 - 0.20	5				
	0.20 - 0.30	4				
	0.30 - 0.40	4				
	0.40 - 0.50	2				
	0.50 - 0.60	2				0.5
	0.60 - 0.70	2				
	0.70 - 0.80	3				
	0.80 - 0.90	2				
	0.90 - 1.00	2				1.0
	1.00 - 1.10	12				
	1.10 - 1.20	12				
						1.5
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres	M		TOPSOIL
		0.10m			
	CH	Sandy CLAY, high plasticity, orange/pale brown; fine to medium grained sand	M	F - St	ALLUVIUM
		1.30m			
	SP	Clayey SAND, fine to medium grained, orange/pale grey; medium plasticity clay	W		1.50: Groundwater Encountered
		2.00m			
	SP	SAND, fine to medium grained, pale grey	W	D	
		3.00m			
		Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH19
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393569.0, N: 6374282.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : NWR CHECKED BY : ML

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	3				0.0
	0.10 - 0.20	3				
	0.20 - 0.30	3				
	0.30 - 0.40	4				
	0.40 - 0.50	5				0.5
	0.50 - 0.60	6				
	0.60 - 0.70	8				
	0.70 - 0.80	10				
	0.80 - 0.90	10				1.0
						1.5
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained with grass root fibres	M		TOPSOIL
		0.10m SAND, fine to medium grained, pale grey			ALLUVIUM
	SP		M		
		1.00m Clayey SAND, fine to medium grained, pale grey; medium plasticity clay			
	SP		M - W		
		1.50m SAND, fine to medium grained, pale grey		MD - D	1.50: Groundwater Encountered
	SP		W		
		3.00m Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD
- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH20
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393621.1, N: 6374356.7 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	3			
	0.10 - 0.20	3			
	0.20 - 0.30	5			
	0.30 - 0.40	7			
	0.40 - 0.50	4			
	0.50 - 0.60	4			
	0.60 - 0.70	5			
	0.70 - 0.80	4			
	0.80 - 0.90	7			
	0.90 - 1.00	11			
	1.00 - 1.10	12			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		CI-CH	FILL: Silty Sandy CLAY, medium to high plasticity, brown; fine grained sand	D	F	FILL
0.40m						
0.5		CH	Silty CLAY, high plasticity, brown/red	D	St	RESIDUAL SOIL
1.0						
1.20m						
1.5		CH	Silty CLAY, high plasticity, red/mottled pale grey, becoming pale grey/mottled red at approximately 1.5mbgl	D to M	VSt to H	
2.0						
2.5						
3.00m						
3.0			Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH21
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393588.1, N: 6374369.2 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	2				0.0
	0.10 - 0.20	8				
	0.20 - 0.30	8				
	0.30 - 0.40	10				
	0.40 - 0.50	10				
	0.50 - 0.60	10				0.5
					1.00m U	1.0
					1.20m	
						1.5
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	CI-CH	FILL: Silty Sandy CLAY, medium to high plasticity, brown; fine grained sand	D	St	FILL
		0.40m			
	CH	Silty CLAY, high plasticity, brown/red	D to M	St to VSt	RESIDUAL SOIL
		1.40m			
	CH	Silty CLAY, high plasticity, red/mottled pale grey, becoming pale grey/mottled red at approximately 2.0mbgl	D to M	VSt	
		3.00m			
		Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

No Resistance

WATER


10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH22
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393587.8, N: 6374398.8 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	12			
	0.10 - 0.20	6			
	0.20 - 0.30	7			
	0.30 - 0.40	6			
	0.40 - 0.50	8			
	0.50 - 0.60	5			
	0.60 - 0.70	7			
	0.70 - 0.80	8			
	0.80 - 0.90	9			
	0.90 - 1.00	11			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		CI-CH	FILL: Silty Sandy CLAY, medium to high plasticity, brown; fine grained sand	D	St	FILL
0.40m						
0.5			Silty CLAY, high plasticity, brown/red			RESIDUAL SOIL
		CH		D to M	St to VSt	
1.0						
1.30m						
			Silty CLAY, high plasticity, red becoming pale grey/mottled red at 2.0mbgl			
1.5						
2.0		CH		D to M	VSt	
2.5						
3.00m						
3.0			Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH23
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393564.1, N: 6374430.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE, E, F, H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	5			
	0.10 - 0.20	5			
	0.20 - 0.30	6			
	0.30 - 0.40	9			
	0.40 - 0.50	10			
	0.50 - 0.60	14			0.60m U 0.80m

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION (Soil Type, Colour, Plasticity or Particle Characteristic, Secondary and Minor Components)	MOISTURE CONDITION	CONSISTENCY / RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		ML	TOPSOIL: Silty CLAY/Clayey SILT, medium plasticity, brown	D	St	TOPSOIL
0.50m						
0.5			Silty CLAY, high plasticity, brown/orange			RESIDUAL SOIL
1.0		CH		D to M	VSt to H	
1.50m						
1.5			Silty CLAY, high plasticity, pale grey/mottled red/mottled orange			
2.0		CH		M	VSt to H	
2.5						
3.00m						
3.0			Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD
- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH24
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393549.6, N: 6374472.3 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

VE / PENETRATION E F H	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	4			
	0.10 - 0.20	5			
	0.20 - 0.30	5			
	0.30 - 0.40	8			
	0.40 - 0.50	10			
	0.50 - 0.60	12			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		ML	TOPSOIL: Sandy SILT, low plasticity, brown; fine grained sand	M	F	TOPSOIL
0.30m						
0.5		CH	Silty CLAY, high plasticity, brown/orange	M	St to VSt	RESIDUAL SOIL
1.0						
1.40m						
1.5			Silty CLAY, high plasticity, pale grey/mottled red/mottled orange			
2.0		CH		M	VSt	
2.5						
3.00m						
3.0			Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION

No Resistance

WATER


10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BH25
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393627.0, N: 6374536.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	4				0.0
	0.10 - 0.20	5				
	0.20 - 0.30	4				
	0.30 - 0.40	5				
	0.40 - 0.50	6				0.5
	0.50 - 0.60	9			0.60m	
	0.60 - 0.70	8			U	
	0.70 - 0.80	10			0.80m	
	0.80 - 0.90	10				1.0
	0.90 - 1.00	11				
						1.5
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	ML	TOPSOIL: Sandy SILT, low plasticity, brown; fine grained sand	M	F	TOPSOIL
		0.40m			
	CH	Silty CLAY, high plasticity, brown/orange	M	St	RESIDUAL SOIL
		1.20m			
	CH	Silty CLAY, high plasticity, pale grey/mottled red/mottled orange	M	VSt	
		3.00m			
		Hole Terminated at 3.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

VE E F H VH — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-1
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393590.1, N: 6374332.3 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	1				0.0
	0.10 - 0.20	2				
	0.20 - 0.30	2			0.30m	
	0.30 - 0.40	3			B	
	0.40 - 0.50	2				0.5
	0.50 - 0.60	3				
	0.60 - 0.70	5			0.70m	
	0.70 - 0.80	7				
	0.80 - 0.90	8				
	0.90 - 1.00	7				1.0
	1.00 - 1.10	7				
	1.10 - 1.20	6				
	1.20 - 1.30	4				
	1.30 - 1.40	5				
	1.40 - 1.50	5				1.5
	1.50 - 1.60	5				
	1.60 - 1.70	6				
	1.70 - 1.80	5				
	1.80 - 1.90	6				2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained, pale brown/grey	M	L	TOPSOIL
		0.30m			
	SP	Silty SAND, fine to medium grained, brown/dark brown	W	MD - D	ALLUVIUM
		1.00m			
	SP	SAND, fine to medium grained, grey/pale grey	W	MD - D	
		2.00m			
		Hole Terminated at 2.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-2
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393597.2, N: 6374252.9 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP Depth (m)	DCP Blows	DCP CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
						0.0
						0.5
						1.0
						1.5
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	SP	TOPSOIL: Silty SAND, fine to medium grained, pale brown/grey	M	L	TOPSOIL
		0.40m			
	SP	Silty SAND, fine to medium grained, grey/pale grey	M	MD - D	ALLUVIUM
		0.60m			
	SP	SAND, fine to medium grained, brown/dark brown with fine to coarse gravel, becoming grey/dark brown/dark grey at approximately 1.0mbgl	W	MD - D	
		2.00m			
		Hole Terminated at 2.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

VE E F H VH — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-3
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393606.0, N: 6374263.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

DCP AS 1289.6.3.2-1997

PENETRATION	Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
VE E F H	0.00 - 0.10	2			
	0.10 - 0.20	5			
	0.20 - 0.30	5			
	0.30 - 0.40	7			0.40m
	0.40 - 0.50	6			U
	0.50 - 0.60	4			
	0.60 - 0.70	10			
	0.70 - 0.80	11			
	0.80 - 0.90	10			1.00m

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	TOPSOIL: Silty SAND, fine to medium grained, grey/brown	M	L	TOPSOIL
			0.20m			
		SP	Silty SAND, fine to medium grained, grey/pale grey	M	MD	ALLUVIUM
			0.40m			
0.5			SAND, fine to medium grained, brown/dark brown with fine to coarse gravel, becoming brown/dark brown/dark grey/black at approximately 0.8mbgl			
1.0		SP		M to W	D	
1.5						
			2.00m			
2.0			Hole Terminated at 2.00 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION

VE E F H VH — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-4
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393631.5, N: 6374255.1 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

DCP AS 1289.6.3.2-1997

PENETRATION	Depth (m)	Blows	CBR
VE E F H	0.00 - 0.10	20	
	0.10 - 0.20	Refusal	

LAB SOAKED CBR

SAMPLES & FIELD TESTS

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	FILL: Silty Gravelly SAND, fine to medium grained, pale brown; fine to coarse gravel	M	D	FILL
0.50m						
0.5		SP	FILL: SAND, medium grained, pale brown/yellow with pockets of clay at 0.8mbgl	M to W	MD to D	
1.00m						
1.0		SP	SAND, fine to medium grained, pale brown/pale grey	W	MD	ALLUVIUM
1.5						
2.00m						
2.0			Hole Terminated at 2.00 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-5
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393616.3, N: 6374221.0 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

DCP AS 1289.6.3.2-1997

PENETRATION (VE E F H)	Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	6			
	0.10 - 0.20	7			
	0.20 - 0.30	9			
	0.30 - 0.40	6			
	0.40 - 0.50	6			0.50m B
	0.50 - 0.60	9			
	0.60 - 0.70	9			
	0.70 - 0.80	8			
	0.80 - 0.90	10			1.00m

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	FILL: Silty Gravelly SAND, fine to medium grained, brown/dark brown; fine to medium gravel	M	MD	FILL
0.5		SP	0.50m FILL: SAND, fine to medium grained, pale brown/yellow with clayey sand pockets	M to W	MD	
1.0		SP	1.20m SAND, fine to medium grained, pale grey/grey/pale brown	W	MD	ALLUVIUM
1.5						
2.0			2.00m Hole Terminated at 2.00 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD
- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

File: P1292 BHP-5 1 OF 1

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-6
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393645.0, N: 6374312.6 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

DCP AS 1289.6.3.2-1997

PENETRATION	Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
VE / E / F / H	0.00 - 0.10	2			
	0.10 - 0.20	3			
	0.20 - 0.30	5			
	0.30 - 0.40	6			
	0.40 - 0.50	6			0.50m
	0.50 - 0.60	8			B
	0.60 - 0.70	7			
	0.70 - 0.80	2			
	0.80 - 0.90	1			
	0.90 - 1.00	1			1.00m
	1.00 - 1.10	3			
	1.10 - 1.20	Refusal			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		SP	FILL: Silty Gravelly SAND, fine to medium grained, pale brown; fine to coarse gravel	M	D	FILL
0.40m						
0.5		SP	FILL: SAND, medium grained, pale brown/yellow with pockets of clay at 0.8mbgl	M to W	MD	
1.0						
1.40m						
1.5		CI-CH	Sandy CLAY, medium to high plasticity, brown/orange/laminated grey; fine grained sand	W	VSt	ALLUVIUM / RESIDUAL SOIL
2.0			Hole Terminated at 2.00 m Terminated			
2.00m						
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-7
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393658.7, N: 6374342.3 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP Depth (m)	DCP Blows	DCP CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
						0.0
						0.5
						1.0
						1.5
						2.0
						2.5
						3.0

MATERIAL

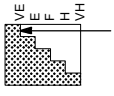
GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	ML	TOPSOIL: Sandy SILT, low plasticity, brown; fine grained sand	D	F	TOPSOIL
		0.20m			
	CH	Silty Sandy Gravelly CLAY, high plasticity, brown; fine grained sand; fine to medium gravel	D	St to VSt	ALLUVIUM
		0.50m			
	CH	Silty Sandy CLAY, high plasticity, brown/red, trace of fine gravel; fine grained sand, becoming silty CLAY at approximately 1.0mbgl	D	VSt	
		2.00m			
		Hole Terminated at 2.00 m Terminated			

PAVEMENT CONDITION / REMARK

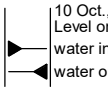
METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION



WATER



SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-8
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393623.1, N: 6374317.9 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

DCP AS 1289.6.3.2-1997

PENETRATION (VE / E / F / H)	Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
	0.00 - 0.10	1			
	0.10 - 0.20	3			
	0.20 - 0.30	2			
	0.30 - 0.40	2			
	0.40 - 0.50	3			
	0.50 - 0.60	3			
	0.60 - 0.70	2			
	0.70 - 0.80	3			
	0.80 - 0.90	2			
	0.90 - 1.00	2			
	1.00 - 1.10	3			
	1.10 - 1.20	5			
	1.20 - 1.30	12			
	1.30 - 1.40	13			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0		ML	Sandy SILT, low plasticity, brown/dark brown with clay	M	F	ALLUVIUM
0.70m						
0.5		CH	Sandy CLAY, high plasticity, brown/red/laminated grey; fine to medium grained sand, fine gravel at 1.5mbgl	M	F	
1.0						
1.5				W		
1.60m						
		CH	Sandy CLAY, high plasticity, brown/grey; medium grained sand	W	VSt	
2.0						
2.00m			Hole Terminated at 2.00 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N Natural Exposure
E Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
PP - Pocket Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-9
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393647.5, N: 6374366.2 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

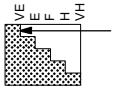
DRILLING							MATERIAL					
PENETRATION (VE, E, F, H)	DCP Depth (m)	DCP Blows	DCP CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
						0.0		ML	TOPSOIL: Sandy SILT, low plasticity, brown; fine grained sand	M	F	ALLUVIUM
					0.40m B							
						0.5						
					1.00m	1.0		CH	Silty Sandy Gravelly CLAY, high plasticity, brown; fine grained sand; fine to medium gravel	M	St to VSt	
						1.5						
						2.0			2.00m Hole Terminated at 2.00 m Terminated			
						2.5						
						3.0						

PAVEMENT CONDITION / REMARK

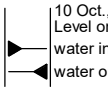
METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION



WATER



SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-10
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393629.6, N: 6374430.7 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

DCP AS 1289.6.3.2-1997

PENETRATION	Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS
VE E F H	0.00 - 0.10	4			
	0.10 - 0.20	9			
	0.20 - 0.30	7			
	0.30 - 0.40	5			
	0.40 - 0.50	3			
	0.50 - 0.60	2			
	0.60 - 0.70	3			
	0.70 - 0.80	3			
	0.80 - 0.90	2			
	0.90 - 1.00	3			
	1.00 - 1.10	3			
	1.10 - 1.20	2			
	1.20 - 1.30	2			1.30m
	1.30 - 1.40	3			B
	1.40 - 1.50	3			
	1.50 - 1.60	3			
	1.60 - 1.70	3			
	1.70 - 1.80	4			1.80m
	1.80 - 1.90	4			
	1.90 - 2.00	9			
	2.00 - 2.10	10			
	2.10 - 2.20	10			

MATERIAL

DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
0.0			FILL: Sandy Clayey SILT, low plasticity, brown; fine grained sand			
0.5		ML		M	F to St	
1.0						
			1.30m			
1.5			Silty CLAY, high plasticity, laminated pale brown/ orange/pale grey with thin lamination of dark organics/trace of red mottling			
		CH		M	VSt	
2.0			2.00m Hole Terminated at 2.00 m Terminated			
2.5						
3.0						

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-11
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393607.5, N: 6374458.2 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	2				0.0
	0.10 - 0.20	3				
	0.20 - 0.30	3				
	0.30 - 0.40	4				
	0.40 - 0.50	5				0.5
	0.50 - 0.60	5				
	0.60 - 0.70	6				
	0.70 - 0.80	5				
	0.80 - 0.90	7				
	0.90 - 1.00	9				1.0
	1.00 - 1.10	10				
	1.10 - 1.20	12				
	1.20 - 1.30	12				
						1.5
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	ML	TOPSOIL: Sandy SILT, low plasticity, brown; fine grained sand	M	F	TOPSOIL
		0.20m			
	CI	Sandy Silty CLAY, medium plasticity, brown/dark brown; fine sand	M	St	ALLUVIUM
		0.40m			
	CH	Silty CLAY, high plasticity, brown/mottled orange/mottled red	M	St to VSt	RESIDUAL SOIL
		1.40m			
		Hole Terminated at 1.40 m Refusal			

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

WATER

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-12
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393613.4, N: 6374491.5 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING

PENETRATION (VE / E / F / H)	DCP AS 1289.6.3.2-1997 Depth (m)	Blows	CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)
	0.00 - 0.10	3				0.0
	0.10 - 0.20	2				
	0.20 - 0.30	3				
	0.30 - 0.40	4				
	0.40 - 0.50	4			0.50m	0.5
	0.50 - 0.60	5			B	
	0.60 - 0.70	5				
	0.70 - 0.80	6				
	0.80 - 0.90	8				
	0.90 - 1.00	11			1.00m	1.0
	1.00 - 1.10	14				
						1.5
						2.0
						2.5
						3.0

MATERIAL

GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
	ML	TOPSOIL: Sandy SILT, low plasticity, brown; fine grained sand	M	F	TOPSOIL
		0.20m			
	CI	Sandy Silty CLAY, medium plasticity, brown/dark brown; fine sand	M	St	ALLUVIUM
		0.50m			
	CH	Silty CLAY, high plasticity, brown/mottled orange/mottled red	M	St to VSt	RESIDUAL SOIL
		2.00m			
		Hole Terminated at 2.00 m Terminated			

PAVEMENT CONDITION / REMARK

METHOD

N	Natural Exposure
E	Existing Excavation
BH	Backhoe Bucket
B	Bulldozer Blade
R	Ripper

PENETRATION

VE E F H VH — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

U	-	Undisturbed Sample
D	-	Disturbed Sample
B	-	Bulk Disturbed Sample
MC	-	Moisture Content
PP	-	Pocket Penetrometer (UCS kPa)
VS	-	Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
PBT	-	Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

D	-	Dry
M	-	Moist
W	-	Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
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St	- Stiff
VSt	- Very Stiff
H	- Hard
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

NON-CORE DRILL HOLE - GEOLOGICAL LOG

HOLE NO : BHP-13
FILE / JOB NO : P1292
SHEET : 1 OF 1

PROJECT : Proposed Development
LOCATION : 507 Medowie Road, Medowie

POSITION : E: 393625.4, N: 6374537.8 (MGA94 Zone 56) SURFACE ELEVATION : ANGLE FROM HORIZONTAL : 90°

RIG TYPE : Christie Rig MOUNTING : Trailer CONTRACTOR : Valley Civilab DRILLER : LB/RB

DATE STARTED : 19/10/2017 DATE COMPLETED : 19/10/2017 DATE LOGGED : 19/10/2017 LOGGED BY : ML CHECKED BY : NWR

DRILLING							MATERIAL					
PENETRATION (VE, E, F, H)	DCP Depth (m)	DCP Blows	DCP CBR	LAB SOAKED CBR	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Type, Colour, Plasticity or Particle Characteristic Secondary and Minor Components	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
						0.0		ML	TOPSOIL: Sandy SILT, low plasticity, brown; fine grained sand	M	F	TOPSOIL
						0.20m		CI	Sandy Silty CLAY, medium plasticity, brown/dark brown; fine sand	M	St	ALLUVIUM
						0.40m			Silty CLAY, high plasticity, brown/mottled orange/mottled red			RESIDUAL SOIL
						0.5						
						1.0		CH		M	St to VSt	
						1.5						
						2.00m			Hole Terminated at 2.00 m Terminated			
						2.0						
						2.5						
						3.0						

PAVEMENT CONDITION / REMARK

METHOD

- N Natural Exposure
- E Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

PENETRATION

VE E F H VH — No Resistance

WATER

10 Oct., 73 Water Level on Date shown
water inflow
water outflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- PP - Pocket Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- PBT - Plate Bearing Test

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

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

See Explanatory Notes for details of abbreviations & basis of descriptions.

VALLEY CIVILAB
Geotechnical & Environmental Services

Annex C

VALLEY CIVILAB
Geotechnical & Environmental Services

Shrink Swell Index Report

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 1/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**24/10/2017**
Project Name :	**Geotechnical Investigation - Medowie**	Order Number :	
Project Number :	**P1292**	Test Method :	**AS1289.7.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road , M**	**Page 1 of 2**	

Sample Number :	S17-5082	S17-5083	S17-5085	S17-5086
Test Number :				
Sampling Method :	AS1289.1.3.1	AS1289.1.3.1	AS1289.1.3.1	AS1289.1.3.1
Sampled By :	Richard Badior	Richard Badior	Richard Badior	Richard Badior
Date Sampled :	19/10/2017	19/10/2017	19/10/2017	19/10/2017
Date Tested :	19/10/2017	19/10/2017	19/10/2017	19/10/2017
Material Type :	existing	existing	existing	existing
Material Source :	Tube Sample	Tube Sample	Tube Sample	Tube Sample
Sample Location :	Client PO; Sample Taken BH9 -0.8m/-1.0m	Client PO; Sample Taken BH10 -0.4m/-0.6m	Client PO; Sample Taken BH12 -0.8m/-1.0m	Client PO; Sample Taken BH16 -0.8m/-1.0m
Inert Material Estimate (%) :	20	20	15	5
PP before (kPa) :	600+	600+	580	320
PP after (kPa) :	490	350	400	250
Shrinkage Moisture Content (%) :	33.1	23.8	24	28.3
Shrinkage (%) :	**3.5**	**4.2**	**4.4**	**5.6**
Swell Moisture Content Before (%) :	32	22.4	21.7	27.9
Swell Moisture Content After (%) :	35.8	31.6	24.8	29.8
Swell (%) :	**0**	**0**	**0**	**0.2**
Unit Weight (t/m³) :	-	-	-	-
Shrink Swell Index Iss (%) :	**2**	**2.3**	**2.4**	**3.2**
Visual Classification :	refer to attached borelogs	refer to attached borelogs	refer to attached borelogs	refer to attached borelogs
Cracking :	Major	Nil	Nil	Nil
Crumbling :	Minor	Nil	Nil	Nil
Remarks :				

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APPROVED SIGNATORY

Richard Badior - Senior Geotechnical Officer
NATA Accreditation Number
14975

VALLEY CIVILAB
Geotechnical & Environmental Services

Shrink Swell Index Report

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 1/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**24/10/2017**
Project Name :	**Geotechnical Investigation - Medowie**	Order Number :	
Project Number :	**P1292**	Test Method :	**AS1289.7.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road , M**	**Page 2 of 2**	

Sample Number :	S17-5087	S17-5088	S17-5089	S17-5090
Test Number :				
Sampling Method :	AS1289.1.3.1	AS1289.1.3.1	AS1289.1.3.1	AS1289.1.3.1
Sampled By :	Richard Badior	Richard Badior	Lonnie Broekman	Lonnie Broekman
Date Sampled :	19/10/2017	19/10/2017	19/10/2017	19/10/2017
Date Tested :	19/10/2017	19/10/2017	19/10/2017	19/10/2017
Material Type :	existing	existing	existing	existing
Material Source :	Tube Sample	Tube Sample	Tube Sample	Tube Sample
Sample Location :	Client PO; Sample Taken BH17 -1.3m/-1.5m	Client PO; Sample Taken BH21 -1.0m/-1.2m	Client PO; Sample Taken BH23 -0.6m/-0.8m	Client PO; Sample Taken BH25 -0.6m/-0.8m
Inert Material Estimate (%) :	5	25	10	10
PP before (kPa) :	450	500	600+	450
PP after (kPa) :	240	250	350	400
Shrinkage Moisture Content (%) :	23.8	30.8	22.4	28.4
Shrinkage (%) :	**4.7**	**5.6**	**3.2**	**5.4**
Swell Moisture Content Before (%) :	22.9	29.1	20.8	28.7
Swell Moisture Content After (%) :	26.3	32.1	33.5	32.9
Swell (%) :	**0.4**	**0**	**0**	**0**
Unit Weight (t/m³) :	-	-	-	-
Shrink Swell Index Iss (%) :	**2.7**	**3.1**	**1.8**	**3**
Visual Classification :	refer to attached borelogs	refer to attached borelogs	refer to attached borelogs	refer to attached borelogs
Cracking :	Nil	Minor	Minor	Nil
Crumbling :	Nil	Minor	Minor	Nil
Remarks :				

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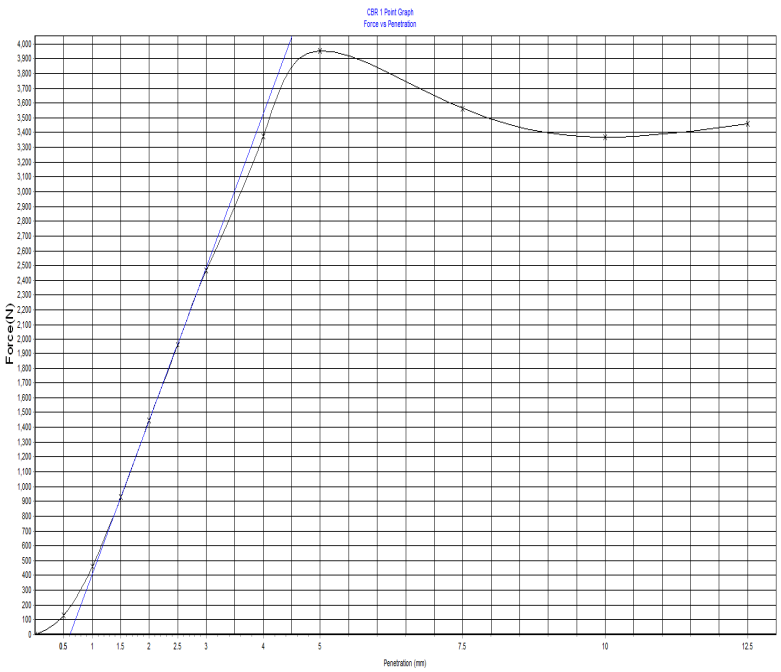
VALLEY CIVILAB
Geotechnical & Environmental Services

California Bearing Ratio Report (1 Point)

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 2/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**31/10/2017**
Project Number :	**P1292**	Order Number :	
Project Name :	**Geotechnical Investigation - Medowie**	Test Method :	**AS1289.6.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road ,**	**Page 1 of 7**	

Sample Number :	S17-5064	SAMPLE LOCATION
Date Sampled :	19/10/2017	BHP1_0.3-0.7m
Date Tested :	23/10/2017	
Sampled By :	Lonnie Broekman	
Sampling Method :	AS1289.1.2.1	
Material Source :	on-site	Lot Number :
Material Type :	soil	Test Number :
Remarks :		#REF!

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m³) :	1.817
Optimum Moisture Content (%) :	10.6
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	99
Achieved Percentage of OMC :	99.0
Dry Density Before Soak (t/m³) :	1.8
Dry Density After Soak (t/m³) :	1.8
Moisture Content Before Soak (%) :	10.5
Moisture Content After Soak (%) :	12.3
Density Ratio After Soak (%) :	99
Field Moisture Content (%) :	14.4
Top Moisture Content - After Penetration (%) :	14.0
Total Moisture Content - After Penetration (%) :	12.2
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.0



CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) :	19
Oversize (%) :	0	CBR 5.0mm (%) :	**20**
Oversize Material Replaced (%) :		**CBR Value (%) :**	**20**

Site Selection :	Random
Soil Description :	refer to attahced borelogs

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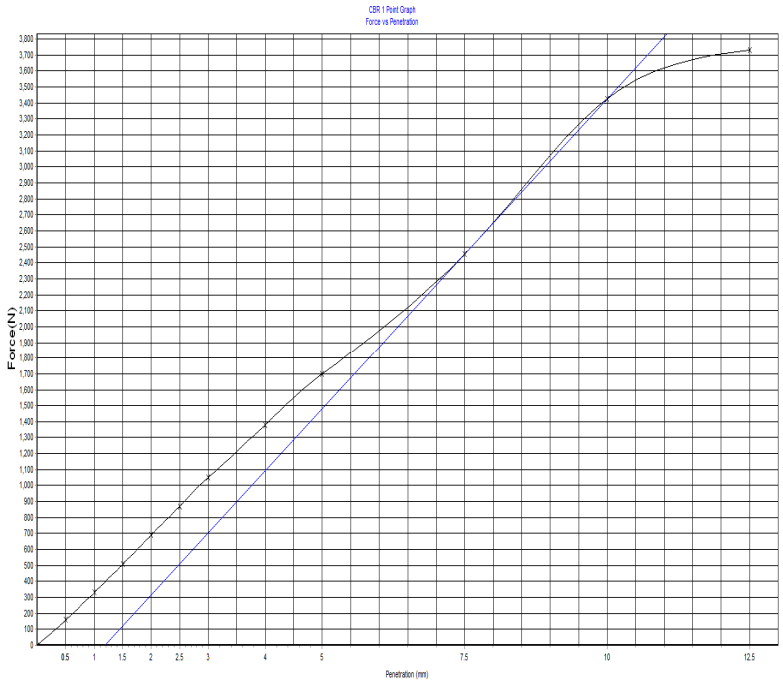
California Bearing Ratio Report (1 Point)

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 2/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**31/10/2017**
Project Number :	**P1292**	Order Number :	
Project Name :	**Geotechnical Investigation - Medowie**	Test Method :	**AS1289.6.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road ,**	**Page 2 of 7**	

Sample Number :	S17-5065	SAMPLE LOCATION
Date Sampled :	19/10/2017	BHP3_0.4-1.0m
Date Tested :	26/10/2017	
Sampled By :	Lonnie Broekman	
Sampling Method :	AS1289.1.2.1	
Material Source :	on-site	Lot Number :
Material Type :	soil	Test Number :
Remarks :		

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m³) :	1.627
Optimum Moisture Content (%) :	13.3
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	101
Achieved Percentage of OMC :	100.0
Dry Density Before Soak (t/m³) :	1.645
Dry Density After Soak (t/m³) :	1.645
Moisture Content Before Soak (%) :	13.3
Moisture Content After Soak (%) :	17.2
Density Ratio After Soak (%) :	101
Field Moisture Content (%) :	18.9
Top Moisture Content - After Penetration (%) :	20.6
Total Moisture Content - After Penetration (%) :	20.3
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.0



CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) :	10
Oversize (%) :	0	CBR 5.0mm (%) :	**10**
Oversize Material Replaced (%) :		**CBR Value (%) :**	**10**

Site Selection :	Random
Soil Description :	refer to attached borelogs

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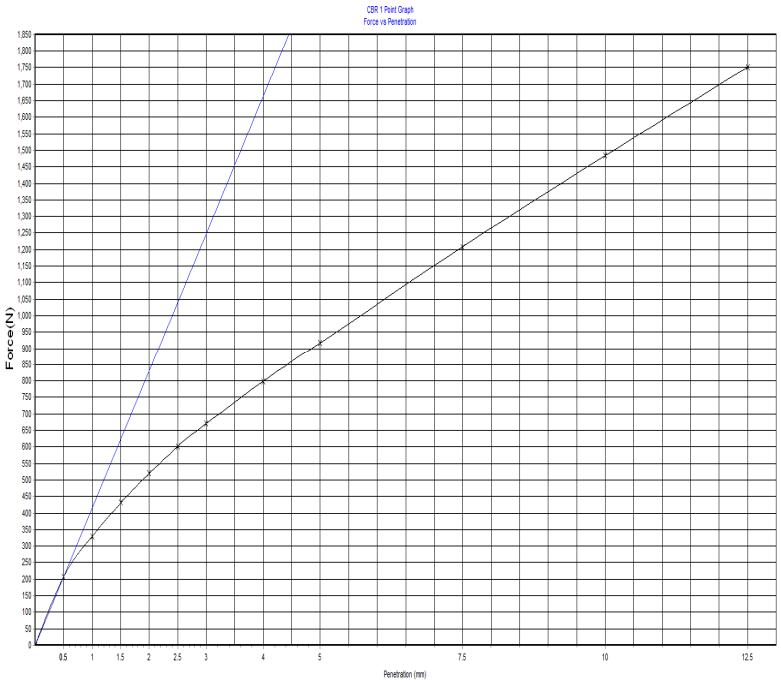
Geotechnical & Environmental Services

California Bearing Ratio Report (1 Point)

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 2/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**31/10/2017**
Project Number :	**P1292**	Order Number :	
Project Name :	**Geotechnical Investigation - Medowie**	Test Method :	**AS1289.6.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road ,**	**Page 3 of 7**	

Sample Number :	S17-5066	SAMPLE LOCATION
Date Sampled :	19/10/2017	BHP5_0.5-1.0m
Date Tested :	26/10/2017	
Sampled By :	Lonnie Broekman	
Sampling Method :	AS1289.1.2.1	
Material Source :	on-site	Lot Number :
Material Type :	soil	Test Number :
Remarks :		#REF!

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m³) :	1.768
Optimum Moisture Content (%) :	12.3
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	99.0
Dry Density Before Soak (t/m³) :	1.762
Dry Density After Soak (t/m³) :	1.758
Moisture Content Before Soak (%) :	12.2
Moisture Content After Soak (%) :	16.1
Density Ratio After Soak (%) :	99
Field Moisture Content (%) :	14.7
Top Moisture Content - After Penetration (%) :	17.3
Total Moisture Content - After Penetration (%) :	16.1
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.5



CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) :	4.5
Oversize (%) :	0	CBR 5.0mm (%) :	**4.5**
Oversize Material Replaced (%) :		**CBR Value (%) :**	**4.5**

Site Selection :	Random
Soil Description :	refer to attached borelogs

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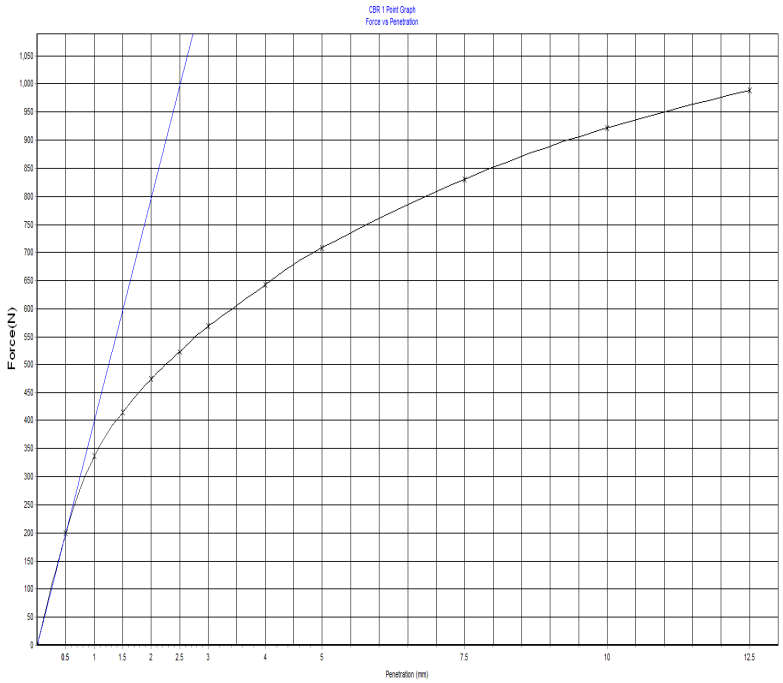
VALLEY CIVILAB
Geotechnical & Environmental Services

California Bearing Ratio Report (1 Point)

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 2/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**31/10/2017**
Project Number :	**P1292**	Order Number :	
Project Name :	**Geotechnical Investigation - Medowie**	Test Method :	**AS1289.6.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road ,**	**Page 4 of 7**	

Sample Number :	S17-5067	SAMPLE LOCATION
Date Sampled :	19/10/2017	BHP6_0.5-1.0m
Date Tested :	26/10/2017	
Sampled By :	Lonnie Broekman	
Sampling Method :	AS1289.1.2.1	
Material Source :	on-site	Lot Number :
Material Type :	soil	Test Number :
Remarks :		#REF!

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m³) :	1.678
Optimum Moisture Content (%) :	17.0
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	102.0
Dry Density Before Soak (t/m³) :	1.674
Dry Density After Soak (t/m³) :	1.674
Moisture Content Before Soak (%) :	17.3
Moisture Content After Soak (%) :	18.5
Density Ratio After Soak (%) :	100
Field Moisture Content (%) :	21.3
Top Moisture Content - After Penetration (%) :	18.6
Total Moisture Content - After Penetration (%) :	18.6
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.0



CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) :	4
Oversize (%) :	0	CBR 5.0mm (%) :	**3.5**
Oversize Material Replaced (%) :		**CBR Value (%) :**	**4**

Site Selection :	Random
Soil Description :	refer to attached borelogs

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NATA Accreditation Number :
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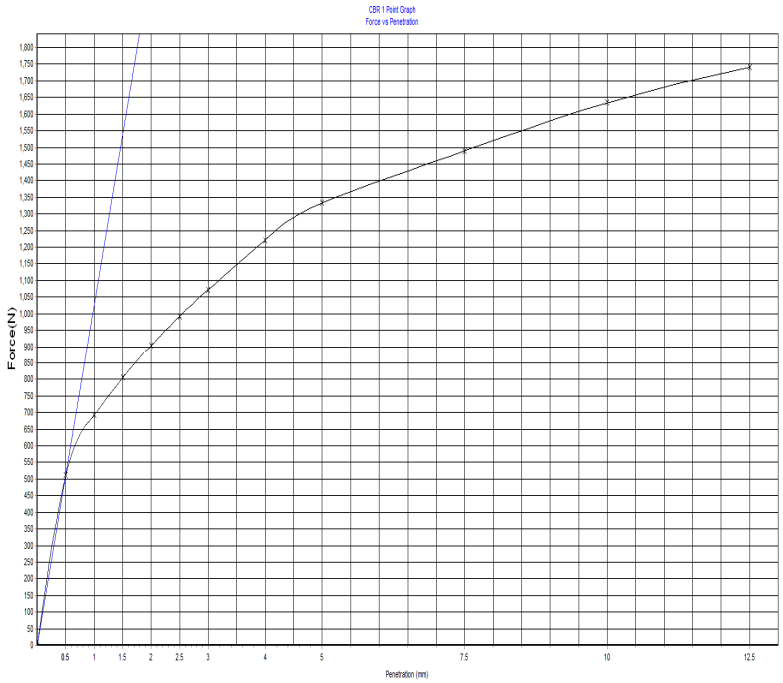
VALLEY CIVILAB
Geotechnical & Environmental Services

California Bearing Ratio Report (1 Point)

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 2/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**31/10/2017**
Project Number :	**P1292**	Order Number :	
Project Name :	**Geotechnical Investigation - Medowie**	Test Method :	**AS1289.6.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road ,**	**Page 5 of 7**	

Sample Number :	S17-5068	SAMPLE LOCATION
Date Sampled :	19/10/2017	BHP9_0.4-1.0m
Date Tested :	26/10/2017	
Sampled By :	Lonnie Broekman	
Sampling Method :	AS1289.1.2.1	
Material Source :	on-site	Lot Number :
Material Type :	soil	Test Number :
Remarks :		#REF!

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m³) :	1.532
Optimum Moisture Content (%) :	23.9
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	101
Achieved Percentage of OMC :	99.0
Dry Density Before Soak (t/m³) :	1.545
Dry Density After Soak (t/m³) :	1.539
Moisture Content Before Soak (%) :	23.7
Moisture Content After Soak (%) :	27.4
Density Ratio After Soak (%) :	100
Field Moisture Content (%) :	22.1
Top Moisture Content - After Penetration (%) :	26.1
Total Moisture Content - After Penetration (%) :	24.8
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.5



CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) :	8
Oversize (%) :	0	CBR 5.0mm (%) :	**7**
Oversize Material Replaced (%) :		**CBR Value (%) :**	**8**

Site Selection :	Random
Soil Description :	refer to attached borelogs

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NATA Accreditation Number :
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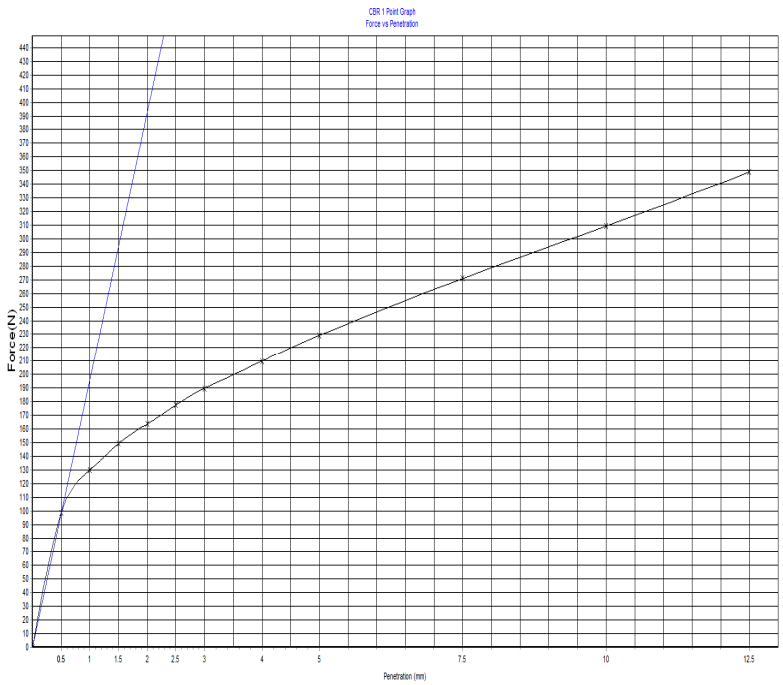
Geotechnical & Environmental Services

California Bearing Ratio Report (1 Point)

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 2/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**31/10/2017**
Project Number :	**P1292**	Order Number :	
Project Name :	**Geotechnical Investigation - Medowie**	Test Method :	**AS1289.6.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road ,**	**Page 6 of 7**	

Sample Number :	S17-5069	SAMPLE LOCATION
Date Sampled :	19/10/2017	BHP10_1.3-1.8m
Date Tested :	26/10/2017	
Sampled By :	Lonnie Broekman	
Sampling Method :	AS1289.1.2.1	
Material Source :	on-site	Lot Number :
Material Type :	soil	Test Number :
Remarks :		#REF!

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m³) :	1.439
Optimum Moisture Content (%) :	25.8
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	100
Achieved Percentage of OMC :	99.0
Dry Density Before Soak (t/m³) :	1.442
Dry Density After Soak (t/m³) :	1.4
Moisture Content Before Soak (%) :	25.5
Moisture Content After Soak (%) :	30.4
Density Ratio After Soak (%) :	97
Field Moisture Content (%) :	29.4
Top Moisture Content - After Penetration (%) :	34.6
Total Moisture Content - After Penetration (%) :	28.9
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	3.0



CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) :	1.5
Oversize (%) :	0	CBR 5.0mm (%) :	**1**
Oversize Material Replaced (%) :		**CBR Value (%) :**	**1.5**

Site Selection :	Random
Soil Description :	refer to attached borelogs

NATA
WORLD RECOGNISED ACCREDITATION

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

APPROVED SIGNATORY

Richard Badior - Senior Geotechnical Officer
NATA Accreditation Number :
14975

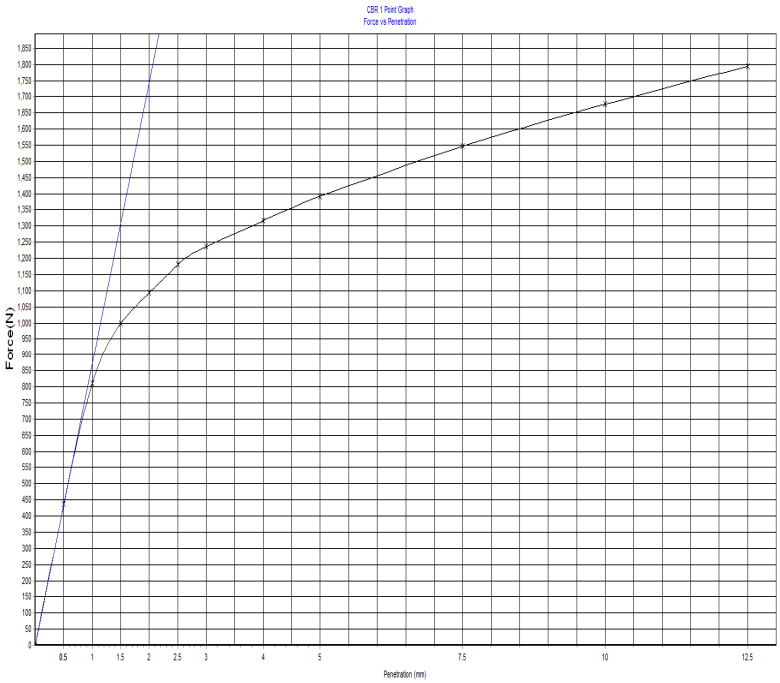
VALLEY CIVILAB
Geotechnical & Environmental Services

California Bearing Ratio Report (1 Point)

Client :	**Diocese of Maitland**	Report Number:	**P1292 - 2/1**
Address :	**PO Box 756, Newcastle, NSW, 2300**	Report Date :	**31/10/2017**
Project Number :	**P1292**	Order Number :	
Project Name :	**Geotechnical Investigation - Medowie**	Test Method :	**AS1289.6.1.1**
Location:	**Catherine McAuley Catholic College - 507 Medowie Road ,**	**Page 7 of 7**	

Sample Number :	S17-5070	SAMPLE LOCATION
Date Sampled :	19/10/2017	BHP12_0.5-1.0m
Date Tested :	26/10/2017	
Sampled By :	Lonnie Broekman	
Sampling Method :	AS1289.1.2.1	
Material Source :	on-site	Lot Number :
Material Type :	soil	Test Number :
Remarks :		#REF!

Moisture Method :	AS1289.2.1.1
Maximum Dry Density (t/m³) :	1.462
Optimum Moisture Content (%) :	25.9
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	101
Achieved Percentage of OMC :	100.0
Dry Density Before Soak (t/m³) :	1.472
Dry Density After Soak (t/m³) :	1.468
Moisture Content Before Soak (%) :	25.8
Moisture Content After Soak (%) :	28.7
Density Ratio After Soak (%) :	100
Field Moisture Content (%) :	23.7
Top Moisture Content - After Penetration (%) :	27.3
Total Moisture Content - After Penetration (%) :	27.2
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%) :	0.5



CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) :	9
Oversize (%) :	0	CBR 5.0mm (%) :	**7**
Oversize Material Replaced (%) :		**CBR Value (%) :**	**9**

Site Selection :	Random
Soil Description :	refer to attached borelogs

NATA
WORLD RECOGNISED ACCREDITATION

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

APPROVED SIGNATORY

Richard Badior - Senior Geotechnical Officer
NATA Accreditation Number :
14975

SYDNEY
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A.B.N. 81 829 182 852
NATA No: 1884

ANALYTICAL REPORT for:

VALLEY CIVILAB

PO BOX 3127
THORNTON 2322

ATTN: NATHAN ROBERTS

JOB NO:	SAL26510F
CLIENT ORDER:	P1292
DATE RECEIVED:	23/10/17
DATE COMPLETED:	31/10/17
TYPE OF SAMPLES:	SOILS
NO OF SAMPLES:	7

NATA Accredited for compliance with ISO/IEC 17025 Testing

.....
Issued on 31/10/17
Lance Smith
(Chief Chemist)

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL26510F
CLIENT ORDER: P1292

	SAMPLES	pH 1:5	COND. uS/cm	Cl %	SO4 %
1	BH4(1)	6.1	30	0.002	0.006
2	BH4(2)	6.5	30	0.003	0.002
3	BH4(3)	6.1	40	0.003	0.002
4	BH10(1)	5.6	45	0.001	0.004
5	BH10(2)	5.1	60	0.002	0.006
6	BH17(1)	5.0	100	0.010	0.008
7	BH17(2)	5.2	170	0.003	0.020
MDL		0.1	10	0.001	0.001
Method Code		C1	WA2	C24	C25
Preparation		P3	P3	P3	P3

RESULTS ON DRY BASIS

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL26510F
CLIENT ORDER: P1292

METHODS OF PREPARATION AND ANALYSIS

The tests contained in this report have been carried out on the samples as received by the laboratory.

P3	Sample dried, jaw crushed and sieved at 1mm
C1	pH - AS1289.4.3.1
WA2	Conductivity - 1:5 soil/water extract Determined by APHA 2510B
C24	Water Soluble Chloride - RMS T1010 Determined by APHA 4110B
C25	Water Soluble Sulphate - BS1377 Part 3 (1990) Determined by APHA 4110B

VALLEY CIVILAB
Geotechnical & Environmental Services

Annex D

Foundation Maintenance and Footing Performance:
A Homeowner's Guide

PUBLISHING

BTF 18-2011 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870-2011, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume, particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.

In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes

Notes

1. Where controlled fill has been used, the site may be classified A to E according to the type of fill used.
2. Filled sites. Class P is used for sites which include soft fills, such as clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soil subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.
3. Where deep-seated moisture changes exist on sites at depths of 3 m or greater, further classification is needed for Classes M to E (M-D, H1-D, H2-D and E-D).

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

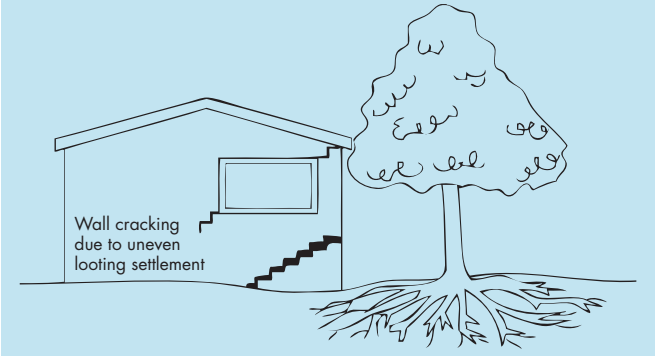
The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Trees can cause shrinkage and damage



Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation causes a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem. Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870-2011.

AS 2870-2011 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

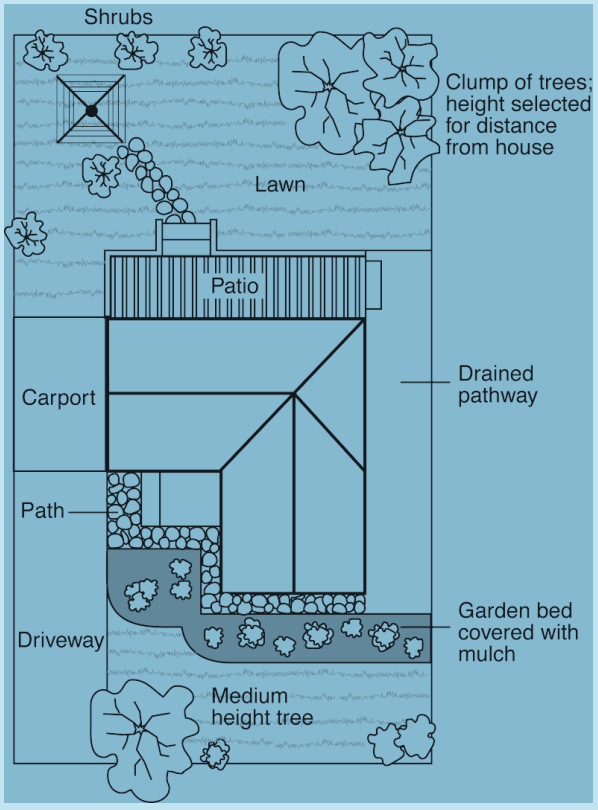
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving should

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly.	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired.	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 mm but also depends on number of cracks	4

Gardens for a reactive site



extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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VALLEY CIVILAB
Geotechnical & Environmental Services

Annex E

Acid Sulfate Soils Field Screening Sheet (Hey 2002 Method)

Date.	**24/10/2017**
Job no.	**P1292**
Location.	**507 Medowie Road, Medowie**
Client.	**Catholic Schools Office - Diocese of Maitland Newcastle**

ABN: 50 103 355 531
VALLEY CIVILAB
Geotechnical, Testing & Engineering Services
Unit 3, 62 Sandringham Ave, Thornton NSW 2322 P (02) 4966 1844 F (02) 4966 1855
www.valleycivilab.com.au

BH	Depth	Sample ID	pH field pHf	pH oxidation pHfox	Delta pH (pHf-pHfox)	Reaction*	Sulfur odour (YES/NO)	Change in colour (YES/NO)	Soil Description / Comments
2	0.4 - 0.5	BH2 0.4-0.5	6.0	3.4	2.6	0	N	N	Refer to borelog report
2	0.8 - 0.9	BH2 0.8-0.9	4.9	3.9	1	0	N	N	Refer to borelog report
2	1.0 - 1.2	BH2 1.0-1.2	5.2	3.6	1.6	0	N	N	Refer to borelog report
2	1.5 - 1.8	BH2 1.5-1.8	5.0	3.8	1.2	0	N	N	Refer to borelog report
5	0.5 - 0.6	BH5 0.5-0.6	5.1	3.7	1.4	0	N	N	Refer to borelog report
5	1.1 - 1.2	BH5 1.1-1.2	5.1	4.0	1.1	0	N	N	Refer to borelog report
5	1.5 - 1.6	BH5 1.5-1.6	4.8	3.6	1.2	0	N	N	Refer to borelog report
8	0.4 - 0.5	BH8 0.4-0.5	5.5	3.3	2.2	1	N	N	Refer to borelog report
8	0.7 - 0.8	BH8 0.7-0.8	5.7	3.9	1.8	0	N	N	Refer to borelog report
8	1.0 - 1.2	BH8 1.0-1.2	5.3	4.0	1.3	0	N	N	Refer to borelog report
8	1.5 - 1.7	BH8 1.5-1.7	5.8	4.5	1.3	0	N	N	Refer to borelog report
8	2.4 - 2.6	BH8 2.4-2.6	6.0	3.8	2.2	0	N	N	Refer to borelog report

Temperature:			**Comments:**						
Tested By:	**GB**	**Date:**	**29/09/2016**	**Checked By:**		**Date:**		**Equipment ID:**	

*** Reaction: 0 = NO reaction** after 5 minutes; **1 = SLIGHT reaction** within 5 minutes; **2 = MEDIUM** reaction within 5 minutes; **3 = STRONG** effervescent within 5 minutes

VALLEY CIVILAB
Geotechnical & Environmental Services

Annex F

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

Certificate of Analysis

Valley Civilab P/L
3/62 Sandringham Ave
Thornton
NSW 2322

NATA Accredited
Accreditation Number 1261
Site Number 20794

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

Attention: **Nathan Roberts**

Report **569429-S**
Project name
Project ID P1292
Received Date Oct 26, 2017

Client Sample ID			**BH2**	**BH5**	**BH8**
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Oc29131**	**B17-Oc29132**	**B17-Oc29133**
Date Sampled			**Oct 19, 2017**	**Oct 19, 2017**	**Oct 19, 2017**
Test/Reference	LOR	Unit			
SPOCAS Suite					
pH-KCL	0.1	pH Units	7.0	4.3	5.3
pH-OX	0.1	pH Units	5.5	2.6	4.0
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	98	3.0
Acid trail - Titratable Peroxide Acidity	2	mol H+/t	< 2	410	< 2
Acid trail - Titratable Sulfidic Acidity	2	mol H+/t	< 2	310	-3
sulfidic - TAA equiv. S% pyrite	0.02	% pyrite S	< 0.02	0.16	< 0.02
sulfidic - TPA equiv. S% pyrite	0.02	% pyrite S	< 0.02	0.66	< 0.02
sulfidic - TSA equiv. S% pyrite	0.02	% pyrite S	< 0.02	0.50	< 0.02
Sulfur - KCl Extractable	0.02	% S	< 0.02	< 0.02	< 0.02
Sulfur - Peroxide	0.02	% S	< 0.02	0.05	< 0.02
Sulfur - Peroxide Oxidisable Sulfur	0.02	% S	< 0.02	0.05	< 0.02
acidity - Peroxide Oxidisable Sulfur	10	mol H+/t	< 10	30	< 10
HCl Extractable Sulfur	0.02	% S	n/a	< 0.02	n/a
Net Acid soluble sulfur	0.02	% S	n/a	< 0.02	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	< 10	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	n/a	< 0.02	n/a
Calcium - KCl Extractable	0.02	% Ca	0.04	< 0.02	< 0.02
Calcium - Peroxide	0.02	% Ca	0.04	< 0.02	< 0.02
Acid Reacted Calcium	0.02	% Ca	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Calcium	10	mol H+/t	< 10	< 10	< 10
sulfidic - Acid Reacted Ca equiv. S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02
Magnesium - KCl Extractable	0.02	% Mg	< 0.02	< 0.02	< 0.02
Magnesium - Peroxide	0.02	% Mg	< 0.02	< 0.02	< 0.02
Acid Reacted Magnesium	0.02	% Mg	< 0.02	< 0.02	< 0.02
acidity - Acid Reacted Magnesium	10	mol H+/t	< 10	< 10	< 10
sulfidic - Acid Reacted Mg equiv. S% pyrite	0.02	% S	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity (ANCE)	0.02	%CaCO3	n/a	n/a	n/a
Acid Neutralising Capacity - Acidity units (a-ANCE)	10	mol H+/t	n/a	n/a	n/a
Acid Neutralising Capacity equivalent S% pyrite(s-ANCE)	0.02	% S	n/a	n/a	n/a
ANC Fineness Factor		factor	1.5	1.5	1.5
Net Acidity (sulfur units) - SPOCAS	0.02	% S	< 0.02	0.21	< 0.02
Net Acidity (acidity units) - SPOCAS	10	mol H+/t	< 10	130	< 10
Liming rate - SPOCAS	1	kg CaCO3/t	< 1	10	< 1

Client Sample ID			BH2	BH5	BH8
Sample Matrix			**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B17-Oc29131**	**B17-Oc29132**	**B17-Oc29133**
Date Sampled			**Oct 19, 2017**	**Oct 19, 2017**	**Oct 19, 2017**
Test/Reference	LOR	Unit			
Extraneous Material					
<2mm Fraction	0.005	g	120	160	160
>2mm Fraction	0.005	g	< 0.005	< 0.005	< 0.005
Analysed Material	0.1	%	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1
% Moisture	1	%	2.9	16	18

Sample History

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

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

Description	Testing Site	Extracted	Holding Time
SPOCAS Suite			
SPOCAS Suite	Brisbane	Oct 26, 2017	6 Week
- Method: LTM-GEN-7050			
Extraneous Material	Brisbane	Oct 26, 2017	6 Week
- Method: LTM-GEN-7050/7070			
% Moisture	Brisbane	Oct 26, 2017	14 Day
- Method: LTM-GEN-7080 Moisture			

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NATA # 1261 Site # 20794

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

Company Name: Valley Civilab P/L
Address: 3/62 Sandringham Ave
Thornton
NSW 2322

Project Name:
Project ID: P1292

Order No.: VC: 02470
Report #: 569429
Phone: 4966 1844
Fax: 4966 1855

Received: Oct 26, 2017 8:35 AM
Due: Oct 31, 2017
Priority: 3 Day
Contact Name: Nathan Roberts

Eurofins | mgt Analytical Services Manager : Nibha Vaidya

Sample Detail						SPOCAS Suite	Moisture Set
Melbourne Laboratory - NATA Site # 1254 & 14271							
Sydney Laboratory - NATA Site # 18217							
Brisbane Laboratory - NATA Site # 20794						X	X
Perth Laboratory - NATA Site # 23736							
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	BH2	Oct 19, 2017		Soil	B17-Oc29131	X	X
2	BH5	Oct 19, 2017		Soil	B17-Oc29132	X	X
3	BH8	Oct 19, 2017		Soil	B17-Oc29133	X	X
Test Counts						3	3

Internal Quality Control Review and Glossary

General

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

Holding Times

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

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

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

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

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

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

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

Terms

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

QC - Acceptance Criteria

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

Results <10 times the LOR : No Limit

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

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

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

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

QC Data General Comments

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

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
SPOCAS Suite				Result 1	Result 2	RPD			
pH-KCL	B17-Oc29131	CP	pH Units	7.0	7.1	1.0	30%	Pass	
pH-OX	B17-Oc29131	CP	pH Units	5.5	5.5	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B17-Oc29131	CP	mol H+/t	< 2	< 2	<1	30%	Pass	
Acid trail - Titratable Peroxide Acidity	B17-Oc29131	CP	mol H+/t	< 2	< 2	<1	30%	Pass	
Acid trail - Titratable Sulfidic Acidity	B17-Oc29131	CP	mol H+/t	< 2	< 2	<1	30%	Pass	
sulfidic - TAA equiv. S% pyrite	B17-Oc29131	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
sulfidic - TPA equiv. S% pyrite	B17-Oc29131	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
sulfidic - TSA equiv. S% pyrite	B17-Oc29131	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Sulfur - KCl Extractable	B17-Oc29131	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Sulfur - Peroxide	B17-Oc29131	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Sulfur - Peroxide Oxidisable Sulfur	B17-Oc29131	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
acidity - Peroxide Oxidisable Sulfur	B17-Oc29131	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
HCl Extractable Sulfur	B17-Oc29131	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur	B17-Oc29131	CP	% S	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - acidity units	B17-Oc29131	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
Net Acid soluble sulfur - equivalent S% pyrite	B17-Oc29131	CP	% S	n/a	n/a	n/a	30%	Pass	
Calcium - KCl Extractable	B17-Oc29131	CP	% Ca	0.04	0.04	6.0	30%	Pass	
Calcium - Peroxide	B17-Oc29131	CP	% Ca	0.04	0.04	<1	30%	Pass	
Acid Reacted Calcium	B17-Oc29131	CP	% Ca	< 0.02	< 0.02	<1	30%	Pass	
acidity - Acid Reacted Calcium	B17-Oc29131	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
sulfidic - Acid Reacted Ca equiv. S% pyrite	B17-Oc29131	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Magnesium - KCl Extractable	B17-Oc29131	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
Magnesium - Peroxide	B17-Oc29131	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
Acid Reacted Magnesium	B17-Oc29131	CP	% Mg	< 0.02	< 0.02	<1	30%	Pass	
acidity - Acid Reacted Magnesium	B17-Oc29131	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
sulfidic - Acid Reacted Mg equiv. S% pyrite	B17-Oc29131	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Acid Neutralising Capacity (ANCE)	B17-Oc29131	CP	%CaCO3	n/a	n/a	n/a	30%	Pass	
Acid Neutralising Capacity - Acidity units (a-ANCE)	B17-Oc29131	CP	mol H+/t	n/a	n/a	n/a	30%	Pass	
ANC Fineness Factor	B17-Oc29131	CP	factor	1.5	1.5	<1	30%	Pass	
Liming rate - SPOCAS	B17-Oc29131	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	B17-Oc29131	CP	%	2.9	2.8	3.0	30%	Pass	

Comments

Sample Integrity

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

Comments

Qualifier Codes/Comments

Code	Description
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5

Authorised By

Nibha Vaidya	Analytical Services Manager
Bryan Wilson	Senior Analyst-Metal (QLD)
Jonathon Angell	Senior Analyst-Inorganic (QLD)

Glenn Jackson
National Operations Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

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

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

VALLEY CIVILAB
Geotechnical & Environmental Services

Annex G

1 General Acid Sulfate Soil Management Strategies

In order to minimise the risks that can arise from the excavation of acid sulfate soils, some general acid sulfate management strategies can be followed. These will ensure that the works will be undertaken in a safe and environmentally friendly manner.

For excavation and construction on the site that is not detailed in Section 8 of this report, it is highly recommended that suitably qualified engineer be present during works and that they be carried out in accordance with the following general recommendations.

1.1 Staff Responsibilities

All staff that are involved in the excavation and testing of ASS during any site works should be trained in identifying indicators of ASS. Indicators include iron stains, crystal clear water, a 'rotten egg' type smell from exposed soils, poor vegetation growth, yellow coatings on soil peds. All staff are also to ensure that they adhere to the requirements detailed below.

Managers and supervisors of the site are required to ensure that the site specific controls for ASS are in place, are adequately maintained and are effective. They are also responsible for maintaining a regular monitoring and testing program for the acids sulfate soils at the site and ensuring that all material is suitably treated.

1.2 General Procedures

General requirements for maintaining a safe and environmentally friendly worksite can be found in **Table 1.1** below.

Table 1.1 - General Procedures for the Management of Acid Sulfate Soils

Procedure	Requirement
Minimise disturbance of ASS on site	Generally speaking ASS in their natural state pose little to no problem. It's only after they are excavated and exposed to the air do they begin to become a problem. As such, the best way to minimise their impact is to not disturb them from their natural state. There should be an aim to minimise disturbance of acid sulfate soils by limiting where possible the extent of excavations.
Limit the use of de-watering measures	De-watering requires the disposal of treated soil water. There is a high risk of potentially acidic water running off to the surrounding areas. It is best to avoid de-watering during construction and operation if possible.
Minimise spoil exposure time to the air	When acid sulfate soils are exposed to the air they oxidize and can become more acidic. The best course of action is to minimise exposure time to the air. It is recommended that progressive development be undertaken to minimise the exposure of stockpiles.
Dose excavated material and water	All excavated material on site and all water removed must be treated as per Section 8 of this report
Control Leachate	Controls must be in place to minimise the movement of water on site by either containment or diversion. No excavation is to be undertaken during periods of wet weather.
Undertake chemical pH tests	Regular chemical testing must be undertaken on excavated soils and water during treatment and before disposal.

Once groundwater or soilwater leachate and excavated material have been treated as per Section 8 of this report then they may be disposed of offsite. Additional testing may be required for the excavated soils to determine their waste classification prior to removal from site. The local council for the site should be consulted prior to removal to determine the waste classification requirements.

2 Monitoring

Monitoring of the soils, soilwater leachate and groundwater must be undertaken during excavation, treatment and construction. Regular monitoring should be undertaken using pH field testing to determine the effectiveness of the management plan. The field pH test provides information on the likely presence of actual acid sulfate soils.

Soil monitoring should be undertaken using pH field tests on any disturbed material during construction and treatment. Soil testing for pH is to be undertaken on a saturated soil using a spear point pH probe or a field pH metre. It is recommended that pH, soil texture, colour and mottle are recorded for each sample tested. Soils are to be treated to a level of between 5.5 an 8.0. Soils outside this range must not be transported from site or moved around the site.

Groundwater and soilwater leachate should be tested for pH during de-watering and during excavation. De-watering may also require the monitoring of salinity and turbidity as a change in these may have effect on the surrounding environment. The local council to the site should be consulted prior to de-watering as they may require salinity and turbidity testing and a license may be required to dispose of groundwater and soilwater leachate. Groundwater and soilwater leachate pH can be tested using a field pH metre. Discharged groundwater and soilwater leachate must have a pH between 6.5 and 8.5. Water outside this range must not be transported from site or irrigated across the site.

3 Contingency Plan

In case of a failure of the Acid Sulfate Soil Management Plan then the Contingency Plan detailed below should be enacted. The plan is based on the ASSMAC Assessment Guidelines.

3.1 Remedial Action Plan

If the results of field testing during monitoring of the works indicate that the agreed standards are not being achieved then remedial action should be taken. A remedial action plan should be created by the site developer in consultation with the site contractors, field testing personnel, consulting engineers or scientists and relevant government authorities. A new plan should be created and the relevant authorities should be informed as to the new plan and the reasons for the changes.

3.2 Restoration Plan

If the Remedial Action Plan fails then all works should stop immediately and action must be taken to restore the site to a condition equivalent to that before construction began.

Prior to implementation of the restoration plan and assessment must be undertaken to determine where the problem lies. An assessment should be undertaken to determine whether the Acid Sulfate Management Strategies, their implementation or whether no suitable management plan can implemented is the cause of the problem. If further

modifications to the Acid Sulfate Soil Management Plan is required then the relevant authorities should be informed as to the new plan and the reasons for the changes.

4 Lime Details

Dosing lime may pose health risks and these must be addressed prior to the use of lime on site. A risk assessment should be undertaken by all individuals involved prior to the use of any lime and a Material Safety Data Sheet should be obtained and distributed for the specific lime being used on the site.