Assyrian Schools Limited
C/- PMDL

Preliminary Geotechnical and Salinity Assessment and Pavement Thickness Design:
17 and 19 Kosovich Place, Cecil Park, NSW

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August 2018

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All enquiries regarding this project are to be directed to the Project Manager.

Contents

1 Introduction

1.1 Overview

This report documents the findings of a preliminary geotechnical and salinity assessment completed to support State Significant development application (SSDA) to NSW Department of Planning and Environment for the proposed development at 17 and 19 Kosovich Place, Cecil Park, NSW (the 'site'), being Lots 2320 and 2321 in DP 1223137. This report has been prepared in accordance with the agreed scope of work.

The site location is shown on a site plan in Attachment A.

1.2 Objectives

The assessment objectives include:

- Carrying out investigations to assess sub-surface materials and groundwater conditions, including collecting soil samples for laboratory testing.
- Carrying out a salinity assessment.
- Carrying out a CBR assessment for preliminary pavement thickness design.
- Provision of details of sub-surface conditions encountered during field investigations and information for foundation design including site classification.

1.3 Proposed Development

Preliminary plans and sections prepared by PMDL (refer PMDL, 2018) and the project brief indicates that the development will include construction of a new primary school including 2 two-storey GLA buildings, a multi-purpose hall, library, canteen, a primary admin / library with associated playgrounds and staff carpark including access for student drop-off and pick-up. Some cuttings and fillings of up to approximately 5.0 m will likely be required as part of construction works.

1.4 Site Description

General site details are summarised in Table 1.

Table 1: General site description summary.

Element	Description/Detail
Lot / DP	Lots 2320 and 2321 in DP 1223137
Local Government Area (LGA)	Fairfield City Council (FCC)
Site Area	Approximately 3 ha
Existing site development	Predominantly open grassland and paddocks
Neighbouring environment	Site is surrounded by rural and rural residential properties. The western boundary includes half of a dam. The north-eastern boundary is Kosovich Place and the north-western boundary is a church.
Expected Geology	Bringelly Shale comprising shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coal and tuff (*Penrith 1:100 000 Geological Sheet 9030, 1st edition*, Geological Survey of New South Wales, Sydney)
Site Topography	Mid-slope of a west facing slope within moderately undulating land and near-level valley floor in the west of the site
Site Aspect	West
Site Elevation	Ranges between approximately 89 mAHD (west) and 102 mAHD (east)
Typical Slope	Approximately 15 – 20 % in the east, and <5 % in the west
Existing Vegetation	Grass
Site Drainage	Via overland flow west to a drainage depression at the western boundary. This flows into Ropes Creek 100 m north-west of the site's north-western boundary

2 Geotechnical Assessment

2.1 Field Investigations

Field investigations undertaken on 10 February 2017 included:

- General site walkover to assess existing site conditions.
- Drilling and logging of fourteen boreholes (BH101 to BH114) up to 4.0 metres below ground level (mBGL).
- Standard Penetration Tests (SPT), conducted in BH101, BH102 and BH103.
- Seven Dynamic Cone Penetrometer (DCP) tests, conducted in BH104 to BH110.
- Collection of soil samples for laboratory testing and for future reference.

Approximate borehole, in-situ testing and CBR sampling locations are shown in Figure 2, Attachment A.

2.2 Sub-surface Conditions

The sub-surface profile typically comprises the following units:

Unit A: Silty clay loam, typically brown in colour and stiff, with some organic matter (mainly grass and rootlets).

Unit B: Residual light, light medium and medium clay, typically brown to red/orange for light clays and light medium clays, and yellow-brown to grey for medium clays. Typically stiff to very stiff, becoming harder as depth increases.

Unit C: Layer of weathered sandstone/shale/laminite, distinctly weathered and very low to low strength.

Unit D: Fill material comprising light medium clay, clayey sand, silty clay loam, silty clay and ripped/crushed sandstone, encountered in BH113 and BH114.

Table 2 summarises depths of encountered sub-surface conditions across different sections of the site. Depth ranges vary across the site depending on borehole location. Refer to borehole logs in Attachment B for more details.

Table 2: Generalised depth range of sub-surface profile.

Unit	Indicative depth range of unit (mBGL)		
	Eastern half of site 15-20% slope	Western half of site near existing creek <5% slope	B114 [1]
A	0.0 – 0.5	0.00 – 0.15	-
B	0.5 – 2.0	0.15 – 1.50 [2]	-
C	2.0 – 2.5 [3]	-	-
D	-	0.0 – 0.3 [4]	0.0 – 4.0

Notes:

1. BH114 only contained fill material up to investigation termination depth of 4.0 mBGL.
2. BH111-BH113 terminated at investigation termination depth of 1.5 mBGL. Depth of unit likely to be greater.
3. Borehole terminated on inferred medium strength shale/laminite.
4. Fill material encountered in BH113.

2.3 Groundwater

2.3.1 NSW Department of Primary Industries Water (DPI-Water) Bore Search

The NSW DPI-Water online groundwater bore mapping website was reviewed on 1 March 2017 to identify licensed groundwater bores within an approximately 500 m radius of the site. One borehole was found within this radius. Bore details are provided in Table 3.

Table 3: Available hydrogeological information from the NSW DPI.

Bore ID	Distance from site	Surface RL (mAHD) [1]	Depth to groundwater (mBGL)	Groundwater RL (mAHD)	Water bearing zone material
GW108121	260 m NE	100.0	34.0	66.0	Shale

Notes:

1. Relative ground surface level at borehole based on Nearmap data.

Based on the data above, groundwater at the site is expected to be encountered at approximately 66.0 mAHD, or deeper. The drainage depression on the western boundary, dam to the west and presence of Ropes Creek north of the site suggest that an ephemeral or perched groundwater table may be shallow.

2.3.2 Findings

Groundwater was not encountered in any borehole up to 4.0 mBGL. Ephemeral perched groundwater may occur near the soil/rock interface as a result of heavy rainfall events.

Should further information on permanent site groundwater levels be required, additional investigation would need to be carried out (i.e. rock coring and installation of groundwater monitoring wells).

Groundwater may lead to increased risk of slope instability at foundation locations, the build-up of pore water pressure behind strip footings or retaining structures and impact excavation and construction methodologies, if not adequately managed.

2.4 Laboratory Testing

2.4.1 Atterberg Limits Testing

Laboratory testing was undertaken on three soil samples for the purpose of characterising encountered soil profiles. Testing was carried out by Resource Laboratories, a National Association of Testing Authorities (NATA) accredited laboratory. Table 4 presents a summary of test results. A test certificate is presented in Attachment D.

Table 4: Atterberg limit testing results summary.

BH	Depth (mBGL)	Soil Type	Atterberg Limits (%)			Plasticity Classification
			LL [1]	PL [1]	PI [1]	
BH101	0.6	Light Medium Clay	59	17	42	High plasticity
BH105	0.9	Medium Clay	64	17	47	High plasticity
BH108	0.6	Light Medium Clay	75	18	57	High plasticity

Notes:

1. LL = Liquid limit, PL= Plastic limit, PI=Plasticity index.

2.5 Potential Geotechnical Hazards

2.5.1 Slope Instability

No apparent evidence of former or existing land or slope instability was observed during the site walkover and field investigation works. The proposed development is located in the eastern section of the site, which comprises slopes between 15 % and 20 %. This area is also underlain by residual soils and a layer of inferred very low to low strength shale/laminite. Appropriate foundation and retaining wall design will be required to manage potential slope stability risks as a result of the proposed development.

2.5.2 Surface Movement / Settlement

Medium and possibly heavy clay soils, which are potentially highly reactive soils, were encountered in the eastern section of the site.

Buildings founded on these soils may experience foundation movements unless appropriate foundation design and management of soil moisture content conditions is carried out to limit excessive shrink/swell of soils and resultant differential foundation movements.

3 Salinity Assessment

3.1 Risk Mapping

The *Map of Salinity Potential in Western Sydney* (Department of Infrastructure, Planning and Natural Resources (DIPNR), 2002) indicates the site to be in an area with moderate to high salinity potential, and in close proximity to an area with known salinity. Refer to Figure 1 for site location with respect to salinity potential.

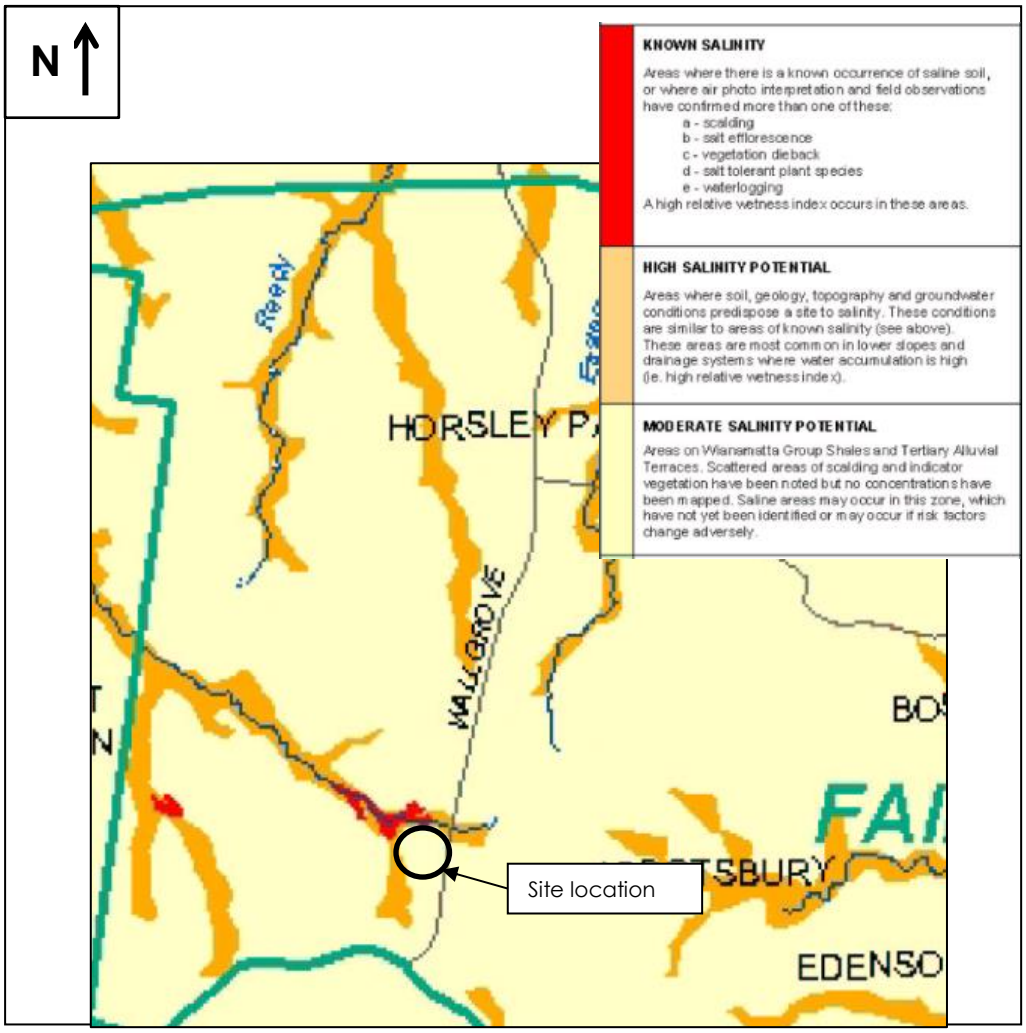


Figure 1: Salinity potential at site based on *Map of Salinity Potential in Western Sydney* (DIPNR, 2002).

3.2 Signs of Potential Saline Soils

The following observations relating to saline soil conditions are discussed below:

- Vegetation growth adjacent to the site appeared healthy and uninhibited.
- No water marks or salt crystals were observed on the ground surface.
- Site surface drainage appeared to be generally good.
- No evidence of concentrated surface erosion was observed.

3.3 Possible Site Conditions Impacting Site Salinity

Site conditions that may impact salinity potential at the site include:

- Proximity to the dam west of the site and Ropes Creek 100 m north of the site's northern boundary may facilitate increased surface water infiltration.
- Surface water infiltration into clayey soil layers may facilitate transportation of salts to surface or upper layers through capillary movement.
- Localised waterlogged soils.

3.4 Assessed Salinity Risk Potential

Table 5 provides an assessment of the broad scale salinity processes likely to impact the site. These were assessed in terms of the likelihood of each process occurring at the site based on the proposed development, our site observations and investigation findings.

Table 5: Potential for broad scale salinity processes at the site.

Key Salinity Process	Description	Potential at subject site
Localised concentration of salinity	o Localised concentration of salts due to relatively high evaporation rates. o Usually associated with waterlogged soil and poor drainage. o Exacerbated by increased water use and/ or blocking of surface and sub-surface water flow associated with urban development.	Low to medium – no evidence of localised concentration of salt was observed at the time of investigation. Potential for waterlogged soil due to clayey soils.
Shale Soil Landscapes	o In poorly drained duplex (texture contrast) soils shallow sub-surface water flows laterally across a clayey upper B-Horizon with salt usually accumulating in the clayey sub-soil. o Salt concentrations may increase where sub-surface water accumulates and evaporates, e.g. on lower slopes or natural and constructed flats in mid-slope. o Exacerbated by sub-soils exposure through deep cutting, by installing buildings into the B-horizon and by impeding sub-surface water flows. o Highly dispersive, erodible and poorly draining sodic soils due to salinity.	Low to medium – The site is underlain by low permeable clays. No observable evidence of impeded surface vegetation growth and surface soil erosion. No shallow sub-surface water encountered.
Deep Groundwater Salinity	o Brackish or saline groundwater rises to a level where, through capillary action in the soil, the water with dissolved salts reaches the ground surface and evaporates, resulting in localised salt concentration. o Groundwater rises are typically caused by increased water infiltration, e.g. above average rainfall, vegetation loss, irrigation, increased water use in urban areas, construction of surface pits. o Exacerbated by buildings or infrastructure intercepting the zone of groundwater level fluctuation.	Low to medium – groundwater was not encountered in all boreholes. However, the site is underlain by clays facilitating capillary action. Proposed structures are to be constructed with appropriate drainage measures installed.
Deeply Weathered Soil Landscape	o High salt loads with high sulphate levels related to un-mapped deeply weathered soil landscapes beneath fluvial gravel, sand and clay. o Usually in mid-slope or on hilltops affected by perched saline groundwater.	Low to medium – no depositional soils; however possible deeply weathered residual soils.

3.5 Laboratory Test Results

3.5.1 Overview

10 soil samples collected from BH102, BH103 and BH111 were submitted to Envirolab Services, a NATA accredited laboratory, for salinity and aggressivity (EC, pH and soluble SO_4) testing. The samples were selected to achieve a representative coverage of the soil profile.

Groundwater was not observed down to investigation termination depth of all boreholes which was between 1.5 and 4.0 mBGL. However, perched groundwater from surface water infiltration may occur, particularly in the vicinity of creeks and drainage depressions as a result of rainfall events, and should be tested if encountered during construction.

3.5.2 Results A – Salinity Classification

Laboratory test results for salinity classification are summarised in Table 6 and the laboratory test certificate is provided in Attachment E.

Table 6: Soil salinity test results.

Borehole	Sample Depth (mBGL)	Material	EC (1:5) (dS/m)	EC_e (dS/m) [1]	Salinity Classification [2]
BH102	0.25	Silty Clay	0.071	0.639	Non-saline
BH102	0.50	Silty Clay	0.085	0.765	Non-saline
BH102	1.00	Silty Clay	0.056	0.504	Non-saline
BH102	2.00	Light Medium Clay	0.065	0.520	Non-saline
BH103	0.20	Silty Clay	0.110	0.990	Non-saline
BH103	0.50	Silty Clay	0.170	1.530	Non-saline
BH103	1.50	Medium Clay	0.240	1.680	Non-saline
BH103	2.50	Medium Clay	0.180	1.260	Non-saline
BH111	0.30	Light Medium Clay	0.047	0.376	Non-saline
BH111	0.60	Medium Clay	0.054	0.378	Non-saline

Notes:

1. Based on EC to EC_e multiplication factors from Table 6.1 in *Site Investigations for Urban Salinity* (2002) guidelines.
2. Based on Table 6.2 in *Site Investigations for Urban Salinity* (2002) guidelines, where EC_e <2 dS/m = non-saline, EC_e of 2-4 dS/m = slightly saline, EC_e of 4-8 dS/m = moderately saline, EC_e of 8-16 dS/m = very saline, EC_e of >16 dS/m = highly saline.

Results indicate sub-surface materials are classified as non-saline.

3.6 Results B – Exposure Classification

Sulphate and pH test results are summarised in Table 7 and the laboratory test certificate is provided in Attachment E.

Table 7: Exposure classification test results.

Borehole	Sample Depth (mBGL)	Material	EC_e (dS/m) [1]	pH	Sulphate (1:5) (mg/kg)	Exposure Classification [2]
BH102	0.20	Silty Clay	0.639	7.1	41	A1
BH102	0.50	Silty Clay	0.765	6.9	60	A1
BH102	1.00	Silty Clay	0.504	8.3	26	A1
BH102	2.00	Light Medium Clay	0.520	8.4	39	A1
BH103	0.20	Silty Clay	0.990	5.9	91	A1
BH103	0.50	Silty Clay	1.530	5.8	140	A1
BH103	1.50	Medium Clay	1.680	8.8	20	A1
BH103	2.50	Medium Clay	1.260	8.9	<10	A1
BH111	0.30	Light Medium Clay	0.376	6.8	<10	A1
BH111	0.60	Medium Clay	0.378	6.8	54	A1

Notes:

1. Based on EC to ECe multiplication factors from Table 6.1 in *Site Investigations for Urban Salinity* (2002) guidelines.
2. Exposure classification for buried reinforced concrete based on Tables 4.8.1 and 4.8.2 of AS 3600 (2009).

In accordance with AS3600 (2009) exposure classification for buried concrete structures is 'A1'.

3.7 Conclusion

The site assessment and laboratory test results suggest the site is not impacted by saline soil conditions. Buried concrete structures may be designed considering an exposure classification of 'A1' in accordance with AS3600 (2009).

4 Preliminary Pavement Thickness Design

4.1 Overview

A preliminary pavement thickness design has been undertaken for the proposed new access road in accordance with *Policy 4-515 Specification for Roadwork and Drainage* (Fairfield City Council, 2011) and *Guide to Pavement Technology Part 2: Pavement Structural Design* (Austroads, 2012).

4.2 Equivalent Standard Axles

An ESA value of $5x10^5$ was adopted for design of the private access road in accordance with Council specifications.

4.3 CBR Assessment

Three bulk soil samples were collected from BH101, BH102 and BH103, and submitted to Resource Laboratories, a NATA accredited laboratory, for CBR testing. A 4-day soaked CBR test was conducted in accordance with AS1289.1.1, AS1289.2.1.1, AS1289.5.1.1 and AS1289.6.1.1. Sampling locations are provided in Attachment A and the laboratory test certificate is provided in Attachment F. Laboratory test results are summarised in Table 8.

Table 8: CBR results.

Borehole	Sample Depth (mBGL)	Material	Laboratory CBR (%)
BH101	0.2 – 0.6	Silty Clay Loam / Light Medium Clay	4.5
BH102	0.2 – 0.6	Silty Clay	6
BH103	0.2 – 0.6	Silty Clay	2.5

Based on the CBR values in Table 8 and DCP/CBR test result correlations, we recommend adopting a CBR value of 3.0 for preliminary design of proposed pavements. This considers minimum council requirements, possible differences in the natural soil profiles across the site and the possible re-use of site-won excavated material. However, if material of inferior quality is uncovered during excavation, lower CBR values may be applicable and pavement material thickness designs may need to be revised.

Additional CBR testing is recommended to provide a better indication of subgrade conditions across proposed pavement areas, considering final design alignments and levels, and / or to provide statistical means to

support a higher CBR design value. The additional testing may be undertaken at Construction Certificate stage.

4.4 Preliminary Pavement Thickness Design

Table 9 presents a preliminary pavement thickness design for the private access roads.

Table 9: Preliminary pavement material thickness design.

Road Type	Layer	Thickness (mm)
Rural Residential Local Road (CBR=3.0)	Thin bituminous surfacing (AC10)	45 [1]
	Base (DGB20)	150
	Sub-base (DGS40)	315
	Total pavement thickness	510

Notes:

1. Minimum value based on Council specifications.

4.5 Earthworks

4.5.1 Subgrade Preparation

It is recommended that surface loam and / or root affected soils be removed prior to pavement construction.

The subgrade is to be trimmed and compacted with density testing of the upper 300 mm layer at a rate of 1 test per 50 m of road length. Minimum density shall be adopted as specified in Section 4.5.3. Prior to placement of pavement material, the subgrade shall be proof rolled and approved by a geotechnical engineer.

Unsuitable, soft, loose or wet material or heaving areas can be treated by one of the following methods subject to final design by Martens:

1. Removal and replacement with approved fill under geotechnical engineer's direction.

2. *In-situ* stabilisation with cement, lime or similar binding agent to a depth of at least 300 mm below finished level. Use of this method and extent will depend on the condition of material to be stabilised.

4.5.2 Subsoil Drainage

Surface and subsoil drainage should be provided in accordance with Council requirements. Typically subsoil drainage is installed on the upslope side of all internal roads and generally extends to 1.0 m below finished surface of pavement. Where pavement extends to rock, or

where silts or clay soils are located at subgrade level, it is recommended that subsoil drains are installed on both sides of the pavement.

4.5.3 Placement and Testing of Pavement Material

Pavement materials shall be placed in layers (when compacted) not thicker than 150 mm or less than 75 mm. Pavement materials shall be compacted to the following condition:

- Sub-base - Minimum 98 % Maximum Dry Density (MDD) at modified compactive effort (±2% OMC).
- Base - Minimum 98% MDD at modified compactive effort (±2% OMC).

Compaction testing shall be undertaken by a NATA accredited laboratory in accordance with procedures as outlined in AS1289. Testing should be carried out at a rate of 1 per 250 m^2 per layer or 3 per layer placed, whichever is the greater. Each pavement layer shall be proof rolled under geotechnical engineers' supervision. Subsequent pavement layers shall not be placed prior to approval of underlying layer by the geotechnical engineer.

4.5.4 Fill Placement and Testing

All earthwork, subgrade work, use of site-won excavated material as fill and fill material testing and preparation is to be approved by a geotechnical engineer and undertaken in accordance with AS 3798 (2007). Fill material placed at the site should be tested by a NATA accredited laboratory to achieve the following:

- For landscaping: Minimum density of 95 % Standard Maximum Dry Density (SMDD) at a standard compactive effort within 2 % and -2 % of optimum moisture content (OMC).
- Under pavement and structures: Minimum density of 98 % MDD at a modified compactive effort within 0 % and -2 % of OMC and 100% SMDD in upper 300 mm below final subgrade level.

5 Recommendations and Further Works

5.1 Key Constraints

The proposed development may be impacted by the following key constraints:

1. Slope stability: The proposed development may be subject to slope stability risks as outlined in Section 2.5.1. Appropriate foundation design and retaining wall or batter design will be required to manage potential slope instability risks.

2. Potential highly reactive soils: Shallow foundations for the proposed development may be subject to surface movement/settlement risks if founding on highly reactive soils. Appropriate foundation design and management of soil moisture content conditions will be required to manage potential movement risks.

3. Excavation for benches: Excavation up to 4.75 mBGL is proposed to create benches for proposed structures. Excavation in some areas will likely encounter rock, particularly if extending past 2.5 mBGL. Appropriate foundation design will be required to ensure all footings are founded on similar foundation conditions to limit differential movements, particularly where structures are located in areas with varying soil depths.

5.2 Recommendations

General geotechnical recommendations for the proposed development are provided in Attachment G. Site specific recommendations are as follows:

- Shallow footings, such as pad footings or strip footings may be adopted for lightly loaded structures, provided they are founded on at least very stiff or hard clay. An allowable bearing of capacity of 150 kPa may be adopted if founding in very stiff clay.

- We recommend adopting deepened footings for the large buildings, such as bored cast in-situ piles or piers used to extend footing through unsuitable soils and into rock. Based on the varying depths of residual soil and very low to low strength weathered rock encountered, we recommend founding all footings on at least medium strength shale to achieve uniform foundation conditions and limit differential settlement. An allowable bearing capacity of 1500 kPa may be adopted if founding in medium strength shale.

- Excavations which are >0.75 m deep may be battered back at maximum temporary and permanent grades of 1V:2H and 1V:3H respectively. Where steeper grades are proposed, temporary or permanent support / retaining systems are required.

- A preliminary site classification of 'H1' should be adopted (in areas where there is no fill) for design of lightly loaded shallow footings founding in clay, and a classification of 'S' if founding in rock, in accordance with AS 2870 (2011). This classification is subject to the recommendations presented in this report, CSIRO guidelines (CSIRO BTF 18, 2003), the design of footings in accordance with the relevant Australian Standards, and the following conditions:

    1. Footings extend through all unsuitable foundation materials such as topsoil, uncontrolled fill, root affected soils, silt and soft or firm clay and very loose and loose sand.

    2. Provision of adequate drainage of surface and sub-surface water to limit soil moisture variations impacting on foundation conditions.

    3. Footings are unlikely to be impacted by the presence of environments that could lead to exceptional foundation material movements, such as existing or future trees or surface/sub-surface water accumulation.

5.3 Salinity

We recommend that future buried concrete structures are designed based on concrete cover specifications in accordance with AS3600 (2009) considering an exposure classification of 'A1' (refer to Section 3.7). Additional saline soil management strategies are unlikely to be required.

5.4 Works Prior to Construction Certificate

As part of the construction certificate design and documentation process, the following should be undertaken:

1. Boreholes and rock coring at footing locations to confirm/modify/develop design assumptions.

2. Further laboratory testing of rock, such as point load testing, to assess rock strength.

3. Preparation of a filling and earthworks specification plan for the site earthworks.

4. Review of final design details by a senior geotechnical engineer.

5.5 Construction Monitoring and Inspections

We recommend the following monitoring and inspections during the bulk earthworks and construction phase of the project, summarised in Table 10. This program may be updated following further detailed site investigations.

Table 10: Recommended inspection/monitoring plan during site works.

Scope of works	Frequency/Duration	Party to complete
Inspect excavation retention (shoring, retaining wall) installations and monitor associated performance	Daily / As required	MA / Builder
If required, inspect unsupported cut and battered excavations to assess adequacy of design and additional support requirements	1.0 to 1.5 m depth increments during excavation	MA
Inspect exposed material at foundation level to verify suitability as foundation material	Prior to reinforcement setup and concrete placement	MA
Inspect fill material to verify suitability as foundation / lateral support / subgrade	Prior to fill placement	MA
Proof roll pavement subgrade to verify suitability for placement at the site and for provision of advice associated with fill placement	Prior to pavement material placement	MA
Monitor groundwater seepage / inflow from excavation faces, if encountered, to assess adequacy of drainage provisions	When encountered	MA / Builder
Monitor groundwater levels and seepage / inflow in groundwater monitoring wells, if installed	Weekly (or as required)	MA
Monitor sedimentation downslope of excavated areas	During and after rainfall events	Builder
Monitor sediment and erosion control structures to assess adequacy and for removal of built up spoil	After rainfall events	Builder

Notes:

MA = Martens & Associates geotechnical engineer.

6 References

Australian Geomechanics Society (2007) *Practice Note Guidelines for Landslide Risk Management.*

Austroads Ltd (2012) *Guide to Pavement Technology Part 2: Pavement Structural Design*.

Clark N.R. & Jones D.C. (1991) *Penrith 1:100 000 Geological Sheet 9030, 1st edition*, Geological Survey of New South Wales, Sydney.

Department of Infrastructure, Planning and Natural Resources (2002) *Map of Salinity Potential in Western Sydney 2002*.

CSIRO (2012) *Building Technology File (BTF) 18-2011 – Foundation Maintenance and Footing Performance: A Homeowner's Guide*.

Fairfield City Council (2011) *Policy 4-515 Specification for Roadwork and Drainage.*

Landcom (2004) *Managing Urban Stormwater: Soils and Construction.*

Lilicrap A., McGhie S. (2002) *Site Investigations for Urban Salinity*, Department of Land and Water Conservation, Sydney, NSW, Australia.

Pells P.J.N. et al (1989) *Engineering Geology of the Sydney Region*.

PMDL (2018) *Architectural Plan*, Drawing No. DA105, dated July 2018 (PMDL, 2018).

Standards Australia AS1289.1.1 (2001) *Sampling and preparation of soils – Preparation of disturbed soil samples for testing.*

Standards Australia AS1289.2.1.1 (1992) *Soil moisture content tests – Determination of the moisture content of a soil – Oven drying method (standard method).*

Standards Australia AS1289.5.1.1 (2003) *Soil compaction and density tests – Determination of the dry density/moisture content relation of a soil using standard compactive effort.*

Standards Australia AS1289.6.1.1 (1998) *Soil strength and consolidation tests – Determination of the California Bearing Ratio of a soil – Standard laboratory method for a remoulded specimen.*

Standards Australia AS1289.6.3.2 (1984) *Soil strength and consolidation tests – Determination of the penetration resistance of a soil – 9 kg dynamic cone penetrometer test.*

Standards Australia AS1726 (1993) *Geotechnical site investigations*.

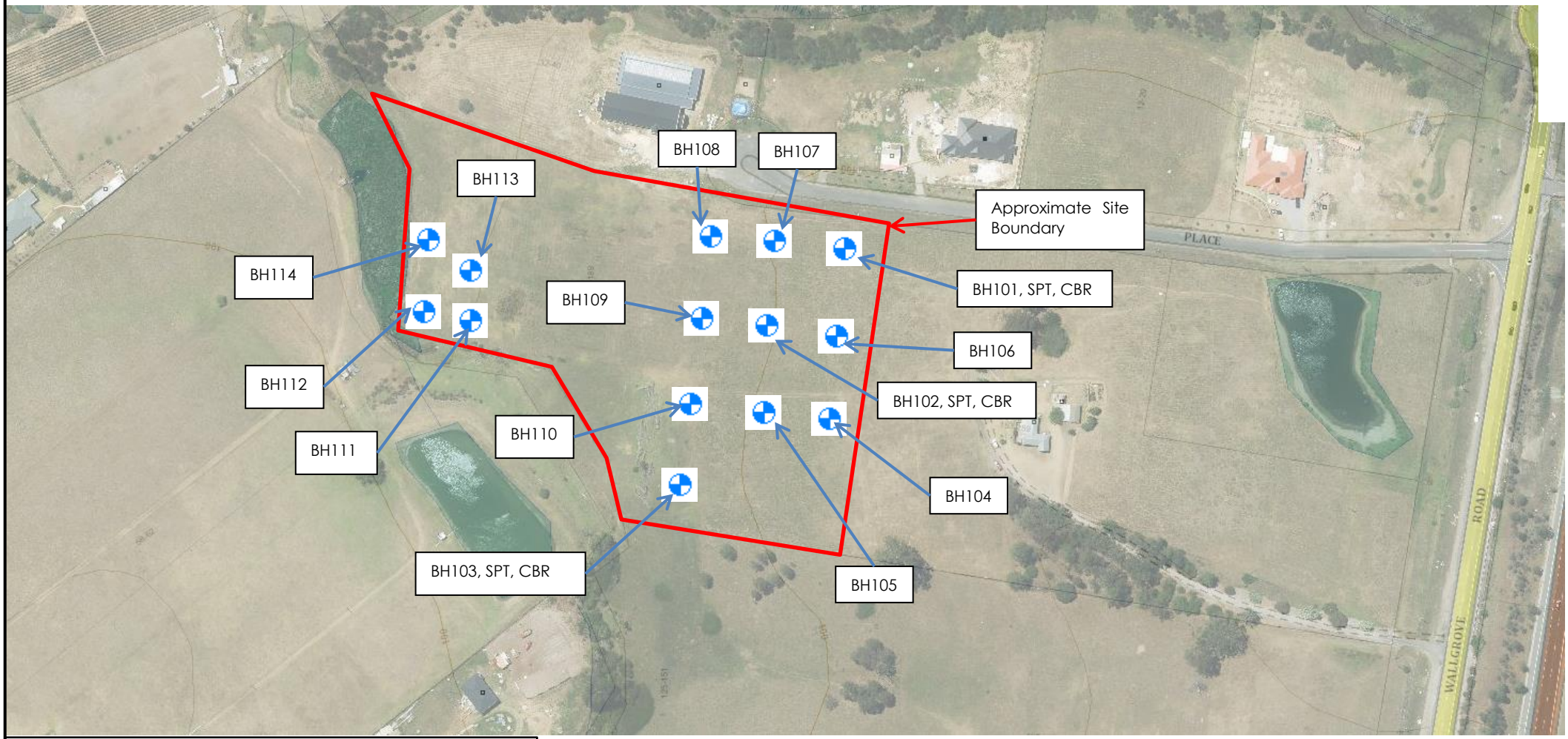
Standards Australia AS2870 (2011) *Residential slabs and footings*.

Standards Australia AS3600 (2009) *Concrete structures*.

Standards Australia AS3798 (2007) *Guidelines on earthworks for commercial and residential developments.*

WorkCover NSW (2015) *Work Health and Safety (Excavation Work) Code of Practice 2015.*

7 Attachment A – Site Layout and Geotechnical Testing Plan



KEY:

Indicative borehole, CBR sampling and / or in-situ test location

Martens & Associates Pty Ltd ABN 85 070 240 890		**Environment | Water | Wastewater | Geotechnical | Civil | Management**	
Drawn:	MH/WB	**SITE LAYOUT AND GEOTECHNICAL TESTING PLAN** **17 and 19 Kosovich Place, Cecil Park, NSW** (Image source: SIXMaps online viewer, accessed 22.02.2017)	Drawing: **FIGURE 2**
Approved:	RE		
Date:	23.08.2018		File No: P1705798JR02V04
Scale:	NA		

8 Attachment B – Borehole Logs

CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH101**
PROJECT	Geotechnical Investigation		LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	99 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.80 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.5	99.00	SPT 0.00-0.45 m 1,3,4 N=7			SiCL	Silty Clay Loam, low plasticity, brown/red.		F	RESIDUAL SOIL
				0.50 98.50	5798/101/0.40/S/1 D 0.40 m			LMC	Light Medium Clay, medium plasticity, orange-brown.			
				0.70 98.30	5798/101/0.60/S/1 D 0.60 m			LC	Light Clay, medium plasticity, brown.	M	St	
	H		1.0		5798/101/0.90/S/1 D 0.90 m SPT 1.00-1.45 m 21,15,8 HB N=23						VSt	
AD/T			1.5	***1.50*** 97.50					SANDSTONE/SHALE LAMINITE, inferred distinctly weathered, inferred very low to low strength.	D		1.45: V-bit refusal. WEATHERED ROCK
				1.80					Hole Terminated at 1.80 m			1.80: TC-bit refusal on inferred medium strength laminite.
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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Engineering Log - BOREHOLE

CLIENT	Assyrian Schools Limited C/- PMDL	COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH102**
PROJECT	Geotechnical Investigation	LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT	4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	96 m	DATUM AHD
EXCAVATION DIMENSIONS	Ø100 mm x 2.10 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.5	96.00	SPT 0.00-0.45 m 3,5,5 N=10			SiCL	Silty Clay Loam, low plasticity, dark brown.	M	St	RESIDUAL SOIL
				0.15 95.85	5798/102/0.25/S/1 D 0.25 m			SiC	Silty Clay, low plasticity, red/brown, sandstone gravels.			
					5798/102/0.50/S/1 D 0.50 m						VSt	
AD/T	H		1.0		SPT 1.00-1.45 m 12,18,18 HB N=36 5798/102/1.0/S/1 D 1.00 m						H	1.20: V-bit refusal.
			1.5	*1.70* 94.30				LMC	Light Medium Clay, low plasticity, brown.			
			2.0	*2.10*	5798/102/2.0/S/1 D 2.00 m				Hole Terminated at 2.10 m			2.10: TC-bit refusal on inferred medium strength sandstone.
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH103**
PROJECT	Geotechnical Investigation		LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	92 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.00 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0	92.00	SPT 0.00-0.45 m 1,6,8 N=14			CL	Clay Loam, low plasticity, dark brown.			RESIDUAL SOIL
				0.20 91.80	5798/103/0.25/S/1 D 0.25 m			SiC	Silty Clay, medium plasticity, orange/brown, trace shale gravels.		St	
	M		0.5		5798/103/0.5/S/1 D 0.50 m				@0.60m - grading to orange/grey.			
			1.0	*1.10* 90.90	SPT 1.00-1.45 m 9,9,12 N=21			MC	Medium Clay, medium-high plasticity, grey, shale gravel inclusions.		VSt	
			1.5		5798/103/1.5/S/1 D 1.50 m					M		
AD/T	H		2.0									2.00: V-bit refusal.
			2.5		5798/103/2.5/S/1 D 2.50 m						H	
			3.0	*2.90* 89.10					Weathered SHALE, grey, inferred distinctly weathered, inferred very low to low strength.			WEATHERED ROCK
			3.5							D		
			4.0	*4.00*					Hole Terminated at 4.00 m (Investigation Limit)			
			4.5									

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CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH104**
PROJECT	Geotechnical Investigation		LOGGED	RM	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	103 m	DATUM AHD
EXCAVATION DIMENSIONS		2.20 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
		Not Encountered	0.5	103.00				SiCL	Silty Clay Loam, low plasticity, brown.		S	RESIDUAL SOIL
				0.15								
				102.85				LMC	Light Medium Clay, medium plastcity, red/orange.			
					5798/104/0.40/S/1 D 0.40 m							
				0.70								
				102.30				MC	Medium Clay, medium plastcity, yellow/brown, trace sandstone gravels.			0.70: V-bit refusal.
			1.0		5798/104/0.85/S/1 D 0.85 m					M	St	
			1.5						@1.8m-grading to grey.			
			2.0								H	
				2.20					Hole Terminated at 2.20 m			2.20: TC-bit refusal on inferred medium strength shale.
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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PROJECT	Geotechnical Investigation	LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW	GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT	4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	99 m	DATUM AHD
EXCAVATION DIMENSIONS	Ø100 mm x 3.00 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.5	99.00	5798/105/0.10/S/1 D 0.10 m			SCL	Sandy Clay Loam, low plasticity, brown.	M	St	RESIDUAL SOIL
				0.20 98.80				LMC	Light Medium Clay, medium plasticity, yellow/brown.		St - H	
					5798/105/0.40/S/1 D 0.40 m							
				0.60 98.40				MC	Medium Clay, medium to high plasticity, grey, shale gravels.			
AD/T	H		1.0		5798/105/0.90/S/1 D 0.90 m						H	1.00: V-bit refusal.
				1.40 97.60	5798/105/1.3/S/1 D 1.30 m				Weathered SHALE, grey, inferred very low strength.	D		WEATHERED ROCK
			2.5	*3.00*					Hole Terminated at 3.00 m			3.00: TC-bit refusal on inferred low strength shale.
			3.5									
			4.0									
			4.5									

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PROJECT	Geotechnical Investigation		LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	102 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.70 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.5	102.00 *0.40* 101.60 *0.60* 101.40	5798/106/0.20/S/1 D 0.20 m			SCL	Sandy Clay Loam, low plasticity, brown, fine sands.		St	RESIDUAL SOIL
								LMC	Light Medium Clay, medium plasticity, red/orange.	M	VSt	
								MC	Medium Clay, medium to high plasticity, orange/grey, shale gravels.		St - H	0.80: V-bit refusal.
AD/T	H		1.0	*1.00* 101.00	5798/106/0.20/S/1 D 0.90 m				Weathered SHALE, yellow, inferred low strength.	D		WEATHERED ROCK
			1.5	*1.70*					Hole Terminated at 1.70 m			1.70: TC-bit refusal on inferred low to medium strength sandstone.
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH107**
PROJECT	Geotechnical Investigation		LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	97 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 3.00 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.5	97.00	5798/107/0.20/S/1 D 0.20 m			SCL	Sandy Clay Loam, low plasticity, brown.	M	St	RESIDUAL SOIL
				0.40 96.60				LMC	Light Medium Clay, medium plasticity, orange.			
					5798/107/0.50/S/1 D 0.50 m							
				0.60 96.40				MC	Medium Clay, medium to high plasticity, brown/grey.		VSt	
			1.0									
			1.5						@1.5m - grading to grey.		H	1.50: V-bit refusal
AD/T	H		2.0	*2.00* 95.00					Weathered SHALE, grey, inferred distinctly weathered, inferred low strength.	D		WEATHERED ROCK
			2.5									
			3.0	*3.00*					Hole Terminated at 3.00 m			
			3.5									
			4.0									
			4.5									

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CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH108**
PROJECT	Geotechnical Investigation		LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	93 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 2.80 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V		Not Encountered	0	93.00				SiCL	Silty Clay Loam, low plasticity, brown.			RESIDUAL SOIL
					5798/108/0.20/S/1 D 0.20 m						St	
	M			*0.50*								
			0.5	92.50				LMC	Light Medium Clay, low to medium plasticity, brown, with shale gravels.			
					5798/108/0.60/S/1 D 0.60 m							
			1.0						@1.0m - grading to grey.	M		
					5798/108/1.1/S/1 D 1.10 m						H	
				1.50								
			1.5	91.50				MC	Medium Clay, medium plasticity, orange/grey.			1.50: V-bit refusal.
	H			*2.00*								
AD/T			2.0	91.00					Weathered SHALE, grey, inferred distinctly weathered, inferred very low to low strength.			WEATHERED ROCK
										D		
			2.5									
				2.80					Hole Terminated at 2.80 m			2.80: TC-bit refusal on inferred medium strength shale.
			3.0									
			3.5									
			4.0									
			4.5									

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CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH109**
PROJECT	Geotechnical Investigation		LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	94 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 3.00 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.5	94.00 *0.15* 93.85	5798/109/0.40/S/1 D 0.40 m 5798/109/0.50/S/1 D 0.50 m			SiCL	Silty Clay Loam, low plasticity, brown.	M	S	RESIDUAL SOIL
								LMC	Light Medium Clay, medium plasticity, red/orange/brown.		St - VSt	
			1.0						@1.2m - grading to grey.			
AD/T	H		1.5	*1.50* 92.50					Weathered SHALE, grey, inferred distinctly weathered, inferred very low strength.	D	H	1.20: V-bit refusal. WEATHERED ROCK
			2.0		5798/109/2.1/S/1 D 2.10 m							
			2.5									
			3.0	*3.00*					Hole Terminated at 3.00 m			
			3.5									
			4.0									
			4.5									

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CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH110**
PROJECT	Geotechnical Investigation		LOGGED	RM/HD	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	94 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 2.00 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.0	94.00	5798/110/0.10/S/1 D 0.10 m			SiCL	Silty Clay Loam, low plasticity, brown.	M	S	RESIDUAL SOIL
				0.25 93.75				LMC	Light Medium Clay, medium plasticity, orange.			
			0.5		5798/110/0.50/S/1 D 0.50 m						F	
			1.0		5798/110/1.0/S/1 D 1.00 m							
	H			*1.20* 92.80				MC	Medium Clay, medium to high plastictity, grey.		H	1.30: V-bit refusal.
AD/T			1.5	*1.50* 92.50					Weathered SHALE, grey, inferred distinctly weathered, inferred low strength.	D		WEATHERED ROCK
			2.0	*2.00*					Hole Terminated at 2.00 m			2.00: TC-bit refusal on inferred medium strength shale.
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH111**
PROJECT	Geotechnical Investigation		LOGGED	RM	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	91 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.50 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/T	M	Not Encountered	0	91.00				SiCL	Silty Clay Loam, low plasticity, brown.			RESIDUAL SOIL
				0.15 90.85	5798/111/0.10/S/1 D 0.10 m							
					5798/111/0.30/S/1 D 0.30 m			LMC	Light Medium Clay, low to medium plasticity.		S	
			0.5	*0.50* 90.50				MC	Medium Clay, medium plasticity, orange.	M		
					5798/111/0.60/S/1 D 0.60 m						F	
			1.0									
			1.5	*1.50*					Hole Terminated at 1.50 m (Investigation Limit)			
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH112**
PROJECT	Geotechnical Investigation		LOGGED	RM	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	90 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.50 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.5	90.00 *0.15* 89.85 *0.60* 89.40	5798/112/0.40/S/1 D 0.40 m 5798/112/0.80/S/1 D 0.80 m			SiCL	Silty Clay Loam, low plasticity, brown.	M	S	RESIDUAL SOIL
								LMC	Light Medium Clay, low plasticity, grey.			
			1.0					MC	Medium Clay, medium plasticity, orange/yellow/brown.		St	
			1.5	*1.50*					Hole Terminated at 1.50 m (Investigation Limit)			
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

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mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH113**
PROJECT	Geotechnical Investigation		LOGGED	RM	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	90 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 1.50 m depth	NORTHING		ASPECT	West	SLOPE 15-20%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
AD/V	M	Not Encountered	0.5	90.00	5798/113/0.20/S/1 D 0.20 m			LMC	FILL: Light Medium Clay, red/grey, sandstone gravels, brick inclusions.		S	FILL
				0.30 89.70	5798/113/0.20/S/2 D 0.20 m			LMC	Light Medium Clay, low plasticity, grey.			RESIDUAL SOIL
					5798/113/0.40/S/1 D 0.40 m							
				0.70 89.30				MC	Medium Clay, medium plasticity, orange/yellow/brown.	M	St	
			1.0		5798/113/0.80/S/1 D 0.80 m							
			1.5	*1.50*					Hole Terminated at 1.50 m (Investigation Limit)			
			2.0									
			2.5									
			3.0									
			3.5									
			4.0									
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
Suite 201, 20 George St. Hornsby, NSW 2077 Australia
Phone: (02) 9476 9999 Fax: (02) 9476 8767
mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

CLIENT	Assyrian Schools Limited C/- PMDL		COMMENCED	10/02/2017	COMPLETED	10/02/2017	**REF BH114**
PROJECT	Geotechnical Investigation		LOGGED	RM	CHECKED	RE	Sheet 1 OF 1
SITE	153-189 Wallgrove Rd, Cecil Park, NSW		GEOLOGY	Bringelly Shale	VEGETATION	Grass	PROJECT NO. P1705798
EQUIPMENT		4WD truck-mounted hydraulic drill rig	EASTING		RL SURFACE	90 m	DATUM AHD
EXCAVATION DIMENSIONS		Ø100 mm x 4.00 m depth	NORTHING		ASPECT	West	SLOPE 5-10%

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS / ASCS CLASSIFICATION	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
				90.00				SiCL	FILL: Silty Clay Loam, low plasticity, brown.			FILL
				0.15 89.85	5798/114/0.10/S/1 D 0.10 m			SiC	FILL: Silty Clay, dark grey, shale gravels.			
			0.5		5798/114/0.40/S/1 D 0.40 m							
				0.70 89.30					FILL: Ripped/Crushed SANDSTONE, yellow brown.			
			1.0		5798/114/0.80/S/1 D 0.80 m							
			1.5	*1.50* 88.50				CLS	FILL: Clayey SAND, grey/dark grey, coarse grained sand, with plastic and metal inclusions.			
AD/V	M	Not Encountered	2.0		5798/114/2.0/S/1 D 2.00 m					M		
			2.5		5798/114/2.40/S/1 D 2.40 m							
			3.0									
			3.5									
			4.0	*4.00*					Hole Terminated at 4.00 m (Investigation Limit)			
			4.5									

EXCAVATION LOG TO BE READ IN CONJUCTION WITH ACCOMPANYING REPORT NOTES AND ABBREVIATIONS

MARTENS & ASSOCIATES PTY LTD
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mail@martens.com.au WEB: http://www.martens.com.au

Engineering Log - BOREHOLE

9 Attachment C – DCP ‘N’ Counts

Dynamic Cone Penetrometer Test Log Summary

martens consulting engineers since 1989

Suite 201, 20 George Street, Hornsby, NSW 2077 Ph: (02) 9476 9999 Fax: (02) 9476 8767, mail@martens.com.au, www.martens.com.au

Site	153 - 189 Wallgrove Road, Cecil Park, NSW	**DCP Group Reference**	P1705798JS01V01
Client	Assyrian Schools Limited c/o - PMDL	**Log Date**	10.02.2017
Logged by	HD		
Checked by	RE		
Comments			

TEST DATA

Depth Interval (m)	DCP104	DCP105	DCP106	DCP107	DCP108	DCP109	DCP110	
0.15	7	6	6	0	6	5	4	
0.30	8	9	12	4	8	4	11	
0.45	12	14	12	5	11	5	11	
0.60	8/50mm	15	14	9	16	7	12	
0.75	Terminated at 0.5 m due to double bounce	15	21	9	20	11	18	
0.90		18	Terminated at 0.75 m due to double bounce	18	19	18	29	
1.05		19/50mm		22	15	12	19	
1.20		Terminated at 0.95 m due to double bounce		17	17	12	Terminated at 1.05 m due to double bounce	
1.35				Terminated at 1.2 m due to double bounce	22	11		
1.50					16	28/100mm		
1.65					17	Terminated at 1.45 m due to double bounce		
1.80					Terminated at 1.65 m due to double bounce			
1.95								
2.10								
2.25								
2.40								
2.55								
2.70								
2.85								
3.00								
3.15								
3.30								
3.45								
3.60								
3.75								
3.90								
4.05								
4.20								
4.35								
4.50								
4.65								
4.80								
4.95								
5.10								
5.25								
5.40								
5.55								
5.70								
5.85								
6.00								
6.15								
6.30								
6.45								
6.60								
6.75								
6.90								
7.05								
7.20								
7.35								
7.50								
7.65								
7.80								
7.95								
8.10								
8.25								
8.40								

10 Attachment D – Laboratory Test Certificate (Atterberg Limit)

resource laboratories
AGGREGATE, ROCK, AND SOIL TESTING
ABN: 25 131 532 020
Sydney: 12/1 Boden Road Seven Hills NSW 2147 | PO Box 45 Pendle Hill NSW 2145
Ph: (02) 9674 7711 | **Fax:** (02) 9674 7755 | **Email:** info@resourcelab.com.au

Test Report

Customer: Martens & Associates Pty Ltd
Project: P1705798
Location: Kosovich Place, Cecil Park, NSW

Job number: 17-0009
Report number: 2
Page: 1 of 1

Soil Index Properties

Sampling method: Samples tested as received

Test method(s): AS 1289.1.1, 2.1.1, 3.1.2, 3.2.1, 3.3.1 .3.4.1

	Results				
Laboratory sample no.	10844	10845	10846		
Customer sample no.	5798/BH101/ 0.6/S/1	5798/BH105/ 0.9/S/1	5798/BH108/ 0.6/S/1		
Date sampled	10/02/2017	10/02/2017	10/02/2017		
Material description	CLAY, brown mottled orange-brown	CLAY, trace of gravel, brown	CLAY, brown		
Liquid limit (%)	59	64	75		
Plastic limit (%)	17	17	18		
Plasticity index (%)	42	47	57		
Linear shrinkage (%)	15.5	16.0	18.0		
Cracking / Curling / Crumbling	Curling	Curling	Curling		
Sample history	Air dried	Air dried	Air dried		
Preparation	Dry sieved	Dry sieved	Dry sieved		

Approved Signatory:  E. Maldonado **Date:** 27/03/2017

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025.

NATA Accredited Laboratory Number: **17062**

11 Attachment E – Laboratory Test Certificate (Salinity)

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 162213

Client:

Martens & Associates Pty Ltd
Suite 201, 20 George St
Hornsby
NSW 2077

Attention: Robert Mehaffey, A Norris

Sample log in details:

Your Reference:	**P1705798JCOC01V01**
No. of samples:	1 Material, 60 Soils, 6 Composites
Date samples received / completed instructions received	15/02/17 / 21/02/17

Analysis Details:

Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by: / Issue Date:	28/02/17 / 27/02/17
Date of Preliminary Report:	Not Issued

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

Results Approved By:

David Springer
General Manager

vTRH(C6-C10)/BTEXN in Soil						
Our Reference:	UNITS	162213-41	162213-46	162213-48	162213-53	162213-60
Your Reference	---------- -	5798/BH111/0.1/ S/1	5798/BH113/0.2/ S/1	5798/BH114/0.1/ S/1	5798/SS01	Trip Spike
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
TRH C_6 - C_9	mg/kg	<25	<25	<25	<25	[NA]
TRH C_6 - C_{10}	mg/kg	<25	<25	<25	<25	[NA]
vTPH C_6 - C_{10} less BTEX (F1)	mg/kg	<25	<25	<25	<25	[NA]
Benzene	mg/kg	<0.2	<0.2	<0.2	<0.2	78%
Toluene	mg/kg	<0.5	<0.5	<0.5	<0.5	84%
Ethylbenzene	mg/kg	<1	<1	<1	<1	89%
m+p-xylene	mg/kg	<2	<2	<2	<2	89%
o-Xylene	mg/kg	<1	<1	<1	<1	89%
Total +ve Xylenes	mg/kg	<1	<1	<1	<1	[NA]
naphthalene	mg/kg	<1	<1	<1	<1	[NA]
Surrogate aaa-Trifluorotoluene	%	86	93	93	82	78

vTRH(C6-C10)/BTEXN in Soil		
Our Reference:	UNITS	162213-61
Your Reference	---------- -	Trip Blank
Composite Reference	----------	-
Date Sampled		10/02/2017
Type of sample		Soil
Date extracted	-	22/02/2017
Date analysed	-	23/02/2017
TRH C_6 - C_9	mg/kg	<25
TRH C_6 - C_{10}	mg/kg	<25
Surrogate aaa-Trifluorotoluene	%	95

svTRH (C10-C40) in Soil						
Our Reference:	UNITS	162213-41	162213-46	162213-48	162213-53	162213-61
Your Reference	----------	5798/BH111/0.1/ S/1	5798/BH113/0.2/ S/1	5798/BH114/0.1/ S/1	5798/SS01	Trip Blank
Composite Reference	- ----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
TRHC$_{10}$ - C$_{14}$	mg/kg	<50	<50	<50	<50	<50
TRHC$_{15}$ - C$_{28}$	mg/kg	<100	<100	<100	<100	<100
TRHC$_{29}$ - C$_{36}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{10}$-C$_{16}$	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{10}$ - C$_{16}$ less Naphthalene (F2)	mg/kg	<50	<50	<50	<50	<50
TRH>C$_{16}$-C$_{34}$	mg/kg	<100	<100	<100	<100	<100
TRH>C$_{34}$-C$_{40}$	mg/kg	<100	<100	<100	<100	<100
Total +ve TRH (>C10-C40)	mg/kg	<50	<50	<50	<50	<50
Surrogate o-Terphenyl	%	89	86	86	88	89

PAHs in Soil					
Our Reference:	UNITS	162213-41	162213-46	162213-48	162213-53
Your Reference	----------	5798/BH111/0.1/ S/1	5798/BH113/0.2/ S/1	5798/BH114/0.1/ S/1	5798/SS01
	-				
Composite Reference	----------	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(b,j+k)fluoranthene	mg/kg	<0.2	<0.2	<0.2	<0.2
Benzo(a)pyrene	mg/kg	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene TEQ calc (zero)	mg/kg	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(half)	mg/kg	<0.5	<0.5	<0.5	<0.5
Benzo(a)pyrene TEQ calc(PQL)	mg/kg	<0.5	<0.5	<0.5	<0.5
Total +ve PAH's	mg/kg	<0.05	<0.05	<0.05	<0.05
Surrogate p-Terphenyl-d14	%	103	107	97	94

Organochlorine Pesticides in soil						
Our Reference:	UNITS	162213-8	162213-41	162213-46	162213-48	162213-53
Your Reference	---------- -	5798/SS10	5798/BH111/0.1/ S/1	5798/BH113/0.2/ S/1	5798/BH114/0.1/ S/1	5798/SS01
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	99	101	98	94	99

Organochlorine Pesticides in soil						
Our Reference:	UNITS	162213-54	162213-55	162213-56	162213-57	162213-58
Your Reference	----------	5798/SS04	5798/Dup101	5798/Dup102	5798/Dup103	5798/Dup104
Composite Reference	- ----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	98	95	94	94

Organochlorine Pesticides in soil						
Our Reference:	UNITS	162213-62	162213-63	162213-64	162213-65	162213-66
Your Reference	---------- -	5798/C01	5798/C02	5798/C03	5798/C04	5798/C05
Composite Reference	----------	1+2+3	4+5+6	7+8+9	10+11+12	13+14+15
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
HCB	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor Epoxide	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-Chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
alpha-chlordane	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan I	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDD	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan II	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
pp-DDT	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endrin Aldehyde	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan Sulphate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	92	96	99	96	96

Organochlorine Pesticides in soil		
Our Reference:	UNITS	162213-67
Your Reference	---------- -	5798/C06
Composite Reference	----------	16+17+18
Date Sampled		10/02/2017
Type of sample		Soil
Date extracted	-	22/02/2017
Date analysed	-	23/02/2017
HCB	mg/kg	<0.1
alpha-BHC	mg/kg	<0.1
gamma-BHC	mg/kg	<0.1
beta-BHC	mg/kg	<0.1
Heptachlor	mg/kg	<0.1
delta-BHC	mg/kg	<0.1
Aldrin	mg/kg	<0.1
Heptachlor Epoxide	mg/kg	<0.1
gamma-Chlordane	mg/kg	<0.1
alpha-chlordane	mg/kg	<0.1
Endosulfan I	mg/kg	<0.1
pp-DDE	mg/kg	<0.1
Dieldrin	mg/kg	<0.1
Endrin	mg/kg	<0.1
pp-DDD	mg/kg	<0.1
Endosulfan II	mg/kg	<0.1
pp-DDT	mg/kg	<0.1
Endrin Aldehyde	mg/kg	<0.1
Endosulfan Sulphate	mg/kg	<0.1
Methoxychlor	mg/kg	<0.1
Total +ve DDT+DDD+DDE	mg/kg	<0.1
Surrogate TCMX	%	96

Organophosphorus Pesticides						
Our Reference:	UNITS	162213-8	162213-41	162213-46	162213-48	162213-53
Your Reference	---------- -	5798/SS10	5798/BH111/0.1/ S/1	5798/BH113/0.2/ S/1	5798/BH114/0.1/ S/1	5798/SS01
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	99	101	98	94	99

Organophosphorus Pesticides						
Our Reference:	UNITS	162213-54	162213-55	162213-56	162213-57	162213-58
Your Reference	---------- -	5798/SS04	5798/Dup101	5798/Dup102	5798/Dup103	5798/Dup104
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	96	98	95	94	94

Organophosphorus Pesticides Our Reference: Your Reference Composite Reference Date Sampled Type of sample	UNITS ---------- - ---------- 	162213-62 5798/C01 1+2+3 10/02/2017 Soil	162213-63 5798/C02 4+5+6 10/02/2017 Soil	162213-64 5798/C03 7+8+9 10/02/2017 Soil	162213-65 5798/C04 10+11+12 10/02/2017 Soil	162213-66 5798/C05 13+14+15 10/02/2017 Soil
Date extracted	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Azinphos-methyl (Guthion)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Bromophos-ethyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Diazinon	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorvos	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dimethoate	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ethion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fenitrothion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Malathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Parathion	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Ronnel	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Surrogate TCMX	%	92	96	99	96	96

Organophosphorus Pesticides Our Reference: Your Reference Composite Reference Date Sampled Type of sample	UNITS ---------- - ---------- 	162213-67 5798/C06 16+17+18 10/02/2017 Soil
Date extracted	-	22/02/2017
Date analysed	-	23/02/2017
Azinphos-methyl (Guthion)	mg/kg	<0.1
Bromophos-ethyl	mg/kg	<0.1
Chlorpyriphos	mg/kg	<0.1
Chlorpyriphos-methyl	mg/kg	<0.1
Diazinon	mg/kg	<0.1
Dichlorvos	mg/kg	<0.1
Dimethoate	mg/kg	<0.1
Ethion	mg/kg	<0.1
Fenitrothion	mg/kg	<0.1
Malathion	mg/kg	<0.1
Parathion	mg/kg	<0.1
Ronnel	mg/kg	<0.1
Surrogate TCMX	%	96

Acid Extractable metals in soil						
Our Reference:	UNITS	162213-8	162213-41	162213-46	162213-48	162213-53
Your Reference	---------- -	5798/SS10	5798/BH111/0.1/ S/1	5798/BH113/0.2/ S/1	5798/BH114/0.1/ S/1	5798/SS01
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Arsenic	mg/kg	9	7	11	6	6
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	20	19	20	20	24
Copper	mg/kg	34	29	14	20	26
Lead	mg/kg	21	71	26	35	42
Mercury	mg/kg	<0.1	0.1	0.1	<0.1	0.1
Nickel	mg/kg	12	9	3	8	21
Zinc	mg/kg	55	100	17	54	76

Acid Extractable metals in soil						
Our Reference:	UNITS	162213-54	162213-55	162213-56	162213-57	162213-58
Your Reference	---------- -	5798/SS04	5798/Dup101	5798/Dup102	5798/Dup103	5798/Dup104
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Arsenic	mg/kg	8	6	8	7	8
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	21	34	18	20	18
Copper	mg/kg	21	26	21	18	28
Lead	mg/kg	22	38	40	20	18
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	11	27	8	11	11
Zinc	mg/kg	290	82	70	290	49

Acid Extractable metals in soil						
Our Reference:	UNITS	162213-62	162213-63	162213-64	162213-65	162213-66
Your Reference	---------- -	5798/C01	5798/C02	5798/C03	5798/C04	5798/C05
Composite Reference	----------	1+2+3	4+5+6	7+8+9	10+11+12	13+14+15
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Arsenic	mg/kg	9	8	8	8	9
Cadmium	mg/kg	<0.4	<0.4	<0.4	<0.4	<0.4
Chromium	mg/kg	18	19	19	20	22
Copper	mg/kg	31	27	29	33	27
Lead	mg/kg	34	24	16	16	13
Mercury	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	9	12	15	13	16
Zinc	mg/kg	110	110	52	52	44

Acid Extractable metals in soil		
Our Reference:	UNITS	162213-67
Your Reference	---------- -	5798/C06
Composite Reference	----------	16+17+18
Date Sampled		10/02/2017
Type of sample		Soil
Date prepared	-	22/02/2017
Date analysed	-	23/02/2017
Arsenic	mg/kg	9
Cadmium	mg/kg	<0.4
Chromium	mg/kg	21
Copper	mg/kg	25
Lead	mg/kg	16
Mercury	mg/kg	<0.1
Nickel	mg/kg	13
Zinc	mg/kg	37

Moisture						
Our Reference:	UNITS	162213-8	162213-41	162213-46	162213-48	162213-53
Your Reference	---------- -	5798/SS10	5798/BH111/0.1/ S/1	5798/BH113/0.2/ S/1	5798/BH114/0.1/ S/1	5798/SS01
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Moisture	%	34	24	17	14	24

Moisture						
Our Reference:	UNITS	162213-54	162213-55	162213-56	162213-57	162213-58
Your Reference	---------- -	5798/SS04	5798/Dup101	5798/Dup102	5798/Dup103	5798/Dup104
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Moisture	%	15	21	17	16	17

Moisture						
Our Reference:	UNITS	162213-62	162213-63	162213-64	162213-65	162213-66
Your Reference	---------- -	5798/C01	5798/C02	5798/C03	5798/C04	5798/C05
Composite Reference	----------	1+2+3	4+5+6	7+8+9	10+11+12	13+14+15
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
Moisture	%	15	17	21	20	19

Moisture		
Our Reference:	UNITS	162213-67
Your Reference	---------- -	5798/C06
Composite Reference	----------	16+17+18
Date Sampled		10/02/2017
Type of sample		Soil
Date prepared	-	22/02/2017
Date analysed	-	23/02/2017
Moisture	%	19

Misc Inorg - Soil						
Our Reference:	UNITS	162213-9	162213-14	162213-21	162213-22	162213-23
Your Reference	---------- -	5798/BH103/0.25/S/1	5798/BH102/0.25/S/1	5798/BH102/0.5/S/1	5798/BH102/1.0/S/1	5798/BH102/2.0/S/1
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
pH 1:5 soil:water	pH Units	5.9	7.1	6.9	8.3	8.4
Electrical Conductivity 1:5 soil:water	µS/cm	110	71	85	56	65
Sulphate, SO4 1:5 soil:water	mg/kg	91	41	60	29	39

Misc Inorg - Soil						
Our Reference:	UNITS	162213-24	162213-25	162213-26	162213-42	162213-43
Your Reference	---------- -	5798/BH103/0.5/S/1	5798/BH103/1.5/S/1	5798/BH103/2.5/S/1	5798/BH111/0.3/S/1	5798/BH111/0.6/S/1
Composite Reference	----------	-	-	-	-	-
Date Sampled		10/02/2017	10/02/2017	10/02/2017	10/02/2017	10/02/2017
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/02/2017	22/02/2017	22/02/2017	22/02/2017	22/02/2017
Date analysed	-	23/02/2017	23/02/2017	23/02/2017	23/02/2017	23/02/2017
pH 1:5 soil:water	pH Units	5.8	8.8	8.9	6.8	6.8
Electrical Conductivity 1:5 soil:water	µS/cm	170	240	180	47	54
Sulphate, SO4 1:5 soil:water	mg/kg	140	20	<10	<10	54

Asbestos ID - materials		
Our Reference:	UNITS	162213-59
Your Reference	---------- -	5798/ASB101
Composite Reference	----------	-
Date Sampled		10/02/2017
Type of sample		Material
Date analysed	-	27/02/2017
Mass / Dimension of Sample	-	33x30x5mm
Sample Description	-	Grey compressed fibre cement material
Asbestos ID in materials	-	Chrysotile asbestos detected Amosite asbestos detected

Method ID	Methodology Summary
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater.
Org-016	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS. Water samples are analysed directly by purge and trap GC-MS. F1 = (C6-C10)-BTEX as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater. Note, the Total +ve Xylene PQL is reflective of the lowest individual PQL and is therefore "Total +ve Xylenes" is simply a sum of the positive individual Xylenes.
Org-014	Soil samples are extracted with methanol and spiked into water prior to analysing by purge and trap GC-MS.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis.
Org-003	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-FID. F2 = (>C10-C16)-Naphthalene as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater (HSLs Tables 1A (3, 4)). Note Naphthalene is determined from the VOC analysis. Note, the Total +ve TRH PQL is reflective of the lowest individual PQL and is therefore "Total +ve TRH" is simply a sum of the positive individual TRH fractions (>C10-C40).
Org-012	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS. Benzo(a)pyrene TEQ as per NEPM B1 Guideline on Investigation Levels for Soil and Groundwater - 2013. For soil results:- 1. 'TEQ PQL' values are assuming all contributing PAHs reported as <PQL are actually at the PQL. This is the most conservative approach and can give false positive TEQs given that PAHs that contribute to the TEQ calculation may not be present. 2. 'TEQ zero' values are assuming all contributing PAHs reported as <PQL are zero. This is the least conservative approach and is more susceptible to false negative TEQs when PAHs that contribute to the TEQ calculation are present but below PQL. 3. 'TEQ half PQL' values are assuming all contributing PAHs reported as <PQL are half the stipulated PQL. Hence a mid-point between the most and least conservative approaches above. Note, the Total +ve PAHs PQL is reflective of the lowest individual PQL and is therefore" Total +ve PAHs" is simply a sum of the positive individual PAHs.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Org-005	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's. Note, the Total +ve reported DDD+DDE+DDT PQL is reflective of the lowest individual PQL and is therefore simply a sum of the positive individually report DDD+DDE+DDT.
Org-008	Soil samples are extracted with dichloromethane/acetone and waters with dichloromethane and analysed by GC with dual ECD's.
Metals-020	Determination of various metals by ICP-AES.
Metals-021	Determination of Mercury by Cold Vapour AAS.
Inorg-008	Moisture content determined by heating at 105+/-5 °C for a minimum of 12 hours.
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.

Method ID	Methodology Summary
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.
ASB-001	Asbestos ID - Qualitative identification of asbestos in bulk samples using Polarised Light Microscopy and Dispersion Staining Techniques including Synthetic Mineral Fibre and Organic Fibre as per Australian Standard 4964-2004.

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/02/2017	[NT]	[NT]	LCS-3	22/02/2017
Date analysed	-			23/02/2017	[NT]	[NT]	LCS-3	23/02/2017
TRHC$_6$ - C$_9$	mg/kg	25	Org-016	<25	[NT]	[NT]	LCS-3	97%
TRHC$_6$ - C$_{10}$	mg/kg	25	Org-016	<25	[NT]	[NT]	LCS-3	97%
Benzene	mg/kg	0.2	Org-016	<0.2	[NT]	[NT]	LCS-3	83%
Toluene	mg/kg	0.5	Org-016	<0.5	[NT]	[NT]	LCS-3	91%
Ethylbenzene	mg/kg	1	Org-016	<1	[NT]	[NT]	LCS-3	102%
m+p-xylene	mg/kg	2	Org-016	<2	[NT]	[NT]	LCS-3	105%
o-Xylene	mg/kg	1	Org-016	<1	[NT]	[NT]	LCS-3	108%
naphthalene	mg/kg	1	Org-014	<1	[NT]	[NT]	[NR]	[NR]
Surrogate aaa-Trifluorotoluene	%		Org-016	95	[NT]	[NT]	LCS-3	101%

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/02/2017	[NT]	[NT]	LCS-3	22/02/2017
Date analysed	-			22/02/2017	[NT]	[NT]	LCS-3	22/02/2017
TRHC$_{10}$ - C$_{14}$	mg/kg	50	Org-003	<50	[NT]	[NT]	LCS-3	94%
TRHC$_{15}$ - C$_{28}$	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-3	94%
TRHC$_{29}$ - C$_{36}$	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-3	91%
TRH>C$_{10}$-C$_{16}$	mg/kg	50	Org-003	<50	[NT]	[NT]	LCS-3	94%
TRH>C$_{16}$-C$_{34}$	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-3	94%
TRH>C$_{34}$-C$_{40}$	mg/kg	100	Org-003	<100	[NT]	[NT]	LCS-3	91%
Surrogate o-Terphenyl	%		Org-003	86	[NT]	[NT]	LCS-3	85%

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/02/2017	[NT]	[NT]	LCS-3	22/02/2017
Date analysed	-			23/02/2017	[NT]	[NT]	LCS-3	23/02/2017
Naphthalene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-3	99%
Acenaphthylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Acenaphthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Fluorene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-3	104%
Phenanthrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-3	109%
Anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Fluoranthene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-3	114%
Pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-3	117%
Benzo(a)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Chrysene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	LCS-3	105%
Benzo(b,j +k)fluoranthene	mg/kg	0.2	Org-012	<0.2	[NT]	[NT]	[NR]	[NR]

QUALITY CONTROL PAHs in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Benzo(a)pyrene	mg/kg	0.05	Org-012	<0.05	[NT]	[NT]	LCS-3	88%
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Dibenzo(a,h)anthracene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Benzo(g,h,i)perylene	mg/kg	0.1	Org-012	<0.1	[NT]	[NT]	[NR]	[NR]
Surrogate p-Terphenyl-d14	%		Org-012	118	[NT]	[NT]	LCS-3	128%
QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/02/2017	162213-8	22/02/2017 || 22/02/2017	LCS-3	22/02/2017
Date analysed	-			23/02/2017	162213-8	23/02/2017 || 23/02/2017	LCS-3	23/02/2017
HCB	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
alpha-BHC	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	93%
gamma-BHC	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
beta-BHC	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	99%
Heptachlor	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	96%
delta-BHC	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Aldrin	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	93%
Heptachlor Epoxide	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	96%
gamma-Chlordane	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
alpha-chlordane	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Endosulfan I	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
pp-DDE	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	95%
Dieldrin	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	103%
Endrin	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	124%
pp-DDD	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	97%
Endosulfan II	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
pp-DDT	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Endrin Aldehyde	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Endosulfan Sulphate	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	LCS-3	121%
Methoxychlor	mg/kg	0.1	Org-005	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Surrogate TCMX	%		Org-005	95	162213-8	99 || 100 || RPD: 1	LCS-3	96%

QUALITY CONTROL Organophosphorus Pesticides	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date extracted	-			22/02/2017	162213-8	22/02/2017 || 22/02/2017	LCS-3	22/02/2017
Date analysed	-			23/02/2017	162213-8	23/02/2017 || 23/02/2017	LCS-3	23/02/2017
Azinphos-methyl (Guthion)	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Bromophos-ethyl	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Chlorpyriphos	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	LCS-3	93%
Chlorpyriphos-methyl	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Diazinon	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Dichlorvos	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	LCS-3	89%
Dimethoate	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	[NR]	[NR]
Ethion	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	LCS-3	99%
Fenitrothion	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	LCS-3	101%
Malathion	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	LCS-3	100%
Parathion	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	LCS-3	90%
Ronnel	mg/kg	0.1	Org-008	<0.1	162213-8	<0.1 || <0.1	LCS-3	88%
Surrogate TCMX	%		Org-008	95	162213-8	99 || 100 || RPD: 1	LCS-3	94%

QUALITY CONTROL Acid Extractable metals in soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			22/02/2017	162213-8	22/02/2017 || 22/02/2017	LCS-3	22/02/2017
Date analysed	-			23/02/2017	162213-8	23/02/2017 || 23/02/2017	LCS-3	23/02/2017
Arsenic	mg/kg	4	Metals-020	<4	162213-8	9 || 9 || RPD: 0	LCS-3	110%
Cadmium	mg/kg	0.4	Metals-020	<0.4	162213-8	<0.4 || <0.4	LCS-3	100%
Chromium	mg/kg	1	Metals-020	<1	162213-8	20 || 20 || RPD: 0	LCS-3	106%
Copper	mg/kg	1	Metals-020	<1	162213-8	34 || 33 || RPD: 3	LCS-3	106%
Lead	mg/kg	1	Metals-020	<1	162213-8	21 || 21 || RPD: 0	LCS-3	97%
Mercury	mg/kg	0.1	Metals-021	<0.1	162213-8	<0.1 || <0.1	LCS-3	92%
Nickel	mg/kg	1	Metals-020	<1	162213-8	12 || 12 || RPD: 0	LCS-3	95%
Zinc	mg/kg	1	Metals-020	<1	162213-8	55 || 54 || RPD: 2	LCS-3	98%

QUALITY CONTROL Misc Inorg - Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			22/02/2017	[NT]	[NT]	LCS-1	22/02/2017
Date analysed	-			22/02/2017	[NT]	[NT]	LCS-1	22/02/2017
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	[NT]	[NT]	LCS-1	102%
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	[NT]	[NT]	LCS-1	105%
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	[NT]	[NT]	LCS-1	104%

QUALITY CONTROL vTRH(C6-C10)/BTEXN in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	162213-53	22/02/2017 || 22/02/2017
Date analysed	-	162213-53	23/02/2017 || 23/02/2017
TRHC$_6$ - C$_9$	mg/kg	162213-53	<25 || <25
TRHC$_6$ - C$_{10}$	mg/kg	162213-53	<25 || <25
Benzene	mg/kg	162213-53	<0.2 || <0.2
Toluene	mg/kg	162213-53	<0.5 || <0.5
Ethylbenzene	mg/kg	162213-53	<1 || <1
m+p-xylene	mg/kg	162213-53	<2 || <2
o-Xylene	mg/kg	162213-53	<1 || <1
naphthalene	mg/kg	162213-53	<1 || <1
Surrogate aaa-Trifluorotoluene	%	162213-53	82 || 94 || RPD: 14

QUALITY CONTROL svTRH (C10-C40) in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	162213-53	22/02/2017 || 22/02/2017
Date analysed	-	162213-53	22/02/2017 || 22/02/2017
TRHC$_{10}$ - C$_{14}$	mg/kg	162213-53	<50 || <50
TRHC$_{15}$ - C$_{28}$	mg/kg	162213-53	<100 || <100
TRHC$_{29}$ - C$_{36}$	mg/kg	162213-53	<100 || <100
TRH>C$_{10}$-C$_{16}$	mg/kg	162213-53	<50 || <50
TRH>C$_{16}$-C$_{34}$	mg/kg	162213-53	<100 || <100
TRH>C$_{34}$-C$_{40}$	mg/kg	162213-53	<100 || <100
Surrogate o-Terphenyl	%	162213-53	88 || 88 || RPD: 0

QUALITY CONTROL PAHs in Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	162213-53	22/02/2017 || 22/02/2017
Date analysed	-	162213-53	23/02/2017 || 23/02/2017
Naphthalene	mg/kg	162213-53	<0.1 || <0.1
Acenaphthylene	mg/kg	162213-53	<0.1 || <0.1
Acenaphthene	mg/kg	162213-53	<0.1 || <0.1
Fluorene	mg/kg	162213-53	<0.1 || <0.1
Phenanthrene	mg/kg	162213-53	<0.1 || <0.1
Anthracene	mg/kg	162213-53	<0.1 || <0.1
Fluoranthene	mg/kg	162213-53	<0.1 || <0.1
Pyrene	mg/kg	162213-53	<0.1 || <0.1
Benzo(a)anthracene	mg/kg	162213-53	<0.1 || <0.1
Chrysene	mg/kg	162213-53	<0.1 || <0.1
Benzo(b,j+k)fluoranthene	mg/kg	162213-53	<0.2 || <0.2
Benzo(a)pyrene	mg/kg	162213-53	<0.05 || <0.05
Indeno(1,2,3-c,d)pyrene	mg/kg	162213-53	<0.1 || <0.1
Dibenzo(a,h)anthracene	mg/kg	162213-53	<0.1 || <0.1
Benzo(g,h,i)perylene	mg/kg	162213-53	<0.1 || <0.1
Surrogate p-Terphenyl-d14	%	162213-53	94 || 101 || RPD: 7

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	162213-53	22/02/2017 || 22/02/2017
Date analysed	-	162213-53	23/02/2017 || 23/02/2017
HCB	mg/kg	162213-53	<0.1 || <0.1
alpha-BHC	mg/kg	162213-53	<0.1 || <0.1
gamma-BHC	mg/kg	162213-53	<0.1 || <0.1
beta-BHC	mg/kg	162213-53	<0.1 || <0.1
Heptachlor	mg/kg	162213-53	<0.1 || <0.1
delta-BHC	mg/kg	162213-53	<0.1 || <0.1
Aldrin	mg/kg	162213-53	<0.1 || <0.1
Heptachlor Epoxide	mg/kg	162213-53	<0.1 || <0.1
gamma-Chlordane	mg/kg	162213-53	<0.1 || <0.1
alpha-chlordane	mg/kg	162213-53	<0.1 || <0.1
Endosulfan I	mg/kg	162213-53	<0.1 || <0.1
pp-DDE	mg/kg	162213-53	<0.1 || <0.1
Dieldrin	mg/kg	162213-53	<0.1 || <0.1
Endrin	mg/kg	162213-53	<0.1 || <0.1
pp-DDD	mg/kg	162213-53	<0.1 || <0.1
Endosulfan II	mg/kg	162213-53	<0.1 || <0.1
pp-DDT	mg/kg	162213-53	<0.1 || <0.1
Endrin Aldehyde	mg/kg	162213-53	<0.1 || <0.1
Endosulfan Sulphate	mg/kg	162213-53	<0.1 || <0.1

QUALITY CONTROL Organochlorine Pesticides in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Methoxychlor	mg/kg	162213-53	<0.1 || <0.1
Surrogate TCMX	%	162213-53	99 || 98 || RPD: 1
QUALITY CONTROL Organophosphorus Pesticides	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date extracted	-	162213-53	22/02/2017 || 22/02/2017
Date analysed	-	162213-53	23/02/2017 || 23/02/2017
Azinphos-methyl (Guthion)	mg/kg	162213-53	<0.1 || <0.1
Bromophos-ethyl	mg/kg	162213-53	<0.1 || <0.1
Chlorpyriphos	mg/kg	162213-53	<0.1 || <0.1
Chlorpyriphos-methyl	mg/kg	162213-53	<0.1 || <0.1
Diazinon	mg/kg	162213-53	<0.1 || <0.1
Dichlorvos	mg/kg	162213-53	<0.1 || <0.1
Dimethoate	mg/kg	162213-53	<0.1 || <0.1
Ethion	mg/kg	162213-53	<0.1 || <0.1
Fenitrothion	mg/kg	162213-53	<0.1 || <0.1
Malathion	mg/kg	162213-53	<0.1 || <0.1
Parathion	mg/kg	162213-53	<0.1 || <0.1
Ronnel	mg/kg	162213-53	<0.1 || <0.1
Surrogate TCMX	%	162213-53	99 || 98 || RPD: 1
QUALITY CONTROL Acid Extractable metals in soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	162213-53	22/02/2017 || 22/02/2017
Date analysed	-	162213-53	23/02/2017 || 23/02/2017
Arsenic	mg/kg	162213-53	6 || 8 || RPD: 29
Cadmium	mg/kg	162213-53	<0.4 || <0.4
Chromium	mg/kg	162213-53	24 || 23 || RPD: 4
Copper	mg/kg	162213-53	26 || 27 || RPD: 4
Lead	mg/kg	162213-53	42 || 40 || RPD: 5
Mercury	mg/kg	162213-53	0.1 || 0.1 || RPD: 0
Nickel	mg/kg	162213-53	21 || 19 || RPD: 10
Zinc	mg/kg	162213-53	76 || 76 || RPD: 0

QUALITY CONTROL Misc Inorg - Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	[NT]	[NT]	162213-14	22/02/2017
Date analysed	-	[NT]	[NT]	162213-14	22/02/2017
pH 1:5 soil:water	pH Units	[NT]	[NT]	[NR]	[NR]
Electrical Conductivity 1:5 soil:water	µS/cm	[NT]	[NT]	[NR]	[NR]
Sulphate, SO4 1:5 soil:water	mg/kg	[NT]	[NT]	162213-14	94%

QUALITY CONTROL Misc Inorg - Soil	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	162213-9	22/02/2017 || 22/02/2017
Date analysed	-	162213-9	23/02/2017 || 23/02/2017
pH 1:5 soil:water	pH Units	162213-9	5.9 || 6.0 || RPD: 2
Electrical Conductivity 1:5 soil:water	µS/cm	162213-9	110 || 100 || RPD: 10
Sulphate, SO4 1:5 soil:water	mg/kg	162213-9	91 || 70 || RPD: 26

Report Comments:

Asbestos ID was analysed by Approved Identifier: Lucy Zhu
Asbestos ID was authorised by Approved Signatory: Paul Ching

INS: Insufficient sample for this test
NR: Test not required
<: Less than
PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than
NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike : A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample) : This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

12 Attachment F – Laboratory Test Certificate (CBR)

resource laboratories
AGGREGATE, ROCK, AND SOIL TESTING
ABN: 25 131 532 020
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Test Report

Customer: Martens & Associates Pty Ltd
Job number: 17-0009
Project: P1705798
Report number: 1
Location: Kosovich Place, Cecil Park, NSW
Page: 1 of 1

California Bearing Ratio

Sampling method: Samples tested as received
Test method(s): AS 1289.1.1, 2.1.1, 5.1.1, 6.1.1

	Results			
Laboratory sample no.	10608	10609	10610	
Customer sample no.	5798/BH101/ CBR01/0.2-0.6	5798/BH102/ CBR02/0.2-0.6	5798/BH103/ CBR03/0.2-0.6	
Date sampled	10/02/2017	10/02/2017	10/02/2017	
Material description	SILTY CLAY, trace of gravel, brown mottled grey	SILTY CLAY, trace of gravel and sand, brown	SILTY CLAY, trace of gravel and sand, brown	
Maximum dry density (t/m^3)	1.58	1.65	1.61	
Optimum moisture content (%)	21.1	19.4	20.3	
Field moisture content (%)	n/a	n/a	n/a	
Oversize retained on 19.0mm sieve (%)	0	0	0	
Oversize included (Y/N)	N	N	N	
Dry density before soak (t/m^3)	1.54	1.62	1.58	
Dry density after soak (t/m^3)	1.52	1.59	1.54	
Moisture content before soak (%)	21.5	19.5	20.2	
Moisture content after soak (%)	25.3	22.3	24.7	
Moisture content after test - top 30mm (%)	26.2	23.6	28.4	
Moisture content after test - remaining depth (%)	24.0	21.1	23.0	
Density ratio before soaking (%)	97.5	98.0	98.0	
Moisture ratio before soaking (%)	102.0	100.5	99.5	
Period of soaking (days)	4	4	4	
Compactive effort	Standard	Standard	Standard	
Mass of surcharge applied (kg)	4.5	4.5	4.5	
Swell after soaking (%)	2.0	1.5	3.0	
Penetration (mm)	2.5	5.0	2.5	
CBR Value (%)	**4.5**	**6**	**2.5**	

Notes: Specified LDR: 98 ±1%

Approved Signatory: E. Maldonado **Date:** 28/02/2017

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025.

NATA Accredited Laboratory Number: **17062**

13 Attachment G – General Geotechnical Recommendations

Geotechnical Recommendations

Important Recommendations About Your Site (1 of 2)

These general geotechnical recommendations have been prepared by Martens to help you deliver a safe work site, to comply with your obligations, and to deliver your project. Not all are necessarily relevant to this report but are included as general reference. Any specific recommendations made in the report will override these recommendations.

Batter Slopes

Excavations in soil and extremely low to very low strength rock exceeding 0.75 m depth should be battered back at grades of no greater than 1 Vertical (V) : 2 Horizontal (H) for temporary slopes (unsupported for less than 1 month) and 1 V : 3 H for longer term unsupported slopes.

Vertical excavation may be carried out in medium or higher strength rock, where encountered, subject to inspection and confirmation by a geotechnical engineer. Long term and short term unsupported batters should be protected against erosion and rock weathering due to, for example, stormwater run-off.

Batter angles may need to be revised depending on the presence of bedding partings or adversely oriented joints in the exposed rock, and are subject to on-site inspection and confirmation by a geotechnical engineer. Unsupported excavations deeper than 1.0 m should be assessed by a geotechnical engineer for slope instability risk.

Any excavated rock faces should be inspected during construction by a geotechnical engineer to determine whether any additional support, such as rock bolts or shotcrete, is required.

Earthworks

Earthworks should be carried out following removal of any unsuitable materials and in accordance with AS3798 (2007). A qualified geotechnical engineer should inspect the condition of prepared surfaces to assess suitability as foundation for future fill placement or load application.

Earthworks inspections and compliance testing should be carried out in accordance with Sections 5 and 8 of AS3798 (2007), with testing to be carried out by a National Association of Testing Authorities (NATA) accredited testing laboratory.

Excavations

All excavation work should be completed with reference to the *Work Health and Safety (Excavation Work) Code of Practice (2015)*, by Safe Work Australia. Excavations into rock may be undertaken as follows:

1. Extremely low to low strength rock - conventional hydraulic earthmoving equipment.

2. Medium strength or stronger rock - hydraulic earthmoving equipment with rock hammer or ripping tyne attachment.

Exposed rock faces and loose boulders should be monitored to assess risk of block / boulder movement, particularly as a result of excavation vibrations.

Fill

Subject to any specific recommendations provided in this report, any fill imported to site is to comprise approved material with maximum particle size of two thirds the final layer thickness. Fill should be placed in horizontal layers of not more than 300 mm loose thickness, however, the layer thickness should be appropriate for the adopted compaction plant.

Foundations

All exposed foundations should be inspected by a geotechnical engineer prior to footing construction to confirm encountered conditions satisfy design assumptions and that the base of all excavations is free from loose or softened material and water. Water that has ponded in the base of excavations and any resultant softened material is to be removed prior to footing construction.

Footings should be constructed with minimal delay following excavation. If a delay in construction is anticipated, we recommend placing a concrete blinding layer of at least 50 mm thickness in shallow footings or mass concrete in piers / piles to protect exposed foundations.

A geotechnical engineer should confirm any design bearing capacity values, by further assessment during construction, as necessary.

Shoring - Anchors

Where there is a requirement for either soil or rock anchors, or soil nailing, and these structures penetrate past a property boundary, appropriate permission from the adjoining land owner must be obtained prior to the installation of these structures.

Shoring - Permanent

Permanent shoring techniques may be used as an alternative to temporary shoring. The design of such structures should be in accordance with the findings of this report and any further testing recommended by this report. Permanent shoring may include [but not be limited to] reinforced block work walls, contiguous and semi contiguous pile walls, secant pile walls and soldier pile walls with or without reinforced shotcrete infill panels. The choice of shoring system will depend on the type of structure, project budget and site specific geotechnical conditions.

Permanent shoring systems are to be engineer designed and backfilled with suitable granular

material and free-draining drainage material. Backfill should be placed in maximum 100 mm thick layers compacted using a hand operated compactor. Care should be taken to ensure excessive compaction stresses are not transferred to retaining walls.

Shoring design should consider any surcharge loading from sloping / raised ground behind shoring structures, live loads, new structures, construction equipment, backfill compaction and static water pressures. All shoring systems shall be provided with adequate foundation designs.

Suitable drainage measures, such as geotextile enclosed 100 mm agricultural pipes embedded in free-draining gravel, should be included to redirect water that may collect behind the shoring structure to a suitable discharge point.

Shoring - Temporary

In the absence of providing acceptable excavation batters, excavations should be supported by suitably designed and installed temporary shoring / retaining structures to limit lateral deflection of excavation faces and associated ground surface settlements.

Soil Erosion Control

Removal of any soil overburden should be performed in a manner that reduces the risk of sedimentation occurring in any formal stormwater drainage system, on neighbouring land and in receiving waters. Where possible, this may be achieved by one or more of the following means:

1. Maintain vegetation where possible
2. Disturb minimal areas during excavation
3. Revegetate disturbed areas if possible

All spoil on site should be properly controlled by erosion control measures to prevent transportation of sediments off-site. Appropriate soil erosion control methods in accordance with Landcom (2004) shall be required.

Trafficability and Access

Consideration should be given to the impact of the proposed works and site subsurface conditions on trafficability within the site e.g. wet clay soils will lead to poor trafficability by tyred plant or vehicles.

Where site access is likely to be affected by any site works, construction staging should be organised such that any impacts on adequate access are minimised as best as possible.

Vibration Management

Where excavation is to be extended into medium or higher strength rock, care will be required when using a rock hammer to limit potential structural distress from excavation-induced vibrations where nearby structures may be affected by the works.

To limit vibrations, we recommend limiting rock hammer size and set frequency, and setting the hammer parallel to bedding planes and along defect planes, where possible, or as advised by a geotechnical engineer. We recommend limiting vibration peak particle velocities (PPV) caused by construction equipment or resulting from excavation at the site to 5 mm/s (AS 2187.2, 2006, Appendix J).

Waste – Spoil and Water

Soil to be disposed off-site should be classified in accordance with the relevant State Authority guidelines and requirements.

Any collected waste stormwater or groundwater should also be tested prior to discharge to ensure contaminant levels (where applicable) are appropriate for the nominated discharge location.

MA can complete the necessary classification and testing if required. Time allowance should be made for such testing in the construction program.

Water Management - Groundwater

If the proposed works are likely to intersect ephemeral or permanent groundwater levels, the management of any potential acid soil drainage should be considered. If groundwater tables are likely to be lowered, this should be further discussed with the relevant State Government Agency.

Water Management – Surface Water

All surface runoff should be diverted away from excavation areas during construction works and prevented from accumulating in areas surrounding any retaining structures, footings or the base of excavations.

Any collected surface water should be discharged into a suitable Council approved drainage system and not adversely impact downslope surface and subsurface conditions.

All site discharges should be passed through a filter material prior to release. Sump and pump methods will generally be suitable for collection and removal of accumulated surface water within any excavations.

Contingency Plan

In the event that proposed development works cause an adverse impact on geotechnical hazards, overall site stability or adjacent properties, the following actions are to be undertaken:

1. Works shall cease immediately.
2. The nature of the impact shall be documented and the reason(s) for the adverse impact investigated.
3. A qualified geotechnical engineer should be consulted to provide further advice in relation to the issue.

14 Attachment H – Notes Relating To This Report

Information

Important Information About Your Report (1 of 2)

These notes have been prepared by Martens to help you interpret and understand the limitations of your report. Not all are necessarily relevant to all reports but are included as general reference.

Engineering Reports - Limitations

The recommendations presented in this report are based on limited investigations and include specific issues to be addressed during various phases of the project. If the recommendations presented in this report are not implemented in full, the general recommendations may become inapplicable and Martens & Associates accept no responsibility whatsoever for the performance of the works undertaken.

Occasionally, sub-surface conditions between and below the completed boreholes or other tests may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact Martens & Associates.

Relative ground surface levels at borehole locations may not be accurate and should be verified by on-site survey.

Engineering Reports – Project Specific Criteria

Engineering reports are prepared by qualified personnel. They are based on information obtained, on current engineering standards of interpretation and analysis, and on the basis of your unique project specific requirements as understood by Martens. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the Client.

Where the report has been prepared for a specific design proposal (e.g. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (e.g. to a twenty storey building). Your report should not be relied upon, if there are changes to the project, without first asking Martens to assess how factors, which changed subsequent to the date of the report, affect the report's recommendations. Martens will not accept responsibility for problems that may occur due to design changes, if not consulted.

Engineering Reports – Recommendations

Your report is based on the assumption that site conditions, as may be revealed through selective point sampling, are indicative of actual conditions throughout an area. This assumption often cannot be substantiated until project implementation has commenced. Therefore your site investigation report recommendations should only be regarded as preliminary.

Only Martens, who prepared the report, are fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report, there is a risk that the report will be misinterpreted and Martens cannot be held responsible for such misinterpretation.

Engineering Reports – Use for Tendering Purposes

Where information obtained from investigations is provided for tendering purposes, Martens recommend that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document.

Martens would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Engineering Reports – Data

The report as a whole presents the findings of a site assessment and should not be copied in part or altered in any way.

Logs, figures, drawings *etc* are customarily included in a Martens report and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel), desktop studies and laboratory evaluation of field samples. These data should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Engineering Reports – Other Projects

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

Subsurface Conditions - General

Every care is taken with the report in relation to interpretation of subsurface conditions, discussion of geotechnical aspects, relevant standards and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions - the potential will depend partly on test point

(eg. excavation or borehole) spacing and sampling frequency, which are often limited by project imposed budgetary constraints.

- Changes in guidelines, standards and policy or interpretation of guidelines, standards and policy by statutory authorities.

- The actions of contractors responding to commercial pressures.

- Actual conditions differing somewhat from those inferred to exist, because no professional, no matter how qualified, can reveal precisely what is hidden by earth, rock and time.

  The actual interface between logged materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

If these conditions occur, Martens will be pleased to assist with investigation or providing advice to resolve the matter.

Subsurface Conditions - Changes

Natural processes and the activity of man create subsurface conditions. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Reports are based on conditions which existed at the time of the subsurface exploration / assessment.

Decisions should not be based on a report whose adequacy may have been affected by time. If an extended period of time has elapsed since the report was prepared, consult Martens to be advised how time may have impacted on the project.

Subsurface Conditions - Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those that were expected from the information contained in the report, Martens requests that it immediately be notified. Most problems are much more readily resolved at the time when conditions are exposed, rather than at some later stage well after the event.

Report Use by Other Design Professionals

To avoid potentially costly misinterpretations when other design professionals develop their plans based on a Martens report, retain Martens to work with other project professionals affected by the report. This may involve Martens explaining the report design implications and then reviewing plans and specifications produced to see how they have incorporated the report findings.

Subsurface Conditions – Geo-environmental Issues

Your report generally does not relate to any findings, conclusions, or recommendations about the potential for hazardous or contaminated materials existing at the site unless specifically required to do so as part of Martens' proposal for works.

Specific sampling guidelines and specialist equipment, techniques and personnel are typically used to perform geo-environmental or site contamination assessments. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Martens for information relating to such matters.

Responsibility

Geo-environmental reporting relies on interpretation of factual information based on professional judgment and opinion and has an inherent level of uncertainty attached to it and is typically far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded.

To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Martens to other parties but are included to identify where Martens' responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Martens closely and do not hesitate to ask any questions you may have.

Site Inspections

Martens will always be pleased to provide engineering inspection services for aspects of work to which this report relates. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site. Martens is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction.

Soil Data

Explanation of Terms (1 of 3)

Definitions

In engineering terms, soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material does not exhibit any visible rock properties and can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

The methods of description and classification of soils and rocks used in this report are typically based on Australian Standard 1726 and the Unified Soil Classification System (USCS) – refer Soil Data Explanation of Terms (2 of 3). In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

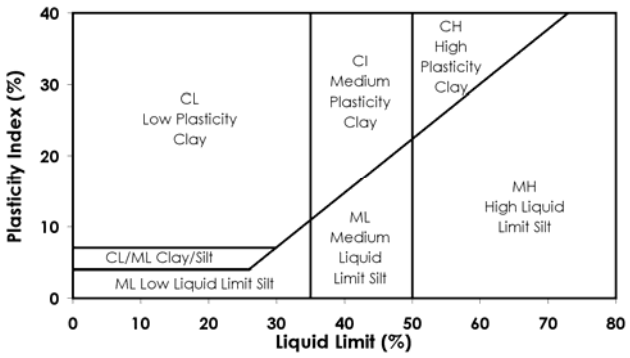
Particle Size

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (e.g. sandy CLAY). Unless otherwise stated, particle size is described in accordance with the following table.

Division	Subdivision	Size (mm)
BOULDERS		>200
COBBLES		63 to 200
GRAVEL	Coarse	20 to 63
	Medium	6 to 20
	Fine	2.36 to 6
SAND	Coarse	0.6 to 2.36
	Medium	0.2 to 0.6
	Fine	0.075 to 0.2
SILT		0.002 to 0.075
CLAY		< 0.002

Plasticity Properties

Plasticity properties of cohesive soils can be assessed in the field by tactile properties or by laboratory procedures.



Moisture Condition

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

Consistency of Cohesive Soils

Cohesive soils refer to predominantly clay materials.

Term	C_u (kPa)	Approx. SPT "N"	Field Guide
Very Soft	<12	2	A finger can be pushed well into the soil with little effort. Sample extrudes between fingers when squeezed in fist.
Soft	12 - 25	2 – 4	A finger can be pushed into the soil to about 25mm depth. Easily moulded in fingers.
Firm	25 - 50	4 – 8	The soil can be indented about 5mm with the thumb, but not penetrated. Can be moulded by strong pressure in the figures.
Stiff	50 - 100	8 – 15	The surface of the soil can be indented with the thumb, but not penetrated. Cannot be moulded by fingers.
Very Stiff	100 - 200	15 – 30	The surface of the soil can be marked, but not indented with thumb pressure. Difficult to cut with a knife. Thumbnail can readily indent.
Hard	> 200	> 30	The surface of the soil can be marked only with the thumbnail. Brittle. Tends to break into fragments.
Friable	-	-	Crumbles or powders when scraped by thumbnail.

Density of Granular Soils

Non-cohesive soils are classified on the basis of relative density, generally from standard penetration test (SPT) or Dutch cone penetrometer test (CPT) results as below:

Relative Density	%	SPT 'N' Value* (blows/300mm)	CPT Cone Value (q_c MPa)
Very loose	< 15	< 5	< 2
Loose	15 - 35	5 - 10	2 - 5
Medium dense	35 - 65	10 - 30	5 - 15
Dense	65 - 85	30 - 50	15 - 25
Very dense	> 85	> 50	> 25

* Values may be subject to corrections for overburden pressures and equipment type.

Minor Components

Minor components in soils may be present and readily detectable, but have little bearing on general geotechnical classification. Terms include:

Term	Assessment	Proportion of Minor component In:
Trace of	Presence just detectable by feel or eye. Soil properties little or no different to general properties of primary component.	Coarse grained soils: < 5 % Fine grained soils: < 15 %
With some	Presence easily detectable by feel or eye. Soil properties little different to general properties of primary component.	Coarse grained soils: 5 – 12 % Fine grained soils: 15 – 30 %

Soil Data

Explanation of Terms (2 of 3)

martens consulting engineers

Symbols for Soils and Other

SOILS


COBBLES/BOULDERS


GRAVEL (GP OR GW)


SILTY GRAVEL (GM)


CLAYEY GRAVEL (GC)


SAND (SP OR SW)


SILTY SAND (SM)


CLAYEY SAND (SC)


SILT (ML OR MH)


ORGANIC SILT (OH)


CLAY (CL, CI OR CH)


SILTY CLAY


SANDY CLAY


PEAT


TOPSOIL

OTHER


FILL


TALUS


ASPHALT


CONCRETE

Unified Soil Classification Scheme (USCS)

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 63 mm and basing fractions on estimated mass)					USCS	Primary Name
COARSE GRAINED SOILS More than 50 % of material less than 63 mm is larger than 0.075 mm	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm.	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Gravel
				Predominantly one size or a range of sizes with more intermediate sizes missing	GP	Gravel
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	GM	Silty Gravel
				Plastic fines (for identification procedures see CL below)	GC	Clayey Gravel
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of intermediate sizes missing.	SW	Sand
				Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Sand
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	SM	Silty Sand
				Plastic fines (for identification procedures see CL below)	SC	Clayey Sand

FINE GRAINED SOILS More than 50 % of material less than 63 mm is smaller than 0.075 mm	IDENTIFICATION PROCEDURES ON FRACTIONS < 0.2 MM					
	DRY STRENGTH (Crushing Characteristics)	DILATANCY	TOUGHNESS	DESCRIPTION	USCS	Primary Name
	None to Low	Quick to Slow	None	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	ML	Silt
	Medium to High	None	Medium	Inorganic clays of low to medium plasticity [1], gravely clays, sandy clays, silty clays, lean clays	CL [2]	Clay
	Low to Medium	Slow to Very Slow	Low	Organic slits and organic silty clays of low plasticity	OL	Organic Silt
	Low to Medium	Slow to Very Slow	Low to Medium	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	MH	Silt
	High	None	High	Inorganic clays of high plasticity, fat clays	CH	Clay
	Medium to High	None	Low to Medium	Organic clays of medium to high plasticity	OH	Organic Silt
HIGHLY ORGANIC SOILS	Readily identified by colour, odour, spongy feel and frequently by fibrous texture				Pt	Peat

Notes:

1. Low Plasticity – Liquid Limit W_L < 35 % Medium Plasticity – Liquid limit W_L 35 to 60 % High Plasticity - Liquid limit W_L > 60 %.
2. CI may be adopted for clay of medium plasticity to distinguish from clay of low plasticity.

Soil Data

Explanation of Terms (3 of 3)

Soil Agricultural Classification Scheme

In some situations, such as where soils are to be used for effluent disposal purposes, soils are often more appropriately classified in terms of traditional agricultural classification schemes. Where a Martens report provides agricultural classifications, these are undertaken in accordance with descriptions by Northcote, K.H. (1979) *The factual key for the recognition of Australian Soils*, Rellim Technical Publications, NSW, p 26 - 28.

Symbol	Field Texture Grade	Behaviour of moist bolus	Ribbon length	Clay content (%)
S	Sand	Coherence nil to very slight; cannot be moulded; single grains adhere to fingers	0 mm	< 5
LS	Loamy sand	Slight coherence; discolours fingers with dark organic stain	6.35 mm	5
CLS	Clayey sand	Slight coherence; sticky when wet; many sand grains stick to fingers; discolours fingers with clay stain	6.35mm - 1.3cm	5 - 10
SL	Sandy loam	Bolus just coherent but very sandy to touch; dominant sand grains are of medium size and are readily visible	1.3 - 2.5	10 - 15
FSL	Fine sandy loam	Bolus coherent; fine sand can be felt and heard	1.3 - 2.5	10 - 20
SCL$^-$	Light sandy clay loam	Bolus strongly coherent but sandy to touch, sand grains dominantly medium size and easily visible	2.0	15 - 20
L	Loam	Bolus coherent and rather spongy; smooth feel when manipulated but no obvious sandiness or silkiness; may be somewhat greasy to the touch if much organic matter present	2.5	25
Lfsy	Loam, fine sandy	Bolus coherent and slightly spongy; fine sand can be felt and heard when manipulated	2.5	25
SiL	Silt loam	Coherent bolus, very smooth to silky when manipulated	2.5	25 + > 25 silt
SCL	Sandy clay loam	Strongly coherent bolus sandy to touch; medium size sand grains visible in a finer matrix	2.5 - 3.8	20 - 30
CL	Clay loam	Coherent plastic bolus; smooth to manipulate	3.8 - 5.0	30 - 35
SiCL	Silty clay loam	Coherent smooth bolus; plastic and silky to touch	3.8 - 5.0	30- 35 + > 25 silt
FSCL	Fine sandy clay loam	Coherent bolus; fine sand can be felt and heard	3.8 - 5.0	30 - 35
SC	Sandy clay	Plastic bolus; fine to medium sized sands can be seen, felt or heard in a clayey matrix	5.0 - 7.5	35 - 40
SiC	Silty clay	Plastic bolus; smooth and silky	5.0 - 7.5	35 - 40 + > 25 silt
LC	Light clay	Plastic bolus; smooth to touch; slight resistance to shearing	5.0 - 7.5	35 - 40
LMC	Light medium clay	Plastic bolus; smooth to touch, slightly greater resistance to shearing than LC	7.5	40 - 45
MC	Medium clay	Smooth plastic bolus, handles like plasticine and can be moulded into rods without fracture, some resistance to shearing	> 7.5	45 - 55
HC	Heavy clay	Smooth plastic bolus; handles like stiff plasticine; can be moulded into rods without fracture; firm resistance to shearing	> 7.5	> 50

Rock Data

Explanation of Terms (1 of 2)

Symbols for Rock

SEDIMENTARY ROCK


BRECCIA


CONGLOMERATE


CONGLOMERATIC SANDSTONE


SANDSTONE/QUARTZITE


SILTSTONE


MUDSTONE/CLAYSTONE


SHALE


COAL


LIMESTONE


LITHIC TUFF

IGNEOUS ROCK


GRANITE


DOLERITE/BASALT

METAMORPHIC ROCK


SLATE, PHYLLITE, SCHIST


GNEISS


METASANDSTONE


METASILTSTONE


METAMUDSTONE

Definitions

Descriptive terms used for Rock by Martens are based on AS1726 and encompass rock substance, defects and mass.

Rock Substance In geotechnical engineering terms, rock substance is any naturally occurring aggregate of minerals and organic matter which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Rock substance is effectively homogeneous and may be isotropic or anisotropic.

Rock Defect Discontinuity or break in the continuity of a substance or substances.

Rock Mass Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

Degree of Weathering

Rock weathering is defined as the degree of decline in rock structure and grain property and can be determined in the field.

Term	Symbol	Definition
Residual soil[1]	Rs	Soil derived from the weathering of rock. The mass structure and substance fabric are no longer evident. There is a large change in volume but the soil has not been significantly transported.
Extremely weathered[1]	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly weathered[2]	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decrease compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original rock substance is no longer recognisable.
Moderately weathered[2]	MW	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Slightly weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh	FR	Rock substance unaffected by weathering

Notes:
1 The term "Distinctly Weathered" (DW) may be used to cover the range of substance weathering between EW and SW.
2 Rs and EW material is described using soil descriptive terms.

Rock Strength

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the loading. The test procedure is described by the International Society of Rock Mechanics.

Term	Is (50) MPa	Field Guide	Symbol
Very low	>0.03 ≤0.1	May be crumbled in the hand. Sandstone is 'sugary' and friable.	VL
Low	>0.1 ≤0.3	A piece of core 150mm long x 50mm diameter may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	L
Medium	>0.3 ≤1.0	A piece of core 150mm long x 50mm diameter can be broken by hand with considerable difficulty. Readily scored with a knife.	M
High	>1 ≤3	A piece of core 150mm long x 50mm diameter cannot be broken by unaided hands, can be slightly scratched or scored with a knife.	H
Very high	>3 ≤10	A piece of core 150mm long x 50mm diameter may be broken readily with hand held hammer. Cannot be scratched with pen knife.	VH
Extremely high	>10	A piece of core 150mm long x 50mm diameter is difficult to break with hand held hammer. Rings when struck with a hammer.	EH

Rock Data

Explanation of Terms (2 of 2)

Degree of Fracturing

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude fractures such as drilling breaks (DB) or handling breaks (HB).

Term	Description
Fragmented	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than core diameter.
Highly fractured	Core lengths are generally less than 20 mm to 40 mm with occasional fragments.
Fractured	Core lengths are mainly 30 mm to 100 mm with occasional shorter and longer sections.
Slightly fractured	Core lengths are generally 300 mm to 1000 mm, with occasional longer sections and sections of 100 mm to 300 mm.
Unbroken	The core does not contain any fractures.

Rock Core Recovery

TCR = Total Core Recovery

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100\%$$

SCR = Solid Core Recovery

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100\%$$

RQD = Rock Quality Designation

$$= \frac{\sum \text{Axial lengths of core} > 100\,\text{mm long}}{\text{Length of core run}} \times 100\%$$

Rock Strength Tests

▼ Point load strength Index (Is50) - axial test (MPa)

► Point load strength Index (Is50) - diametral test (MPa)

● Unconfined compressive strength (UCS) (MPa)

Defect Type Abbreviations and Descriptions

Defect Type (with inclination given)

BP	Bedding plane parting
FL	Foliation
CL	Cleavage
JT	Joint
FC	Fracture
SZ/SS	Sheared zone/ seam (Fault)
CZ/CS	Crushed zone/ seam
DZ/DS	Decomposed zone/ seam
FZ	Fractured Zone
IS	Infilled seam
VN	Vein
CO	Contact
HB	Handling break
DB	Drilling break

Planarity

Pl	Planar
Cu	Curved
Un	Undulating
St	Stepped
Ir	Irregular
Dis	Discontinuous

Roughness

Pol	Polished
Sl	Slickensided
Sm	Smooth
Ro	Rough
VR	Very rough

Thickness

Zone	> 100 mm
Seam	> 2 mm < 100 mm
Plane	< 2 mm

Coating or Filling

Cn	Clean
Sn	Stain
Ct	Coating
Vnr	Veneer
Fe	Iron Oxide
X	Carbonaceous
Qz	Quartzite
MU	Unidentified mineral

Inclination

Inclination of defect is measured from perpendicular to and down the core axis.
Direction of defect is measured clockwise (looking down core) from magnetic north.

Test, Drill and Excavation Methods

Explanation of Terms (1 of 3)

Sampling

Sampling is carried out during drilling or excavation to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling or excavation provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples may be taken by pushing a thin-walled sampling tube, e.g. U_{50} (50 mm internal diameter thin walled tube), into soils and withdrawing a soil sample in a relatively undisturbed state. Such samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Other sampling methods may be used. Details of the type and method of sampling are given in the report.

Drilling / Excavation Methods

The following is a brief summary of drilling and excavation methods currently adopted by the Company and some comments on their use and application.

Hand Excavation - in some situations, excavation using hand tools, such as mattock and spade, may be required due to limited site access or shallow soil profiles.

Hand Auger - the hole is advanced by pushing and rotating either a sand or clay auger, generally 75-100 mm in diameter, into the ground. The penetration depth is usually limited to the length of the auger pole; however extender pieces can be added to lengthen this.

Test Pits - these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils and, if it is safe to descend into the pit, collection of bulk disturbed samples. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (e.g. Pengo) - the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling (Push Tube) - the hole is advanced by pushing a 50 - 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength *etc.* is only marginally affected.

Continuous Spiral Flight Augers - the hole is advanced using 90 - 115 mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface or, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling - similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling - a continuous core sample is obtained using a diamond tipped core barrel of usually 50 mm internal diameter. Provided full core recovery is achieved (not always possible in very weak or fractured rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

In-situ Testing and Interpretation

Cone Penetrometer Testing (CPT)

Cone penetrometer testing (sometimes referred to as Dutch Cone) described in this report has been carried out using an electrical friction cone penetrometer.

The test is described in AS 1289.6.5.1-1999 (R2013). In the test, a 35 mm diameter rod with a cone tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system.

Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the push rod centre to an amplifier and recorder unit mounted on the control truck. As penetration occurs (at a rate of approximately 20 mm per second) the information is output on continuous chart recorders. The plotted results given in this report have been traced from the original records. The information provided on the charts comprises:

(i) Cone resistance (q_c) - the actual end bearing force divided by the cross sectional area of the cone, expressed in MPa.

(ii) Sleeve friction (q_f) - the frictional force of the sleeve divided by the surface area, expressed in kPa.

(iii) Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower (A) scale (0 - 5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main (B) scale (0 - 50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1 % - 2 % are commonly encountered in sands and very soft clays rising to 4 % - 10 % in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:

$$q_c \text{ (MPa)} = (0.4 \text{ to } 0.6)\ N \text{ (blows/300 mm)}$$

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:

$$q_c = (12 \text{ to } 18)\ C_u$$

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes *etc.* This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Standard Penetration Testing (SPT)

Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample.

The test procedure is described in AS 1289.6.3.1-2004. The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm penetration depth increments and the 'N' value is taken as the number of blows for the last two 150 mm depth increments (300 mm total penetration). In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued. The test results are reported in the following form:

(i) Where full 450 mm penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7 blows:

as 4, 6, 7
N = 13

(ii) Where the test is discontinued, short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm

as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

Dynamic Cone (Hand) Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods. Two relatively similar tests are used.

Perth sand penetrometer (PSP) - a 16 mm diameter flat ended rod is driven with a 9 kg hammer, dropping 600 mm. The test, described in AS 1289.6.3.3-1997 (R2013), was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

Cone penetrometer (DCP) - sometimes known as the Scala Penetrometer, a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm. The test, described in AS 1289.6.3.2-1997 (R2013), was developed initially for pavement sub-grade investigations, with correlations of the test results with California Bearing Ratio published by various Road Authorities.

Pocket Penetrometers

The pocket (hand) penetrometer (PP) is typically a light weight spring hand operated device with a stainless steel loading piston, used to estimate unconfined compressive strength, q_u, (UCS in kPa) of a fine grained soil in field conditions. In use, the free end of the piston is pressed into the soil at a uniform penetration rate until a line, engraved near the piston tip, reaches the soil surface level. The reading is taken from a gradation scale, which is attached to the piston via a built-in spring mechanism and calibrated to kilograms per square centimetre (kPa) UCS. The UCS measurements are used to evaluate consistency of the soil in the field moisture condition. The results may be used to assess the undrained shear strength, C_u, of fine grained soil using the approximate relationship:

$$q_u = 2 \times C_u.$$

It should be noted that accuracy of the results may be influenced by condition variations at selected test surfaces. Also, the readings obtained from the PP test are based on a small area of penetration and could give misleading results. They should not replace laboratory test results. The use of the results from this test is typically limited to an assessment of consistency of the soil in the field and not used directly for design of foundations.

Test Pit / Borehole Logs

Test pit / borehole log(s) presented herein are an engineering and / or geological interpretation of the subsurface conditions. Their reliability will depend to some extent on frequency of sampling and methods of excavation / drilling. Ideally, continuous undisturbed sampling or excavation / core drilling will provide the most reliable assessment but this is not always practicable, or possible to justify on economic grounds. In any case, the test pit / borehole logs represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of test pits / boreholes, the frequency of sampling and the possibility of other than 'straight line' variation between the test pits / boreholes.

Laboratory Testing

Laboratory testing is carried out in accordance with AS 1289 Methods of Testing Soil for Engineering Purposes. Details of the test procedure used are given on the individual report forms.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly, or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent prior weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes, which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Test, Drill and Excavation Methods

Explanation of Terms (3 of 3)

DRILLING / EXCAVATION METHOD

HA	Hand Auger	RD	Rotary Blade or Drag Bit	NQ	Diamond Core - 47 mm
AD/V	Auger Drilling with V-bit	RT	Rotary Tricone bit	NMLC	Diamond Core – 51.9 mm
AD/T	Auger Drilling with TC-Bit	RAB	Rotary Air Blast	HQ	Diamond Core – 63.5 mm
AS	Auger Screwing	RC	Reverse Circulation	HMLC	Diamond Core – 63.5 mm
HSA	Hollow Stem Auger	CT	Cable Tool Rig	DT	Diatube Coring
S	Excavated by Hand Spade	PT	Push Tube	NDD	Non-destructive digging
BH	Tractor Mounted Backhoe	PC	Percussion	PQ	Diamond Core - 83 mm
JET	Jetting	E	Tracked Hydraulic Excavator	X	Existing Excavation

SUPPORT

Nil	No support	S	Shotcrete	RB	Rock Bolt
C	Casing	Sh	Shoring	SN	Soil Nail
WB	Wash bore with Blade or Bailer	WR	Wash bore with Roller	T	Timbering

WATER

▽ Water level at date shown

▷ Water inflow

◁ Partial water loss

◀ Complete water loss

GROUNDWATER NOT OBSERVED (NO)	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED (NX)	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

PENETRATION / EXCAVATION RESISTANCE

L	Low resistance: Rapid penetration possible with little effort from the equipment used.
M	Medium resistance: Excavation possible at an acceptable rate with moderate effort from the equipment used.
H	High resistance: Further penetration possible at slow rate & requires significant effort equipment.
R	Refusal/ Practical Refusal. No further progress possible without risk of damage/ unacceptable wear to digging implement / machine.

These assessments are subjective and dependent on many factors, including equipment power, weight, condition of excavation or drilling tools, and operator experience.

SAMPLING

D	Small disturbed sample	W	Water Sample	C	Core sample
B	Bulk disturbed sample	G	Gas Sample	CONC	Concrete Core

U63 Thin walled tube sample - number indicates nominal undisturbed sample diameter in millimetres

TESTING

SPT 4,7,11 N=18	Standard Penetration Test to AS1289.6.3.1-2004 4,7,11 = Blows per 150mm. 'N' = Recorded blows per 300mm penetration following 150mm seating
DCP	Dynamic Cone Penetration test to AS1289.6.3.2-1997. 'n' = Recorded blows per 150mm penetration

Notes:

RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB 30/80mm	Hammer double bouncing on anvil after 80 mm penetration
N=18	Where practical refusal occurs, report blows and penetration for that interval

CPT	Static cone penetration test
CPTu	CPT with pore pressure (u) measurement
PP	Pocket penetrometer test expressed as instrument reading (kPa)
FP	Field permeability test over section noted
VS	Field vane shear test expressed as uncorrected shear strength (sv = peak value, sr = residual value)
PM	Pressuremeter test over section noted
PID	Photoionisation Detector reading in ppm
WPT	Water pressure tests

SOIL DESCRIPTION

Density		Consistency		Moisture	
VL	Very loose	VS	Very soft	D	Dry
L	Loose	S	Soft	M	Moist
MD	Medium dense	F	Firm	W	Wet
D	Dense	St	Stiff	Wp	Plastic limit
VD	Very dense	VSt	Very stiff	Wl	Liquid limit
		H	Hard		

ROCK DESCRIPTION

Strength		Weathering	
VL	Very low	EW	Extremely weathered
L	Low	HW	Highly weathered
M	Medium	MW	Moderately weathered
H	High	SW	Slightly weathered
VH	Very high	FR	Fresh
EH	Extremely high		