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GEOTECHNICAL INVESTIGATION
MOSS VALE AQUATIC CENTRE

FOR

WINGECARRIBEE SHIRE COUNCIL

PROJECT NO. 18476/1206C **FEBRUARY 2012**
REPORT NO. 12/0042

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1. INTRODUCTION

This report presents the results of a geotechnical investigation undertaken by SMEC Testing Services Pty Limited (STS) for the proposed new Moss Vale Aquatic Centre (the 'site'). Car parking and driveways are included in the development.

The purpose of the investigation was to:

- determine the subsurface conditions over the site,
- site classification to AS 2870,
- provide recommendations regarding the appropriate foundation system for the site including design parameters,
- address the issue of soil aggressiveness,
- provide retaining wall design parameters,
- give safe batter slopes,
- re use of site materials,
- site trafficability,
- determine the pavement thickness for the driveways and parking areas, and
- comment on site regrading.

The work was carried out at the request of Mr Bob Lewis of Wingecarribee Shire Council. The letter of appointment by Council is dated 20 December 2011 and referenced 6704/4.

Our scope of work did not include a contamination assessment of the site.

2. METHOD OF INVESTIGATION

2.1 Fieldwork

The fieldwork consisted of drilling ten (10) boreholes numbered BH1 to BH10 inclusive, at the locations shown on Drawing No. 12/0042. BH1 to BH6 were drilled to rock for foundation design purposes. BH7 to BH10 were drilled for pavement investigation purposes. The boreholes were drilled using an Edson RP70 drilling rig owned and operated by STS and were advanced using solid flight augers. In order to assist with determining soil strengths, Dynamic cone penetrometer (DCP) tests were carried out at each borehole location. Drilling operations were carried out by one of STS's experienced senior geologists who also logged the subsurface conditions encountered.

The subsurface conditions observed are recorded on the borehole logs in Appendix A. An explanation of the terms used on the logs is also given in Appendix A. Notes relating to geotechnical reports are also attached.

2.2 Laboratory Testing

In order to determine the pavement thickness, the California Bearing Ratio (CBR) of the pavement subgrade material was determined. The test was carried out on a sample compacted to a density ratio of 100% of the Standard maximum dry density.

In order to assess the soils for their aggressiveness selected representative soil samples were tested to determine the following:

- pH
- sulphate and chloride content.

Shrink/swell tests were carried out to assist with determining the classification of the site in accordance with AS 2870.

The detailed test report is given in Appendix B.

3. GEOLOGY AND SITE CONDITIONS

The Wollongong geological series sheet at a scale of 1:250,000 shows Triassie Age Ashfield Shale of the Wiananatta Group underlies the site near to the contact with Tertiary Age basalts and basamites. Ashfield Shale comprises shale and laminate.

At the time of the fieldwork, there was an existing swimming pool complex present on the site. Site vegetation consisted of large trees and shrubs. Council offices and oval are present in the adjoining properties.

The groundsurface falls about 2.5 to 3 metres towards the west.

4. SUBSURFACE CONDITIONS

When making an assessment of the subsurface conditions across a site from a limited number of boreholes there is the possibility that variations may occur between test locations. The data derived from the site investigation programme are extrapolated across the site to form a geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. The actual conditions at the site may differ from those inferred, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies.

The subsurface conditions generally consist of topsoi/ fill overlying silty clays and weathered shale and basalt. Where present, topsoil/fill was observed to depths of 0.4 to 2.7 metres. Underlying the topsoil/fill are natural silty clays to depths of 3.8 to 5.6 metres. The strength of these materials varied between firm to stiff and very stiff. Weathered basalt and shale were observed below depths of 3.8 to 5.8 metres. Auger refusal occurred in BH4 and BH6 at depths of 4.5 and 4.7 metres, respectively.

No groundwater was observed in the boreholes during the fieldwork.

5. DISCUSSION

5.1 Site Classification

The classification has been prepared in accordance with the guidelines set out in the "Residential Slabs and Footings" Code, AS2870 – 2011.

Results of the shrink swell testing are summarised below:

Location	Depth	Material Description	Shrink-Swell
BH2	1.3-1.5	Dark greyish brown silty clay	2.9
BH4	0.7-1.0	Grey brown silty clay	1.1

Because there are building and trees present, abnormal moisture conditions (AMC) prevail at the site (Refer to Section 1.3.3 of AS2870).

Because of the AMC and fill present the site is classified a *problem site (P).* Provided the recommendations given below are adopted, the site may be reclassified *highly reactive (H1).*

Foundation design and construction consistent with this classification shall be adopted as specified in the above reference standard and in accordance with the following design details.

5.2 Foundation Design

The existing fill is not considered suitable to support any foundations. All loads must be transferred to the underlying natural materials.

Footings that bear in firm to stiff natural silty clays may be proportioned using an allowable bearing pressure of 100 kPa. This value may be increased to 150 kPa and 300 kPa in stiff and very stiff materials respectively. In order to overcome the presence of the trees the procedures given in Appendices C and CH of AS2870-2011 must be adopted.

If a higher load carrying capacity is required, piers can be used to transfer the loads to the underlying stronger materials. Piers founded in the very stiff material may be proportioned using an allowable end bearing pressure of 450 kPa, provided their depth to diameter ratio exceeds a value of 4. An allowable adhesion of 20 kPa may be adopted for the portion of the shaft with in natural soils and below a depth of 0.75 metres. Piers founded in the weathered basalt and shale may be proportioned using an allowable end bearing pressure of 700 kPa. An adhesion value of 70 kPa may be used for the portion of the shaft within the weathered rock. When piers are founded on rock adhesion on the overlying soils must be ignored.

In order to ensure the bearing values given can be achieved, care should be taken to ensure the base of the excavations are free of all loose material. All excavations should be concreted as soon as possible, preferably immediately after excavation, cleaning, inspection and approval. Due regard must be given to possible water inflow into pier excavations. Pier excavations should not be left open overnight.

During construction it is recommended that the founding level be inspected by a geotechnical engineer to assess adequate bearing has been achieved.

5.3 Soil Aggressiveness

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of soil pH and the types of salts present, generally sulphates and chlorides. The values obtained during the testing are compared with Tables 6.4.2(C) and 6.5.2(C) in AS2159 – 2009 Piling – Design and Installation. The test results are summarised in Table 5.1.

TABLE 5.1 – TEST RESULT SUMMARY

Sample ID	pH	Soluble Sulphate (mg/kg)	Soluble Chloride (mg/kg)
S1	6.8	30	<20
S2	7.4	20	<20
S3	7.2	20	110
S4	7.5	<10	60
S5	6.8	20	<20
S6	7.1	20	<20
S7	7.7	<10	<20

The report results range between:

- pH - 6.8 to 7.7
- soluble SO_4 - <10 to 30 mg/kg (ppm)
- soluble chloride - <20 to 110 mg/kg (ppm)

A review of the durability aspects indicates that in AS2159 – 2009 criteria for piles in soils are expressed as parts per million (ppm). The soils on the site consist of low permeability silty clays and therefore, the soil conditions B are considered appropriate.

A comparison of the results to the criteria is given below:

- pH : minimum value of 6.8
- SO_4 : maximum value 30 ppm (criteria 5000 ppm)
- C1 : maximum value 110 ppm (criteria 5000 ppm)

The exposure classification for the onsite soils is non-aggressive for steel and concrete.

5.4 Pavement Design and Construction

The flexible pavement thickness has been determined using the procedures given in Report APRG21, titled "A guide to the design of new pavement for light traffic" published by ARRB Transport Research. We have assumed a 95% confidence level that the pavement will perform satisfactorily during its design life. A design traffic loading of 6×10^4

ESAs is considered appropriate for car parking areas and assumes traffic management will be put in place to prevent trucks using the area. For a subgrade CBR value of 3%, the suggested pavement thickness is a recommended minimum of 450 mm, made up as follows:

Material Type	Minimum Thickness (mm)
AC	30
Base Course	125
Subbase	295
Total	450

The sub-grade clays require stabilisation with 2% lime to a depth of 150mm. It should be noted that the field moisture content for some of the subgrade samples exceeded their optimum moisture content. This means that there may be excessive sugrade movement during pavement construction. If this occurs some subgrade replacement may be required. The extent to which this may be necessary can only be determined at the time of construction.

The designs given above assume adequate provisions have been made for both surface and subsurface water.

The clayey site soils, which will make up the pavement subgrade are reactive. They will therefore, be susceptible to shrinkage and swelling due to moisture content changes. If these subgrade soils are allowed to dry following compaction, it is probable that shrinkage will occur resulting in cracking. After placement of the pavement materials, the subgrade soils will moisten, resulting in swelling and partial loss of strength. It is therefore recommended that the subgrade be covered as soon as possible after completion of compaction in order to minimize the potential for evaporation and shrinkage to occur.

The subgrade materials should be compacted to a minimum density ratio of 100% of the Standard maximum dry density. Compaction should be verified by proof-rolling and insitu density tests. Base and subbase course materials should be compacted and tested to a minimum density ratio of 98% of the Modified maximum dry density. The level of compaction should be verified by insitu density testing.

All pavement materials used should comply with the Wingecarribee Shire Council requirements.

5.5 Site Preparation

The performance of the building slabs and pavements can not be guaranteed, unless the following procedures are adopted during the site earthworks:

- Remove any vegetation, topsoil and fill present. The exposed subgrade should be inspected by a geotechnical engineer who may wish to proof roll the exposed subgrade with a heavy, non vibrating roller to detect soft or wet areas. These areas should be excavated to competent material and then filled as detailed below.

- Fill the site to the underside of slab or pavement level, in layers not exceeding 200 mm loose thickness, compacted to achieve a minimum density ratio in the range of 98% of the Standard maximum dry density, at a moisture content within the rate of –2% to +2% of the optimum for the material adopted.

The onsite silty clays can become untrafficable during periods of wet weather.

The onsite materials are considered to be suitable for re use in the site earthworks, however, some drying prior to reuse may be required.

5.6 Batter Slopes

In the short term, dry cut slopes should remain stable at an angle of 1 to 1. In the long term dry cut slopes formed at an angle of 2(H) to 1(V) should remain stable. Slopes cut at this angle would be subject to erosion unless protected by topsoil and diversion drains at the crest of the slope. In order to use mowers to maintain cut slopes, an angle of 4(H) to 1(V) or flatter should be used.

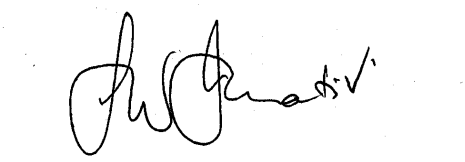
5.7 Retaining Walls

The parameters used to proportion the retaining walls depend on whether the walls can be permitted to deflect. For walls, which cannot be permitted to deflect, the "at rest" (K_o) conditions should be adopted. A value of 0.6 should be adopted. For walls that can be allowed to deflect, an active earth pressure coefficient (K_a) of 0.4 should be adopted. A passive earth pressure coefficient (K_p) of 2.5 may be used for the clays. A bulk density of 19 kN/m^3 may be used.

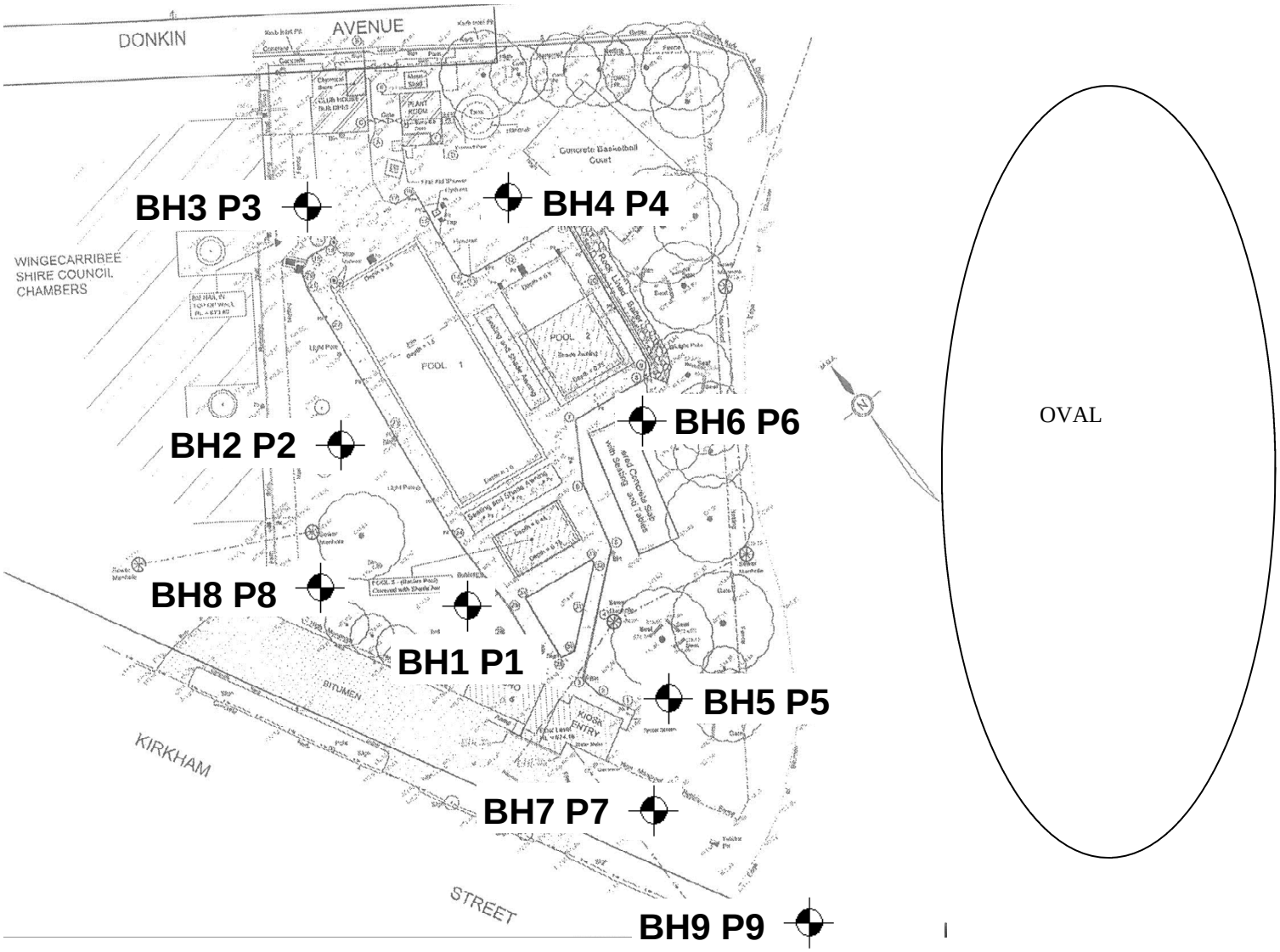
As with all retaining walls, the above coefficient must be adjusted for groundsurface slope, groundwater and external loads, such as buildings and vehicles.

6. FINAL COMMENTS

During construction should the subsurface conditions vary to those inferred in this report, a suitably experienced geotechnical engineer should review the design and recommendations given above to determine if any alterations are required.



Laurie Ihnativ, BE, MEngSc, MBA, FIE Aust.
Manager, SMEC Testing Services Pty Limited



SMEC TESTING SERVICES Pty. Ltd.	Scale: Unknown	Date: January 2012
Client: WINGECARRIBEE SHIRE COUNCIL		
GEOTECHNICAL INVESTIGATION **MOSS VALE AQUATIC CENTRE, KIRKHAM ST, MOSS VALE** **BOREHOLE & PENETROMETER LOCATIONS**	Project No. 18476/1206C Drawing No: 12/0042	

NOTES RELATING TO GEOTECHNICAL REPORTS

Introduction

These notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report.

When copies of reports are made, they should be reproduced in full.

Geotechnical Reports

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (eg. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (eg. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by SMEC Testing Services Pty Limited in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, SMEC Testing Services Pty Limited would be pleased to resolve the matter through further investigation, analysis or advice.

Unforeseen Conditions

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, SMEC Testing Services Pty Limited should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

Subsurface Information

Logs of a borehole, recovered core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

Supply of Geotechnical Information or Tendering Purposes

It is recommended tenderers are provided with as much geological and geotechnical information that is available and that where there are uncertainties regarding the ground conditions, prospective tenders should be provided with comments discussing the range of likely conditions in addition to the investigation data.

APPENDIX A

BOREHOLE LOGS & EXPLANATION SHEETS

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 1**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY CLAY: dark brown, low plasticity	CL	VERY STIFF	M
			FILL			
	S1 @ 0.6 m		SILTY CLAY: yellow brown with dark brown and light grey, medium plasticity, occasional gravel	CL	FIRM TO STIFF	M
		1.0				
			SILTY CLAY: yellow brown, medium to high plasticity	CL/CH	STIFF	M
					VERY STIFF	
		2.0				
	S2 @ 3.0 m	3.0				
		4.0				
		5.0				
			BASALT: dark grey/brown with orange brown, fine grained sand, occasional clay		EXTREMELY LOW STRENGTH	D
			BOREHOLE DISCONTINUED AT 6.0 M ON WEATHERED BASALT			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 2**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY C LAY: dark brown with occasional yellow brown, medium plasticity, trace of gravel	CL	FIRM TO STIFF AND STIFF	M
		1.0	FILL			
			SILTY CLAY: yellow brown/orange brown with occasional black, medium to high plasticity, occasional gravel	CL/CH	FIRM TO STIFF AND STIFF	M
	U50					
		2.0				
			SILTY CLAY: yellow brown, medium to high plasticity	CL/CH	VERY STIFF	M
		3.0				
		4.0				
		5.0				
			BASALT: orange brown with dark grey and light grey, fine grained sand, occasional clay		EXTREMELY LOW STRENGTH	D
			BOREHOLE DISCONTINUED AT 6.0 M ON WEATHERED BASALT			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 3**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY CLAY: dark brown with occasional yellow brown, medium to high plasticity, trace of gravel	CL/CH	VARIABLE FIRM AND STIFF	M
	S3 @ 1.5 m	1.0				
		2.0	FILL			
			SILTY CLAY: yellow brown, medium to high plasticity	CL/CH	VERY STIFF	M
		3.0				
			SILTY C LAY: yellow brown with light grey and occasional orange brown, medium to high plasticity	CL/CH	VERY STIFF	M
	S4 @ 4.0 m	4.0				
		5.0				
			BASALT: orange brown with light grey and dark grey, fine grained sand, clay seams		EXTREMELY LOW STRENGTH	D
			BOREHOLE DISCONTINUED AT 6.0 M ON WEATHERED BASALT			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale
Location: Refer to Drawing No.12/0042

Project No.: 18476/1206C
Date : January 19, 2012
Logged: JK

BOREHOLE NO.: BH 4

Sheet 1 of 1

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
	S5 @ 0.5 m		SILTY CLAY: dark grey/brown with orange brown specks, medium to high plasticity	CL/CH	FIRM TO STIFF	D-M
	U50	1.0	SILTY CLAY: orange brown with occasional dark grey/brown, medium to high plasticity	CL/CH	STIFF	M
		2.0	SILTY CLAY: yellow brown, medium to high plasticity	CL/CH	STIFF	M
					VERY STIFF	
		3.0				
		4.0	BASALT: orange brown with dark grey and light grey, fine grained sand		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 4.5 M ON WEATHERED BASALT			
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 5**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY CLAY: dark brown/grey, medium plasticity, trace of gravel	CL	FIRM TO STIFF	D-M
			FILL			
		1.0	SILTY CLAY: orange brown/yellow brown with dark brown, medium to high plasticity	CL/CH	FIRM TO STIFF	M
			SILTY CLAY: yellow brown, medium to high plasticity	CL/CH	STIFF	M
		2.0			VERY STIFF	
		3.0				
		4.0				
	S6 @ 4.5 m					
		5.0				
			SHALE: dark grey/brown, fine grained sand		EXTREMELY LOW STRENGTH	D
			BOREHOLE DISCONTINUED AT 6.0 M ON WEATHERED SHALE			

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 6**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY CLAY: dark brown/grey, medium to high plasticity	CL	STIFF	D-M
			TOPSOIL/FILL			
			SILTY CLAY: yellow brown with dark brown, medium to high plasticity	CL/CH	STIFF	M
		1.0			VERY STIFF	
		2.0				
	S7 @ 3.0 m	3.0	SILTY CLAY: light grey with orange brown, medium plasticity	CL	VERY STIFF	M-D
		4.0				
			SHALE: dark brown/grey, fine grained sand		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 4.7 M ON WEATHERED SHALE			
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 7**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SANDY GRAVEL: light brown, fine to medium grained FILL	GW	DENSE	D
			SILTY CLAY: dark brown, medium plasticity, occasional gravel FILL	CL	VERY STIFF	M
	B	1.0	SILTY CLAY: yellow brown with orange brown and light grey, medium to high plasticity	CL/CH	FIRM TO STIFF	M
			BOREHOLE DISCONTINUED AT 1.5 M		STIFF TO VERY STIFF	
		2.0				
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 8**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY CLAY: dark brown with occasional orange brown and light grey, medium plasticity	CL	FIRM TO STIFF	M
	B	1.0	FILL		VERY STIFF	
			BOREHOLE DISCONTINUED AT 1.5 M			
		2.0				
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 9**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY CLAY: light grey/brown, low plasticity, tree roots	CL	STIFF	D
			TOPSOIL			
			SILTY CLAY: yellow brown/orange brown, medium to high plasticity	CL/CH	STIFF	M
	B	1.0			VERY STIFF	
			BOREHOLE DISCONTINUED AT 1.5 M			
		2.0				
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Wingecarribee Shire Council	Project No.: 18476/1206C	**BOREHOLE NO.: BH 10**
Project: Moss Vale Aquatic Centre, Kirkham Street, Moss Vale	Date : January 19, 2012	Sheet 1 of 1
Location: Refer to Drawing No.12/0042	Logged: JK	

WATER TABLE	SAMPLES	DEPTH (m)	DESCRIPTION OF DRILLED PRODUCT (Soil type, colour, grain size, plasticity, minor components, observations)	SYMBOL	CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels)	MOISTURE
			SILTY CLAY: light grey/brown, low plasticity TOPSOIL/FILL	CL	FIRM TO STIFF	D
	B	1.0	SILTY CLAY: dark grey, medium to high plasticity	CL/CH	FIRM TO STIFF VERY STIFF	M
		2.0	BOREHOLE DISCONTINUED AT 1.5 M			
		3.0				
		4.0				
		5.0				

NOTES: D - disturbed sample U - undisturbed tube sample B - bulk sample
WT - level of water table or free water N - Standard Penetration Test (SPT)

See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS
Equipment: Edson RP70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Dynamic Cone Penetrometer Test Report

Project: MOSS VALE AQUATIC CENTRE, KIRKHAM STREET, MOSSVALE — Project No.: 18476/1206C
Client: WINGECARRIBEE SHIRE COUNCIL — Report No.: 12/0042
Address: PO Box 141, Moss Vale — Report Date: 23/1/2012
Test Method: AS 1289.6.3.2 — Page: 1 of 3

Site No.	P1	P2	P3	P4		P1	P2	P3	P4
Location	Refer to Drawing No. 12/0042	Refer to Drawing No. 12/0042	Refer to Drawing No. 12/0042	Refer to Drawing No. 12/0042					
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level					
Depth (m)	Penetration Resistance (blows / 150mm)				Depth (m)	Penetration Resistance (blows / 150mm)			
0.00 - 0.15	4	3	2	4	3.00 - 3.15	*	13	16	
0.15 - 0.30	9	4	1	3	3.15 - 3.30	*	14	18	
0.30 - 0.45	10	7	2	4	3.30 - 3.45	*	17	22	
0.45 - 0.60	5	7	2	4	3.45 - 3.60	*	22	R	
0.60 - 0.75	4	8	3	3	3.60 - 3.75	*	R		
0.75 - 0.90	3	4	4	5	3.75 - 3.90	*			
0.90 - 1.05	4	4	4	8	3.90 - 4.05	*			
1.05 - 1.20	4	3	5	8	4.05 - 4.20	*			
1.20 - 1.35	2	4	6	8	4.20 - 4.35	*			
1.35 - 1.50	4	4	8	6	4.35 - 4.50	8			
1.50 - 1.65	5	5	7	6	4.50 - 4.65	10			
1.65 - 1.80	5	6	10	8	4.65 - 4.80	11			
1.80 - 1.95	11	8	6	14	4.80 - 4.95	14			
1.95 - 2.10	16	10	9	8	4.95 - 5.10	17			
2.10 - 2.25	22	12	11	6	5.10 - 5.25	22			
2.25 - 2.40	R	9	5	12	5.25 - 5.40	R			
2.40 - 2.55	*	7	7	15	5.40 - 5.55				
2.55 - 2.70	*	9	6	22	5.55 - 5.70				
2.70 - 2.85	*	10	8	R	5.70 - 5.85				
2.85 - 3.00	*	11	10		5.85 - 6.00				

Remarks: * = Pre-drilled hole prior to testing

Approved Signatory.
Technician: JK — Laurie Ihnativ - Manager

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Dynamic Cone Penetrometer Test Report

Project: MOSS VALE AQUATIC CENTRE, KIRKHAM STREET, MOSSVALE — Project No.: 18476/1206C
Client: WINGECARRIBEE SHIRE COUNCIL — Report No.: 12/0042
Address: PO Box 141, Moss Vale — Report Date: 23/1/2012
Test Method: AS 1289.6.3.2 — Page: 2 of 3

Site No.	P5	P6	P7	P8		P5	P6	P7	P8
Location	Refer to Drawing No. 12/0042	Refer to Drawing No. 12/0042	Refer to Drawing No. 12/0042	Refer to Drawing No. 12/0042					
Starting Level	Surface Level	Surface Level	Surface Level	Surface Level					
Depth (m)	Penetration Resistance (blows / 150mm)				Depth (m)	Penetration Resistance (blows / 150mm)			
0.00 - 0.15	5	4	12	2	3.00 - 3.15	22			
0.15 - 0.30	7	7	10	8	3.15 - 3.30	R			
0.30 - 0.45	6	8	10	8	3.30 - 3.45	*			
0.45 - 0.60	5	9	9	5	3.45 - 3.60	*			
0.60 - 0.75	4	10	6	5	3.60 - 3.75	*			
0.75 - 0.90	4	6	4	6	3.75 - 3.90	*			
0.90 - 1.05	4	10	3	4	3.90 - 4.05	*			
1.05 - 1.20	3	12	3	9	4.05 - 4.20	*			
1.20 - 1.35	4	12	5	7	4.20 - 4.35	*			
1.35 - 1.50	5	18	8	7	4.35 - 4.50	6			
1.50 - 1.65	6	22	9	10	4.50 - 4.65	9			
1.65 - 1.80	6	R	D	D	4.65 - 4.80	11			
1.80 - 1.95	8				4.80 - 4.95	13			
1.95 - 2.10	9				4.95 - 5.10	18			
2.10 - 2.25	9				5.10 - 5.25	22			
2.25 - 2.40	10				5.25 - 5.40	R			
2.40 - 2.55	12				5.40 - 5.55				
2.55 - 2.70	13				5.55 - 5.70				
2.70 - 2.85	15				5.70 - 5.85				
2.85 - 3.00	16				5.85 - 6.00				

Remarks: * = Pre-drilled hole prior to testing

Approved Signatory.
Technician: JK — Laurie Ihnativ - Manager

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Dynamic Cone Penetrometer Test Report

Project: MOSS VALE AQUATIC CENTRE, KIRKHAM STREET, MOSSVALE — Project No.: 18476/1206C
Client: WINGECARRIBEE SHIRE COUNCIL — Report No.: 12/0042
Address: PO Box 141, Moss Vale — Report Date: 23/1/2012
Test Method: AS 1289.6.3.2 — Page: 3 of 3

Site No.	P9	P10				P9	P10		
Location	Refer to Drawing No. 12/0042	Refer to Drawing No. 12/0042							
Starting Level	Surface Level	Surface Level							
Depth (m)	Penetration Resistance (blows / 150mm)				Depth (m)	Penetration Resistance (blows / 150mm)			
0.00 - 0.15	5	4			3.00 - 3.15				
0.15 - 0.30	4	6			3.15 - 3.30				
0.30 - 0.45	6	6			3.30 - 3.45				
0.45 - 0.60	7	5			3.45 - 3.60				
0.60 - 0.75	6	4			3.60 - 3.75				
0.75 - 0.90	6	4			3.75 - 3.90				
0.90 - 1.05	4	6			3.90 - 4.05				
1.05 - 1.20	6	8			4.05 - 4.20				
1.20 - 1.35	8	10			4.20 - 4.35				
1.35 - 1.50	9	11			4.35 - 4.50				
1.50 - 1.65	9	12			4.50 - 4.65				
1.65 - 1.80	D	D			4.65 - 4.80				
1.80 - 1.95					4.80 - 4.95				
1.95 - 2.10					4.95 - 5.10				
2.10 - 2.25					5.10 - 5.25				
2.25 - 2.40					5.25 - 5.40				
2.40 - 2.55					5.40 - 5.55				
2.55 - 2.70					5.55 - 5.70				
2.70 - 2.85					5.70 - 5.85				
2.85 - 3.00					5.85 - 6.00				

Remarks: * = Pre-drilled hole prior to testing

Approved Signatory.
Technician: JK — Laurie Ihnativ - Manager

E1. CLASSIFICATION OF SOILS

E1.1 Soil Classification and the Unified System

An assessment of the site conditions usually includes an appraisal of the data available by combining values of engineering properties obtained by the site investigation with descriptions, from visual observation of the materials present on site.

The system used by SMEC in the identification of soil is the Unified Soil Classification system (USC) which was developed by the US Army Corps of Engineers during World War II and has since gained international acceptance and has been adopted in its metricated form by the Standards Association of Australia.

The Australian Site Investigation Code (AS1726-1981, Appendix D) recommends that the description of a soil includes the USC group symbols which are an integral component of the system.

The soil description should contain the following information in order:

Soil composition

- SOIL NAME and USC classification symbol (IN BLOCK LETTERS)
- plasticity or particle characteristics
- colour
- secondary and minor constituents (name estimated proportion, plasticity or particle characteristics, colour

Soil condition

- moisture condition
- consistency or density index

Soil structure

- structure (zoning, defects, cementing)

Soil origin

interpretation based on observation eg FILL, TOPSOIL, RESIDUAL, ALLUVIUM.

E1.2 Soil Composition

(a) Soil Name and Classification Symbol

The USC system is summarized in Figure E1.2.1. The primary division separates soil types on the basis of particle size into:

- Coarse grained soils - more than 50% of the material less than 60 mm is larger than 0.06 mm (60 µm).

- Fine grained soils - more than 50% of the material less than 60 mm is smaller than 0.06 mm (60 µm).

Initial classification is by particle size as shown in Table E1.2.1. Further classification of fine grained soils is based on plasticity.

TABLE E1.2.1 - CLASSIFICATION BY PARTICLE SIZE

NAME	SUB-DIVISION	SIZE
Clay (1)		< 2 µm
Silt (2)		2 µm to 60 µm
Sand	Fine Medium Coarse	60 µm to 200 µm 200 µm to 600 µm 600 µm to 2 mm
Gravel (3)	Fine Medium Coarse	2 mm to 6 mm 6 mm to 20 mm 20 mm to 60 mm
Cobbles (3)		60 mm to 200 mm
Boulders (3)		> 200 mm

Where a soil contains an appropriate amount of secondary material, the name includes each of the secondary components (greater than 12%) in increasing order of significance, eg sandy silty clay.

Minor components of a soil are included in the description by means of the terms “some” and “trace” as defined in Table E1.2.2.

TABLE E1.2.2 - MINOR SOIL COMPONENTS

TERM	DESCRIPTION	APPROXIMATE PROPORTION (%)
Trace	presence just detectable, little or no influence on soil properties	0-5
Some	presence easily detectable, little influence on soil properties	5-12

The USC group symbols should be included with each soil description as shown in Table E1.2.3

TABLE E1.2.3 - SOIL GROUP SYMBOLS

SOIL TYPE	PREFIX
Gravel	G
Sand	S
Silt	M
Clay	C
Organic	O
Peat	Pt

The group symbols are combined with qualifiers which indicate grading, plasticity or secondary components as shown on Table E1.2.4

TABLE E1.2.4 - SOIL GROUP QUALIFIERS

SUBGROUP	SUFFIX
Well graded	W
Poorly Graded	P
Silty	M
Clayey	C
Liquid Limit <50% - low to medium plasticity	L
Liquid Limit >50% - low to medium plasticity	H

(b) Grading

"Well graded" Good representation of all particle sizes from the largest to the smallest.

"Poorly graded" One or more intermediate sizes poorly represented

"Gap graded" One or more intermediate sizes absent

"Uniformly graded" Essentially single size material.

(c) Particle shape and texture

The shape and surface texture of the coarse grained particles should be described.

Angularity may be expressed as "rounded", "sub-rounded", "sub-angular" or "angular".

Particle **form** can be "equidimensional", "flat" or elongate".

Surface texture can be "glassy", "smooth", "rough", pitted" or striated".

(d) Colour

The colour of the soil should be described in the moist condition using simple terms such as:

Black White Grey Red
Brown Orange Yellow Green
Blue

These may be modified as necessary by "light" or "dark". Borderline colours may be described as a combination of two colours, eg. red-brown.

For soils that contain more than one colour terms such as:

- Speckled Very small (<10 mm dia) patches
- Mottled Irregular
- Blotched Large irregular (>75 mm dia)
- Streaked Randomly oriented streaks

(e) Minor Components

Secondary and minor components should be individually described in a similar manner to the dominant component.

E1.3 ***S****oil Condition*

(a) Moisture

Soil moisture condition is described as "dry", "moist" or "wet".

The moisture categories are defined as:
Dry (D) - Little or no moisture evident. Soils are running.
Moist (M) - Darkened in colour with cool feel. Granular soil particles tend to adhere. No free water evident upon remoulding of cohesive soils.

In addition the moisture content of cohesive soils can be estimated in relation to their liquid or plastic limit.

(b) Consistency

Estimates of the consistency of a clay or silt soil may be made from manual examination, hand penetrometer test, SPT results or from laboratory tests to determine undrained shear or unconfined compressive strengths. The classification of consistency is defined in Table E1.3.1.

TABLE E1.3.1 - CONSISTENCY OF FINE-GRAINED SOILS

TERM	UNCONFINED STRENGTH (kPa)	FIELD IDENTIFICATION
Very Soft	<25	Easily penetrated by fist. Sample exudes between fingers when squeezed in the fist.
Soft	25 – 50	Easily moulded in fingers. Easily penetrated 50 mm by thumb.
Firm	50 – 100	Can be moulded by strong pressure in the fingers. Penetrated only with great effort.
Stiff	100 – 200	Cannot be moulded in fingers. Indented by thumb but penetrated only with great effort.
Very Stiff	200 – 400	Very tough. Difficult to cut with knife. Readily indented with thumb nail.
Hard	>400	Brittle, can just be scratched with thumb nail. Tends to break into fragments.

Unconfined compressive strength as derived by a hand penetrometer can be taken as approximately double the undrained shear strength ($q_u = 2\ c_u$).

(c) Density Index

The insitu density index of granular soils can be assessed from the results of SPT or cone penetrometer tests. Density index should not be estimated visually.

TABLE E1.3.2 - DENSITY OF GRANULAR SOILS

TERM	SPT N VALUE	STATIC CONE VALUE q_c (MPa)	DENSITY INDEX (%)
Very Loose	0 – 3	0 - 2	0 - 15
Loose	3 – 8	2 - 5	15 - 35
Medium Dense	8 – 25	5 - 15	35 - 65
Dense	25 – 42	15 - 20	65 - 85
Very Dense	>42	>20	>85

E1.4 Soil Structure

(a) Zoning

A sample may consist of several zones differing in colour, grain size or other properties. Terms to classify these zones are:

Layer - continuous across exposure or sample
Lens - discontinuous with lenticular shape
Pocket - irregular inclusion
Each zone should be described, their distinguishing features, and the nature of the interzone boundaries.

(b) Defects

Defects which are present in the sample can include:

- fissures
- roots (containing organic matter)
- tubes (hollow)
- casts (infilled)

Defects should be described giving details of dimensions and frequency. Fissure orientation, planarity, surface condition and infilling should be noted. If there is a tendency to break into blocks, block dimensions should be recorded

E1.5 Soil Origin

Information which may be interpretative but which may contribute to the usefulness of the material description should be included. The most common interpreted feature is the origin of the soil. The assessment of the probable origin is based on the soil material description, soil structure and its relationship to other soil and rock materials.

Common terms used are:

“Residual Soil” - Material which appears to have been derived by weathering from the underlying rock. There is no evidence of transport.

“Colluvium” - Material which appears to have been transported from its original location. The method of movement is usually the combination of gravity and erosion.

“Landslide Debris” - An extreme form of colluvium where the soil has been transported by mass movement. The material is obviously distributed and contains distinct defects related to the slope failure.

“Alluvium” - Material which has been transported essentially by water. Usually associated with former stream activity.

“Fill” - Material which has been transported and placed by man. This can range from natural soils which have been placed in a controlled manner in engineering construction to dumped waste material. A description of the constituents should include an assessment of the method of placement.

E1.6 Fine Grained Soils

The physical properties of fine grained soils are dominated by silts and clays.

The definition of clay and silt soils is governed by their Atterberg Limits. Clay soils are characterised by the properties of cohesion and plasticity with cohesion defines as the ability to deform without rupture. Silts exhibit cohesion but have low plasticity or are non-plastic.

The field characteristics of clay soils include:

- dry lumps have appreciable dry strength and cannot be powdered
- volume changes occur with moisture content variation
- feels smooth when moist with a greasy appearance when cut.

The field characteristics of silt soils include:

- dry lumps have negligible dry strength and can be powdered easily
- dilatancy - an increase in volume due to shearing - is indicted by the presence of a shiny film of water after a hand sample is shaken. The water disappears upon remoulding. Very fine grained sands may also exhibit dilatancy.
- low plasticity index
- feels gritty to the teeth

E1.7 Organic Soils

Organic soils are distinguished from other soils by their appreciable content of vegetable matter, usually derived from plant remains.

The soil usually has a distinctive smell and low bulk density.

The USC system uses the symbol Pt for partly decomposed organic material. The O symbol is combined with suffixes “O” or “H” depending on plasticity.

Where roots or root fibres are present their frequency and the depth to which they are encountered should be recorded. The presence of roots or root fibres does not necessarily mean the material is an “organic material” by classification.

Coal and lignite should be described as such and not simply as organic matter.

APPENDIX B

LABORATORY TEST RESULTS

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

California Bearing Ratio Determination Report

Project: MOSS VALE AQUATIC CENTRE, KIRKHAM ST, MOSS VALE
Client: WINGECARRIBEE SHIRE COUNCIL
Address: PO BOX 141, MOSS VALE
Test Method: AS1289.6.1.1
No. of Days Soaked: 4
Client Request No.: N/A

Project No.: 18476
Report No.: 12/0137
Report Date: 8/02/2012
Page: 1 of 1
Compactive Effort: Standard
Target Compaction (%): 100
Surcharge (Kg): 4.5

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.3 - Power Auger Drilling (Not covered under NATA Scope of Accreditation)

STS / Sample No.		1206C/1	1206C/2	1206C/3	1206C/4		
Sample Location		Borehole 7	Borehole 8	Borehole 9	Borehole 10		
Material Description		SILTY CLAY: yellow brown with orange brown and light grey, medium to high plasticity	SILTY CLAY: dark brown with occasional orange brown and light grey, medium plasticity	SILTY CLAY: yellow brown/orange brown, medium to high plasticity	SILTY CLAY: dark grey, medium to high plasticity		
Depth of Sample (m)		0.6 - 1.5m	0.3 - 1.5m	0.4 - 1.5m	0.4 - 1.2m		
Sample Date		19/01/2012	19/01/2012	19/01/2012	19/01/2012		
Oversize on Wet Basis +19mm (%)		Nil	Nil	Nil	Nil		
Field Moisture Content (%)		24	25.9	16	21.1		
Optimum Moisture Contest (%)		22.3	17.4	18.5	25.2		
Maximum Dry Density (t/m³)		1.625	1.685	1.750	1.484		
Dry Density (t/m³)	Before Soaking	1.626	1.675	1.740	1.465		
	After Soaking	1.573	1.631	1.661	1.425		
Relative Compaction (%)	Before Soaking	100.1	99.4	99.4	98.7		
	After Soaking	96.8	96.8	94.9	96		
Moisture Content (%)	Before Soaking	22.1	17.5	18.7	25.2		
	After Soaking	26.2	21.7	22.7	32.4		
Moisture Ratio Before Soaking (%)		99.1	100.4	101.1	99.9		
Moisture Content after test (%)	Top 30mm	23.5	23.4	21	32.6		
	Entire Depth	24.3	21.8	21.1	29.4		
Swell after Soaking (%)		3.4	2.7	4.7	2.9		
CBR Value (%)		**2.0**	**3.5**	**2.5**	**1.5**		
Penetration (mm)		**2.5**	**2.5**	**2.5**	**2.5**		

Remarks: +19mm material excluded from test

Approved Signatory.

Technician: Lincoln Coleman - Senior Geotechnician

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 Fax: (02)9756 1137 Email: enquiries@smectesting.com.au

Shrink Swell Index Report

Project: MOSS VALE AQUATIC CENTRE, KIRKHAM ST, MOSS VALE
Client: WINGECARRIBEE SHIRE COUNCIL
Address: PO BOX 141, MOSS VALE
Test Method: AS 1287.7.1.1

Project No.: 18476
Report No.: 12/0043
Report Date: 24/01/2012
Page: 1 OF 1

Sampling Proceedure: AS 1289.1.2.1 Clause 6.5.4 - Machine Excavated Pit (Not covered under NATA Scope of Accreditation)

STS / Sample No.		1206C/1	1206C/2				
Sample Location		BH2 Refer to Drawing No 12/0042	BH4 Refer to Drawing No 12/0042				
Material Description		SILTY CLAY, dark greyish brown, trace gravel	SILTY CLAY, grey brown, some sand, trace gravel				
Depth (m)		1.3 - 1.5	0.7 - 1.0				
Sample Date		19/01/2012	19/01/2012				
Shrink	Moisture Content (%)	25.8	17.7				
	Soil Crumbling	NA	NA				
	Extent of Cracking	Slight	Slight				
	Strain (%)	2.6	1.1				
Swell	Moisture Content Initial (%)	18.7	17.3				
	Moisture Content Final (%)	27.9	19.3				
	Strain (%)	5.4	1.3				
Inert Inclusions (%)		Zero	Zero				
Shrink Swell Index (%)		**2.9**	**1.1**				

Remarks:

Technician: JH

Approved Signatory.....
Laurie Ihnativ - Manager

ALS Group
Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1201348**	Page	: 1 of 4
Client	: **SMEC TESTING SERVICES PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MR LAURIE IHNATIV	Contact	: Client Services
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Facsimile	: +61 02 97561137	Facsimile	: +61-2-8784 8500
Project	: CHASS VALE POOL 18476	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: 155579	Date Samples Received	: 20-JAN-2012
Sampler	: JK	Issue Date	: 25-JAN-2012
Site	: ----		
		No. of samples received	: 7
Quote number	: EN/025/10	No. of samples analysed	: 7

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA
WORLD RECOGNISED ACCREDITATION

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Hoa Nguyen	Inorganic Chemist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ED041G: LOR raised for Chloride on various samples due to sample matrix.**

Analytical Results

Sub-Matrix: **SOIL**

Compound	CAS Number	LOR	Unit	Client sample ID: S1	S2	S3	S4	S5
				Client sampling date / time: 19-JAN-2012 15:00	19-JAN-2012 15:00	19-JAN-2012 15:00	19-JAN-2012 15:00	19-JAN-2012 15:00
				ES1201348-001	ES1201348-002	ES1201348-003	ES1201348-004	ES1201348-005
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**6.8**	**7.4**	**7.2**	**7.5**	**6.8**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**91**	**110**	**159**	**132**	**82**
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**16.6**	**16.7**	**19.0**	**19.6**	**21.6**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**30**	**20**	**20**	<10	**20**
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<20	<20	**110**	**60**	<20

Analytical Results

Sub-Matrix: SOIL			Client sample ID	S6	S7	----	----	----
			Client sampling date / time	19-JAN-2012 15:00	19-JAN-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1201348-006	ES1201348-007	----	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.1**	**7.7**	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**105**	**106**	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	**19.4**	**12.5**	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**20**	<10	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	10	mg/kg	<20	<20	----	----	----