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GEOTECHNICAL INVESTIGATION
74-78 BELMORE STREET, RYDE

FOR

ACHIEVE AUSTRALIA
C/- NBRS + PARTNERS

PROJECT NO. 17900/8471B **FEBRUARY 2011**
REPORT NO. 10/1335A

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1. INTRODUCTION

This report presents the results of a geotechnical investigation carried out by SMEC Testing Services Pty Limited (STS) for a proposed residential development at 74 to 78 Belmore Street, Ryde. We have been informed the proposed development comprises seven (7) above ground storeys and a basement car park level which will involve excavating about nine (9) metres below the existing groundsurface.

The purpose of the investigation was to:

- determine the subsurface conditions over the site,
- provide foundation design parameters,
- provide recommendations regarding excavation support both in the short and long terms,
- comment on any construction problems that may be anticipated, and
- comment on the presence of Acid Sulfate Soils (ASS).

The work was undertaken at the request of Mr. Angus Bell of NBRS + Partners on behalf of Achieve Australia.

Our commission also included a contamination assessment of the site. Results of that assessment are given in our Report No. 10/1498.

2. SITE DESCRIPTION AND GEOLOGY

The site lies between Belmore Street and Porter Street to the southwest of Junction Street. At the time of the fieldwork several existing buildings were present on the site.

Site vegetation comprises grass lawns, trees and shrubs.

The site is on the crest of a ridge. Site drainage is to the north and the south.

Reference to the Sydney geological map at a scale of 1:100,000 shows rocks of the Triassic Age Ashfield Shale of the Wianamatta Group near to the contact with Triassic Age Hawkesbury Sandstone underlie the site. Rocks within the Ashfield Shale formation comprise shale and laminite, whereas, Hawkesbury Sandstone comprises medium to coarse grained quartz sandstone.

3. FIELDWORK DETAILS

The fieldwork consisted of drilling eight boreholes numbered BH1 to BH10, inclusive, at the locations shown on Drawing No. 10/1335. BH1 to BH8 boreholes were drilled using a Hydropower Scout drilling rig, owned and operated by Terratest. The boreholes were advanced using solid flight augers. Soil strengths were determines by periodically undertaking Standard Penetration Tests (SPTs) in the boreholes. The underlying rock was cored using a diamond cutting tool. Rock strengths were determined by undertaking Point Load tests. In order to measure the groundwater level a PVC standpipe piezometer was installed in each of these boreholes. BH9 and BH10 were drilled for collection of contamination samples. All fieldwork was directed by one of STS's experienced geologists who also logged the subsurface conditions encountered.

The subsurface conditions encountered are given on the borehole logs in Appendix A together with photographs of the core retrieved. A description of the terms used is also given in Appendix A. Notes relating to geotechnical reports are also attached.

The rock strength was determined by undertaking Point Load tests. Results of this testing are given in Appendix B.

4. SUBSURFACE CONDITIONS

The following comments are based on the assumption that the conditions encountered in the boreholes are representative of the subsurface conditions at this site.

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 herein, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies.

The subsurface conditions consist of topsoil, fill and silty clays overlying weathered shale and sandstone. The topsoil and fill are 0.3 and 1.5 metres thick. Silty clays were observed to depths of 1.1 to 2.5 metres. The strength of these materials varied between firm to stiff and hard. Weathered shale was observed in all boreholes to depths of 6.7 to 10.0 metres. Weathered sandstone was observed in all boreholes except BH5 to a depth of 10 metres and under the shale.

The groundwater was measured at the following depths:

Location	BH1	BH2	BH3	BH4	BH5	BH6	BH7	BH8
17/11/10	1.3	1.3	1.4	2.0	1.9	1.8	1.5	1.6
15/12/10	1.3	1.3	1.4	1.5	1.5	1.3	1.3	1.3

5. DISCUSSION & SUPPORT

5.1 Excavation Conditions & Support

Based on subsurface conditions observed in the boreholes, it is expected that the proposed basement excavation will encounter fill, topsoil, silty clays and weathered shale and sandstone. Excavators without assistance should be able to remove the soils and weathered rock to a depth of about 2.5 to 4 metres. Removal of the rock below 2.5 to 4 metres will probably necessitate the use of other rock excavation equipment. Excavators alone without assistance will probably not be able to remove any significant amount of the rock below a depth of about 6 metres. Hydraulic breakers mounted on an excavator will be required to break up the majority of the rock before it can be removed using an excavator. The excavation contractors should note that some high strength sandstone will require excavation. Equipment capable of removing this material should be used.

Excavations methods should be adopted which limit ground vibrations at the adjoining developments to not more than 10 mm/sec. Vibration monitoring will be required to verify that this is achieved. However, if the contractor adopts methods and/or equipment in accordance with the recommendations in Table 1 for a ground vibration limit of 5 mm/sec, vibration monitoring may not be required.

The limits of 5 mm/sec and 10 mm/sec are expected to be achievable if rock breaker equipment or other excavation methods are restricted as indicated in Table 1:

At all times, the excavation equipment must be operated by experienced personnel, according to the manufacturer's instructions and in a manner consistent with minimising vibration effects.

Use of other techniques (eg. grinding, rock sawing), although less productive, would reduce or possibly eliminate risks of damage to property through vibration effects transmitted via the ground. Such techniques may be considered if an alternative to rock breaking is necessary.

TABLE 1 – RECOMMENDATIONS FOR ROCK BREAKING EQUIPMENT

Distance from adjoining structure (m)	Maximum Peak Particle Velocity 5 mm/sec		Maximum Peak Particle Velocity 10 mm/sec	
	Equipment	Operating Limit (% of Maximum Capacity)	Equipment	Operating Limit (% of Maximum Capacity)
1.5 to 2.5	Hand operated jackhammer only	100	300 kg rock hammer	50
2.5 to 5.0	300 kg rock hammer	50	300 kg rock hammer or 600 kg rock hammer	100 50
5.0 to 10.0	300 kg rock hammer or 600 kg rock hammer	100 50	600 kg rock hammer or 900 kg rock hammer	100 50

* Vibration monitoring is recommended for 10 mm/sec vibration limit.

If rock sawing is carried out around excavation boundaries in not less than 1 metre deep lifts, a 900 kg rock hammer could be used at up to 100% maximum operating capacity with an assessed peak particle velocity not exceeding 5 mm/sec, subject to observation and confirmation by a geotechnical engineer at the commencement of excavation.

It should be noted that vibrations that are below threshold levels for building damage may be experienced at adjoining developments.

Saw cutting should be carried out around the perimeter of the excavation before any rock breaking is commenced. It would be appropriate before commencing excavation to undertake a dilapidation survey of any adjacent structures that may potentially be damaged. This will provide a reasonable basis for assessing any future claims.

In our opinion, unless the soil slopes can be battered at a slope of 1 to 1, it will be necessary to provide temporary support. Piles with shotcrete infill are probably the most cost-effective option.

When considering the design of the supports, it will be necessary to allow for the loading from adjacent structures close to the boundaries, any groundsurface slope and groundwater present. Where the structures are within the zone of influence of the excavation, it will be necessary to adopt K_o conditions when designing the temporary support. Anchors or props can be used to provide the required support. If anchors extend into adjoining property, it will be necessary to obtain the permission of the property owners. When props or anchors are used for support, a rectangular earth pressure distribution should be adopted on the active side of the support. The permanent basement support should be designed assuming K_o conditions.

The following parameters are suggested for the design of the retaining wall system where there is a level groundsurface:

Soil and weathered rock (to a depth of about 4 metres)

Active Earth Pressure Coefficient (K_a)	= 0.4
At Rest Pressure Coefficient (K_o)	= 0.5
Total (Bulk) Density	= 19 kN/m^3

Jointed Rock (below a depth of 4 metres)

Earth pressure coefficient	= 0.3
Total (Bulk) Density	= 21 kN/m^3

Weathered Rock (below a depth of 7.5 metres)

Earth Pressure Coefficient	= 0.1 or 10 kPa whichever is lower
Passive Earth Pressure Coefficient (K_p)	= 4.5 (min. penetration of 1.5 metres) in rock
Total (Bulk) Density	= 22 kN/m^3

Groundwater flow can be expected into the basement excavation. It is difficult to quantify the amount, however, the recharge rate when the piezometers were dewatered suggest a moderate quantity of water will require removal. A sump and pump should be capable of handling the amount of water that flows into the excavation.

In order to minimise uplift pressures on the basement slab, we suggest a drainage layer comprising gravel and perforated pipes, be placed under the slab. These pipes would be connected to a sump that would remove the water, thereby reducing the uplift pressure on the slab. Even if this system is implemented a nominal uplift pressure equivalent to 1 metre of water should still be allowed for in the design of the slab.

It will be necessary to provide waterproofing to prevent long term seepage into the basement.

5.2 *Foundations*

The allowable bearing pressures given below have been determined using the procedures given by Pells et al, in their paper titled "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region," published in the Australian Geomechanics Journal, 1998. Pad and/or strip footings should be founded on medium strength shale or sandstone.

At the proposed depth of founding (9 metres), the onsite rock is assessed to be at least Class III shale and sandstone. The pad/strip footings founded on these materials may be proportioned using an allowable bearing pressure of 3.5 MPa.

In order to ensure the bearing values given can be achieved, care should be taken to ensure the base of the excavations is free of all loose material prior to concreting. To this end, it is recommended that all excavations be concreted as soon as possible, preferably immediately after excavation, cleaning, inspection and approval.

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

5.3 Acid Sulfate Soil Assessment

5.3.1 Introduction

ASS are the common name given to sediments and soils containing iron sulfides which, when exposed to oxygen generate sulfuric acid. Natural processes formed the majority of acid sulfate

sediments when certain conditions existed in the Holocene geological period (the last 10,000 years). Formation conditions require the presence of iron-rich sediments, sulfate (usually from seawater), removal of reaction products such as bicarbonate, the presence of sulfate reducing bacteria and a plentiful supply of organic matter. It should be noted that these conditions exist in mangroves, salt marsh vegetation or tidal areas, and at the bottom of coastal rivers and lakes.

The relatively specific conditions under which acid sulfate soils are formed usually limit their occurrence to low lying parts of coastal floodplains, rivers and creeks. This includes areas with saline or brackish water such as deltas, coastal flats, backswamps and seasonal or permanent freshwater swamps that were formerly brackish. Due to flooding and stormwater erosion, these sulfidic sediments may continue to be re-distributed through the sands and sediments of the estuarine floodplain region. Sulfidic sediment may be found at any depth in suitable coastal sediments – usually beneath the watertable.

Any lowering in the watertable that covers and protects potential ASS will result in their aeration and the exposure of iron sulfide sediments to oxygen. The lowering in the water table can occur naturally due to seasonal fluctuations and drought or any human intervention, when carrying out any excavations during site development. Potential ASS can also be the exposed to air during physical disturbance with the material at the disturbance face, as well as the extracted material, both potentially being oxidised. The oxidation of iron sulfide sediments in potential ASS results in ASS soils.

Successful management of areas with ASS is possible but must take into account the specific nature of the site and the environmental consequences of development. While it is preferable that sites exhibiting acid sulfate characteristics not be disturbed, management techniques have been devised to minimise and manage impacts in certain circumstances.

When works involving the disturbance of soil or the change of groundwater levels are proposed, a preliminary assessment should be undertaken to determine whether acid sulfate soils are present and if the proposed works are likely to disturb these soils.

5.3.2 Presence of ASS

Reference to the Prospect/Parramatta River ASS Risk Map indicates the property is an area where there are no known occurrences of ASS.

The following geomorphic or site criteria should be used to determine if acid sulfate soils are likely to be present:

- sediments of recent geological age (Holocene)
- soil horizons less than 5m AHD
- marine or estuarine sediments and tidal lakes
- in coastal wetlands or back swamp areas

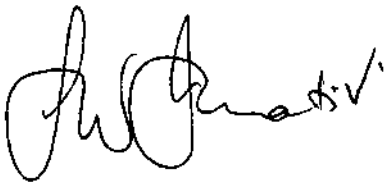
5.3.3 Assessment

The property location is underlain by Ashfield Shale near to the contact with Hawkesbury Sandstone and therefore is not consistent with the subsurface conditions indicative of the presence of ASS. The groundsurface of the site varies between about RL 20 and 22 metres which is well above the level ASS usually occur. Based on our onsite observations and the subsurface conditions exposed in the boreholes, it is our opinion that the proposed construction will not intercept any ASS. As noted above, groundwater is present at depths of 1.3 to 1.5 metres below the existing groundsurface. This means that within the proposed basement excavation, the groundwater will require lowering by about 7.5 metres. Because the on site silty clays and weathered rock are not expected to highly permeable, the drawdown of the groundwater table outside the site is unlikely to be significant. Therefore, any ASS soil present in the area (estimated to be at least 350 metres from the site) is highly unlikely to experience any lowering of groundwater due to the onsite construction.

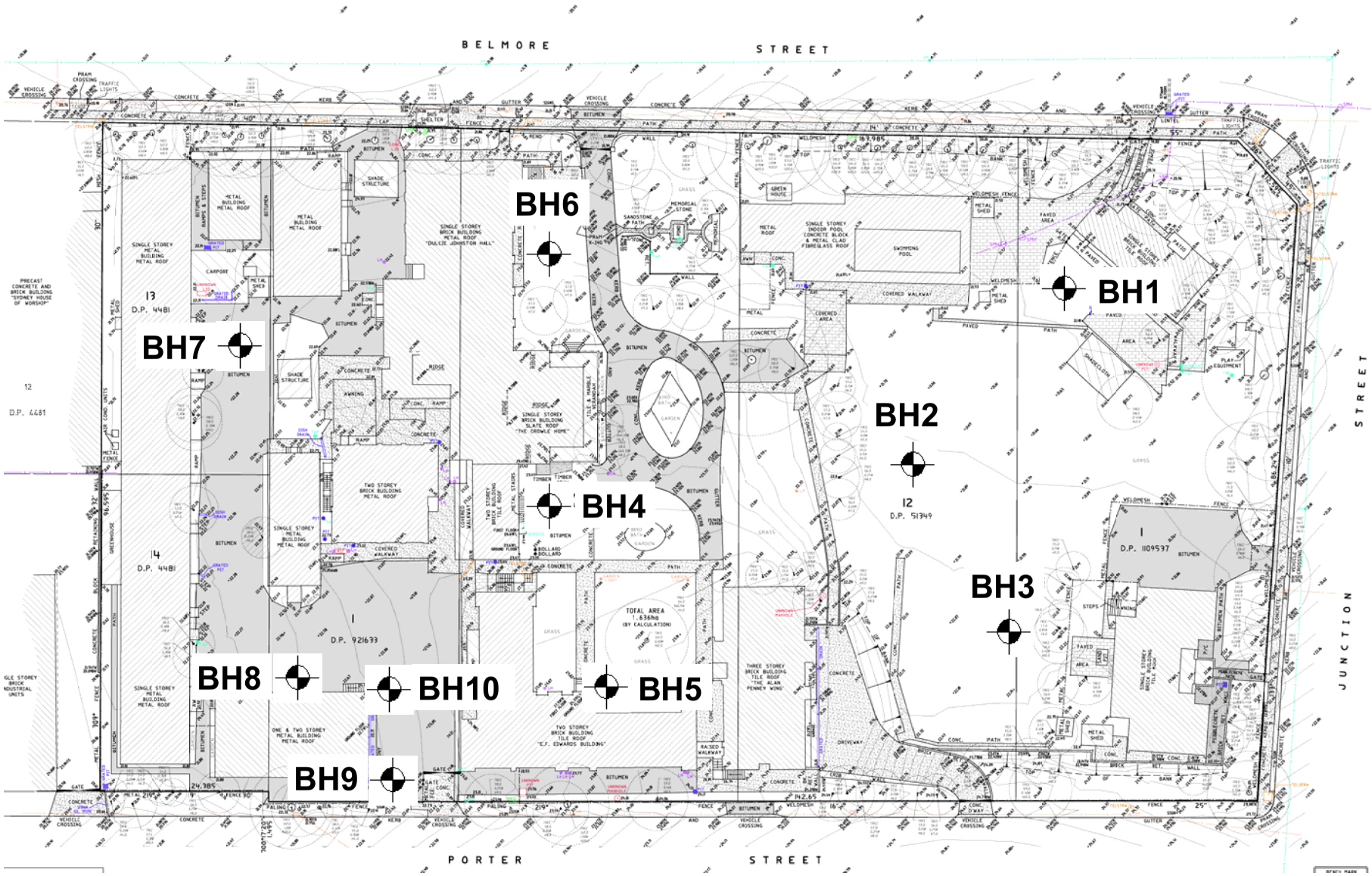
Our assessment is the proposed construction will not require the preparation of an Acid Sulfate Soil Management Plan.

6. FINAL COMMENTS

Should the subsurface conditions vary during construction from those inferred in this report, an experienced geotechnical engineer should review the design above comments to assess 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: November 2010
Client: ACHIEVE AUSTRALIA		
GEOTECHNICAL AND CONTAMINATION ASSESSMENTS **74– 78 BELMORE STREET, RYDE** **BOREHOLE AND SAMPLE LOCATIONS**	Project No. 17900/8471B	
	Drawing No: 10/1335	

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 AND EXPLANATION SHEETS

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.: BH 1**	
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010	Sheet 1 of 3	
Location: Refer to Drawing No.: 10/1335	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, trace fine grained sand TOPSOIL/FILL	CL	FIRM TO STIFF	M
			SILTY CLAY: orange brown with dark grey, light grey and dark brown, medium plasticity, trace of gravel	CL	FIRM TO STIFF	M
	SPT / S1 1.0 - 1.45 m 3, 3, 4, N = 7	1.0	FILL			
WT 17/11/10						
			SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	VERY STIFF	M
		2.0	SILTY CLAY: light grey with orange brown, medium plasticity	CL	VERY STIFF	M
			SHALE: light grey with orange brown and occasional dark grey, fine gravel		EXTREMELY LOW STRENGTH	D
			AUGER REFUSAL AT 2.6 M ON WEATHERED SHALE			
		3.0	For core details, refer to the core log sheets			
		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: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 1**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 2 of 3

DRILLING				MATERIAL STRENGTH										DISCONTINUITIES		
						Estimated Rock Strength							Joint Spacing (mm)			
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20 40 100 300 1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
				For further information refer to the Non Core Borehole sheets											
			1.0												
			2.0	START CORING AT 2.6 M											
N M L C CORING				SHALE: light grey with orange brown and red brown	MW/ HW										Fractured minor clay
			3.0	NO CORE - 3.00 - 3.32 m											
				SHALE: light grey with orange brown and red brown	MW/ HW										Fractured minor clay
			4.0	NO CORE - 4.00 - 4.37m											
				SHALE: light grey with orange brown and red brown	MW/ HW										Fractured minor clay
			5.0												4.96-5.50 Cy, Sm
				NO CORE - 5.74 - 5.88 m											
			6.0	SHALE: light grey with orange brown and red brown	MW/HW										Sm, Cy

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 1**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 3 of 3

DRILLING				MATERIAL STRENGTH											DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)			
													20 40 100 300 1000			
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High			Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
				SHALE: light grey with orange brown and red brown	MW/ HW											6.10-6.20 Cy, Sm Fractured + clay 6.30 - 6.99 Cy, Sm
			7.0	SHALE: dark grey with occasional light grey and orange brown	MW											6.00 - 7.64 - Fractured 7.65 Pt 0 deg, Ir, Ro, Cy 7.77 Pt 0 deg, Ir, Ro, Cy 7.90 Jt 0 deg, Ir, Ro
			8.0	SANDSTONE: orange brown with dark brown and occasional light grey, fine grained	MW											8.12-8.19 Cy, Sm 8.26 Jt, 0 deg. Pl, Ro 8.34 Kt 0 deg, Pl, Ro 8.39 Sm ,Cy 8.52 Pt, 0 deg, Pl, Ro 8.47-8.67 Fractured/Cy 8.80 Jt 5 deg. Pl, Ro
			9.0													8.92 Jt 5 deg, Pl, Ro,Cy
			10.0													9.90 Pt, 0 deg. Pl, Ro
				BOREHOLE DISCONTINUED AT 10.00 M												
			11.0													
			12.0													

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 1
Depth (m): Start 2.60 - 7.00
Box 1 of 2

SMEC Testing Services


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 1
Depth (m): 7.00 - 10.00 End
Box 2 of 2
SMEC
Testing
Services
7
8
9

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.:**	**BH 2**
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010	Sheet 1 of 3	
Location: Refer to Drawing No.: 10/1335	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, trace fine gravel TOPSOIL/FILL	CL	FIRM TO STIFF	M
			SILTY CLAY: orange brown with light grey, medium plasticity, trace gravel	CL	FIRM TO STIFF	M
	SPT 1.0-1.45 m 22/R	1.0	SILTY CLAY: light grey with orange brown, medium plasticity, trace gravel	CL	VERY STIFF	M/D
WT 17/11/10	N > 22		SHALE: dark grey with light grey and orange brown, fine gravel		EXTREMELY LOW STRENGTH	D
		2.0				
			AUGER REFUSAL AT 2.7 M			
		3.0				
		4.0	For further details refer to the cored borehole sheets			
		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: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 2**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 2 of 3

DRILLING				MATERIAL STRENGTH														DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)						
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20	40	100	300	1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
			1.0	For further information refer to the Non Core Borehole sheets															
			2.0	START CORING AT 2.70 M															
N M L C				NO CORE: 2.70-2.88 M															
			3.0	SHALE: dark grey with orange brown and occasional light grey, trace to some clay	MW/ HW														2.88 - 4.50 Fractured clay seams
			4.0	(Becoming darker with depth)															
			5.0																
			6.0																

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client: Achieve Australia
Project: 74 - 78 Belmore Street, Ryde
Location: Refer to Drawing No.: 10/1335
Project / STS No.: 17900/8471B
Date : 10 November 2010
Logged: JK
Checked By:

BOREHOLE NO.: BH 2
Sheet 3 of 3

DRILLING				MATERIAL STRENGTH										DISCONTINUITIES		
						Estimated Rock Strength							Joint Spacing (mm)			
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20 40 100 300 1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
			7.0	SHALE: dark grey with orange brown and occasional light grey, trace to some clay	Fr/sl										Fractured plus minor clay
			8.0	SANDSTONE: light grey with occasional orange brown and dark grey, fine to medium grained	Fr										8.40 Pt, 0 deg. Pl, Ro 8.51 Pt, 0 deg. Pl, Ro 8.83 Jt, Ir, Ro, cy 8.95 Jt 10 deg. Ir, Ro
			9.0												
			10.0	BOREHOLE DISCONTINUED AT 9.4 M											
			11.0												
			12.0												

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 2
Depth (m): Start 2.70 - 7.00
Box 1 of 2
SMEC
Testing
Services
BH2
17900
Start
2.70m
No Core
3
4
5
6


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 2
Depth (m): 7.00 - 9.40 End
Box 2 of 2
SMEC
Testing
Services
7
8
9
9.40
End.

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.:**	**BH 3**
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010		
Location: Refer to Drawing No.: 10/1335	Logged: JK	Sheet 1 of 3	

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, trace gravel TOPSOIL/FILL	CL	FIRM TO STIFF	M
			SILTY CLAY: light grey with orange brown, low plasticity, occasional gravel (Completely weathered shale)	CL	FIRM TO STIFF	M
	SPT 1.0-1.45m 22/R N > 22	1.0				
WT 17/11/10			SHALE: orange brown with dark brown, fine gravel, occasional clay		EXTREMELY LOW STRENGTH	D
		2.0				
			AUGER REFUSAL AT 2.5 M For core details, refer to core log sheets			
		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: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 3**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 2 of 3

DRILLING				MATERIAL STRENGTH														DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)						
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20	40	100	300	1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
			1.0	For further information refer to the Non Core Borehole sheets															
			2.0	START CORING AT 2.50 M															
N M L C C O R I N G			3.0	SHALE: dark grey with orange brown and occasional light grey	MW/ SW														2.50 - 6.00 Numerous Jt, Pt Pl, Ro some clay seam infill
			4.0																
			5.0																
			6.0	SHALE: dark grey with occasional light grey and occasional orange brown	Fr/H														

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 3**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 3 of 3

DRILLING				MATERIAL STRENGTH		Estimated Rock Strength							Joint Spacing (mm)					DISCONTINUITIES	
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20	40	100	300	1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
				SHALE: dark grey with occasional light grey and occasional orange brown															Fractured
			7.0		HW														7.62 Jt 0 deg. Pl, Ro 7.74 J 0 deg. Pl. Ro 7.87 Kt 30 deg. Pl, Ro
			8.0	SANDSTONE: orange brown with light grey, fine grained, occasional clay	MW														7.96 Jt 40 deg. Ir, Ro 8.12 - 8.20 Cy, Sm 8.25 Jt 0 deg. Pl, Ro 8.32-8.30 Jt, Ir, Ro, Cy infill 8.44 Pt 0 deg, Ir, Ro 8.50 Pt, 0 deg, Ir, Ro 8.56-8.67 Ir, Ro, Cy 8.80 Jt 10 deg, Pl, Ro 8.91 Jt 0 deg, Pl, Ro, Cy, Sm
			9.0	SANDSTONE: light grey with dark grey bands, fine grained	Fr														9.12 Pt 0 deg, 9.25 Pt 0 deg, Pl, Ro
			10.0																9.90 Jt 5 deg. Pl, Ro 9.97 Pt 0 deg. Pt, Ro
				BOREHOLE DISCONTINUED AT 10 M															
			11.0																
			12.0																

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 3
Depth (m): Start 2.50 - 7.00
Box 1 of 2
SMEC
Testing
Services
BH3
Start
2.50
3
4
5
6


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 3
Depth (m): 7.00 - 10.00 End
Box 2 of 2
SMEC
Testing
Services
7
8
9

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.:**	**BH 4**
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010	Sheet 1 of 3	
Location: Refer to Drawing No.: 10/1335	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 TOPSOIL	CL	FIRM TO STIFF	M
	S2 @ 0.6 m		SILTY CLAY: orange brown with occasional light grey, medium plasticity trace gravel	CL	VERY STIFF	M
	SPT 1.0 - 1.45m 4, 8.10 N=18	1.0				
WT 15/12/10						
			SHALE: dark grey with light grey and orange brown, fine gravel, clayey seams		EXTREMELY LOW STRENGTH	D
WT 17/11/10		2.0				
		3.0				
		4.0				
			V-BIT REFUSAL AT 4.35 M			
		5.0	For core details, refer to core log sheets			

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: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 4**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 2 of 3

DRILLING				MATERIAL STRENGTH											DISCONTINUITIES		
						Estimated Rock Strength							Joint Spacing (mm)				
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20 40 100 300 1000				Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
			1.0	For further information refer to the Non Core Borehole sheets														
			2.0															
			3.0															
			4.0	START CORING AT 4.32 M														
N M L C C O R I N G			5.0	SHALE : dark grey with orange brown, occasional clay seams	MW													Fractured Jt/Rl, Ir, Ro some clay/ironstone 5.50-5.53 Cy, Sm 5.84-5.90 Cy, Sm
			6.0															

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 4**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 3 of 3

DRILLING				MATERIAL STRENGTH		Estimated Rock Strength							Joint Spacing (mm)					DISCONTINUITIES	
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20	40	100	300	1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
				SHALE: dark grey with orange brown, occasional clay seams															7.45-7.80 Jt 85 deg. Ir, Ro Fractured plus clay
			7.0																
			8.0	SHALE: dark grey, fine grained	Fr/St														8.22 Jt 0 deg. Ir, Ro 8.56 - 8.66 Jt 85 deg. Pl, Ro
			9.0		Fr														9.43 Pt 0 deg. Pl, Ro 9.46-9.64 Jt 80 deg. Pl, Ro 9.67 Pt 0 deg. Pl, Ro
			10.0	SANDSTONE: light grey with dark grey bands, fine grained	Fr														
			11.0	BOREHOLE DISCONTINUED AT 10.0 M															
			12.0																

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 4
Depth (m): Start 4.32 - 9.00
Box 1 of 2

SMEC Testing Services


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 4
Depth (m): 9.00 - 10.00 End
Box 2 of 2
SMEC
Testing
Services
9
10

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.: BH 5**	
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010	Sheet 1 of 3	
Location: Refer to Drawing No.: 10/1335	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 TOPSOIL/FILL	CL	FIRM TO STIFF	M
			SILTY CLAY: orange brown with light grey, medium plasticity, occasional gravel (shale)	CL	FIRM TO STIFF	M
	SPT / S3 1.0-1.45m 11, 16, 16 N=32	1.0	SILTY CLAY: light grey with orange brown, low plasticity, trace gravel (shale) (Completely weathered shale)	CL	HARD	M
WT 15/12/10 WT 17/11/10		2.0	SHALE: dark brown/orange brown with light grey, fine grained		EXTREMELY LOW STRENGTH	D
		3.0	BOREHOLE DISCONTINUED AT 2.5 M			
		4.0	For further details refer to the cored borehole sheets			
		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: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 5**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 2 of 3

DRILLING				MATERIAL STRENGTH											DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)			
													20 40 100 300 1000			
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High			Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
			1.0	For further information refer to the Non Core Borehole sheets												
			2.0	START CORING AT 2.50 M												
N M L C			3.0	SHALE: dark grey with orange brown and occasional light grey, occasion clay seams	MW											2.50-8.0 Jt/Pt 0-45 deg. Pl, Re, Ir Ro clayey seams some fractured zones
			4.0		MW/ SW											
			5.0													
			6.0													

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 5**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 3 of 3

DRILLING				MATERIAL STRENGTH													DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)					
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20	40	100	300	1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
			7.0	SHALE: dark grey with orange brown and occasional light grey, occasional clay seams	MW														
			8.0	SHALE: dark grey with light grey, occasional clay	Fr														8.14 Jt 0 deg. Pl, Ro 8.23 Pt 0 deg. Pl, Sm 8.33 Jt 20 deg. Pl, Ro 8.63-8.67 Sm, Cy 8.67-8.37 Jt 8.77-8.87 Jt 90 deg. Ir, Ro
			9.0																9.00-9.04 Jt 45 deg. Pl, Ro 9.15 Pt 45 deg. Pl, Sm 9.44 Pt 10 deg. Pl, Ro
			10.0																
			11.0	BOREHOLE DISCONTINUED AT 9.92 M															
			12.0																

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 5
Depth (m): Start 2.50 - 7.00
Box 1 of 2
SMEC
Testing
Services
BH5
17900
Belmore St. Ryde.
Start
2.50
3
4
5
6


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 5
Depth (m): 7.00 - 9.92 End
Box 2 of 2
SMEC
Testing
Services
7
8
9
End
9.92m

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.: BH 6**	
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010	Sheet 1 of 3	
Location: Refer to Drawing No.: 10/1335	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	FIRM TO STIFF	M
			SILTY CLAY: orange brown with light grey, medium to high plasticity	CL/CH	FIRM TO STIFF	M
	SPT 1.0-1.45 m 3, 5, 8 N=13	1.0	SILTY CLAY: light grey with orange brown, medium plasticity	CL	STIFF	M
WT 15/12/10			SHALE: dark grey with orange brown and light grey, clayey seams		EXTREMELY LOW STRENGTH	D
WT 17/11/10		2.0				
		3.0	V-BIT REFUSAL AT 2.5 M For further details refer to the cored borehole sheets			
		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: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 6**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 2 of 3

DRILLING				MATERIAL STRENGTH												DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)				
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20 40 100 300 1000				Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
			1.0	For further information refer to the Non Core Borehole sheets														
NMLC CORING				NO CORE: 2.5-2.64 m														
			2.0	SHALE: dark grey with orange brown and light grey	HW/ MW													2.6 - 6.74 m Numerous Jt, Pt, Ir, Ro clayey seams
			3.0															
			4.0															
			5.0	SHALE: dark grey with orange brown and light grey occasional clay		MW												
			6.0															

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 6**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 3 of 3

DRILLING				MATERIAL STRENGTH											DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)			
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20 40 100 300 1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
				SHALE: dark grey with orange brown and light grey occasional clay	MW										Numerous Jt, Pt, Ir, Ro clayey seams
															6.75 Jt 10 deg. Ir, Ro
															6.83 Jt Ir, Ro
				SHALE: dark grey with light grey and orange brown, fine gravel	SW										
			7.0												6.92 Jt, 5 deg. Pl, Ro
															7.02 Jt und, 45 deg. Ro
															7.32 Pt 0 deg. Pl, Ro
															7.46 Jt 5 deg. Pl Sm
				(Sandstone interbedds)	Fr/Sl										7.66-7.71 Jt, Ir Ro
															7.86, Pt, 0 deg. Pl, Ro
			8.0												
															8.18 Jt 0 deg. Pl, Ro cy veneer
				SANDSTONE: light grey with dark grey, fine to medium grained	Fr										
															8.77 Pt 0 deg. Pl, Ro
															8.97 Pt 0 deg. Pl, Ro
			9.0												
															9.29 Pt 0 deg. Pl, Ro
															9.41 Pt 0 deg. Pl Ro
															9.77 Pt 0 deg. Pl Ro
			10.0												9.93 Pt 0 deg. Pl Ro
				BOREHOLE DISCONTINUED AT 10 M											
			11.0												
			12.0												

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols


Project: 74-76 Belmore Street,
RYDE
Project No: 17900/84718
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 6
Depth (m): Start 2.50 - 7.00
Box 1 of 2
SMEC
Testing
Services
BH6 17900
Belmore St. Ryde
Start 2.50
No Core
3
4
5
6


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/84718
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 6
Depth (m): 7.00 - 10.00 End
Box 2 of 2
SMEC
Testing
Services
7
8
9
1

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.:**	**BH 7**
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010		
Location: Refer to Drawing No.: 10/1335	Logged: JK	Sheet 1 of 3	

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
			ASPHALTIC CONCRETE/ SANDY GRAVEL: dark grey, fine to medium grained FILL	GW	DENSE	D
	S4 @ 0.3m		SILTY CLAY: dark brown with occasional orange brown, medium plasticity, occasional gravel TOPSOIL/FILL	CL	FIRM	M
			SILTY CLAY: orange brown with light grey, medium plasticity	CL	FIRM TO STIFF	M
	SPT 1.0-1.45m	1.0				
WT	3, 7, 9					
15/12/10	N=10		SILTY CLAY: light grey with orange brown, medium plasticity, trace gravel (shale)	CL	STIFF	M/D
WT						
17/11/10						
		2.0				
			V-BIT REFUSAL AT 2.50 M			
		3.0				
			For further details refer to the cored borehole sheets			
		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: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 7**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 2 of 3

DRILLING				MATERIAL STRENGTH											DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)			
													20 40 100 300 1000			
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High			Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
			1.0	For further information refer to the Non Core Borehole sheets												
			2.0	START CORING AT 2.50 M												
N M L C CORING			3.0	SHALE: light grey with orange brown and red brown, fine grained, clayey seams	HW											2.57-2.59 Jt, Ir, Ro, Cy 2.66 Jt, 0 deg. Ir, Ro 2.80 Jt 0 deg. Ir, Ro 3.12 Jt 0 deg. Ir, Ro 3.26 Jt 0 deg. Ir, Ro 3.42 Jt 0 deg. Ir, Ro 3.46 Jt 0 deg. Pl, Ro 3.78-3.86 Cy, Sm
			4.0		MW/ SW											4.04 Jt 0 deg. Pl, Ro 4.10-4.15 Jt 45 deg. Pl, Ro 4.24-4.45 Jt Ir, Ro 4.54-4.77 Jt 85 deg. Pl, Ro
			5.0	SHALE: dark grey with orange brown and light grey, fine grained	SW											4.78 Jt 0 deg. Pl, Ro, Fe veneer 4.88 Pt 0 deg. Pl, Ro 4.91 Pt 0 deg. Pl, Ro 5.0-5.05 Jt 90 deg. Ir, Ro 5.19-5.32 Jt 90 deg. Ir, Ro, Cy 5.37 Jt 0 deg. Pl, Ro 5.44 Jt 0 deg. Pl, Ro 5.54 Jt 0 deg. Pl, Ro 5.67-5.71 Jt 45 deg. Pl, Ro
			6.0													5.93 Jt 0 deg. Pl, Ro

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client: Achieve Australia | Project / STS No.: 17900/8471B | **BOREHOLE NO.: BH 7**

Project: 74 - 78 Belmore Street, Ryde | Date : 10 November 2010

Location: Refer to Drawing No.: 10/1335 | Logged: JK | Checked By: | Sheet 3 of 3

DRILLING				MATERIAL STRENGTH															DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)							
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20	40	100	300	1000		Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
				SHALE: dark grey with orange brown and light grey, fine grained	SW															6.04 Pt 0 deg. Pl, Ro 6.18 Jt 0 deg. Pl, Ro 6.35 Jt 0 deg. Pl, Ro 6.44 Jt 0 deg. Pl, Ro 6.51 Jt 0 deg. Pl, Ro 6.67 Jt 0 deg. Pl, Ro 6.70 Jt 0 deg. Pl, Ro
			7.0	SANDSTONE: light grey with orange brown, fine to medium grained, occasional dark grey bands	SW															7.18 Pt 0 deg. Pl, Ro 7.26 Jt 0 deg. Pl, Sm, Cy infill 7.45 Jt 3 deg. Pl, Sm 7.55 Jt 3 deg. Pl, Sm
			8.0																	7.91 Pt 10 deg. Pl, Ro 8.03 Jt 0 deg. Pl, Sm 8.19 Jt 5 deg. Pl, Sm 8.50 Jt 0 deg. Pl, Sm 8.60 Jt 0 deg. Pl, Ro
			9.0	(9.20- 9.48 Shale interbedd)																9.18 Jt 0 deg. Pl, Sm 9.50 Jt 0 deg. Pl, Sm 9.78 Jt 3 deg. Pl, Ro 9.84 Jt 0 deg. Pl, Ro
			10.0																	
				BOREHOLE DISCONTINUED AT 10 M																
			11.0																	
			12.0																	

Notes:

Contractor: Terratest Pty Ltd

Equipment: Hydro Power

Hole Diameter (mm):

Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 7
Depth (m): Start 2.50 - 7.00
Box 1 of 2

SMEC Testing Services


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/84718
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 7
Depth (m): 7.00 - 10.00 End
Box 2 of 2
SMEC
Testing
Services
7
8
9

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.:**	**BH 8**
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010	Sheet 1 of 3	
Location: Refer to Drawing No.: 10/1335	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
			ASPHALTIC CONCRETE/ SANDY GRAVEL: dark grey FILL	GW	DENSE	
			SILTY CLAY: dark brown, low plasticity, occasional gravel TOPSOIL	CL	FIRM	M
	S5 @ 0.3m		SILTY CLAY: orange brown with light grey, medium plasticity, occasional gravel (shale)	CL	FIRM TO STIFF	M
	SPT / S6 1.0-1.45m	1.0				
WT 15/12/10	3, 3, 4 N=7		SILTY CLAY: light grey with orange brown and occasional red brown, medium plasticity trace gravel (shale)	CL	FIRM TO STIFF	M
WT 17/11/10						M/D
		2.0				
			V-BIT REFUSAL AT 2.5 M			
		3.0	For further details refer to the cored borehole sheets			
		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: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client:	Achieve Australia	Project / STS No.: 17900/8471B	**BOREHOLE NO.: BH 8**
Project:	74 - 78 Belmore Street, Ryde	Date : 10 November 2010	
Location:	Refer to Drawing No.: 10/1335	Logged: JK Checked By:	Sheet 2 of 3

DRILLING				MATERIAL STRENGTH													DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)					
													20	40	100	300	1000	
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High						Visual

Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
	For further information refer to the Non Core Borehole sheets		
1.0			
2.0	START CORING AT 2.5 M		
	NO CORE: 2.50 - 3.00		
3.0	SHALE: light grey with red brown and orange brown, clayey seams	HW	3.00-3.07 Cz / fractured 3.13-3.15 Sm, Cy 3.20 Jt 0 deg. Pl, Ro, Cy 3.24-3.29 Sm, Cy 3.36 Jt 0 deg. Ir, Ro, Cy 3.42-3.45 Sm, Cy 3.53-3.62 Sm, Cz 3.69 Jt 0 deg. Pl, Ro 3.78 Jt 0 deg. Pl. Ro
4.0		HW/ MW	3.83 Jt 0 deg. Pl. Ro 4.06 Jt 0 deg. Pl. Ro 4.11 Pt 0 deg. Pl. Ro 4.27 Jt 0 deg. Pl. Ro 4.36-4.50 Sm, Cy 4.63 Pt 0 deg. Pl, Ro 4.75 Jt 5 deg. Pl, Ro 4.81 Jt 0 deg. Pl, Ro 4.91-4.95 Sm, Cy
5.0	SHALE: dark grey with orange brown and light grey occasional clay	MW	5.14-5.19 Jt 90 deg. Ir, Ro, Cy 5.26 Jt 0 deg. Pl, Ro 5.34 Jt 0 deg. Pl, Ro 5.39-5.41 Sm, Cy 5.45 Jt 0 deg. Pl, Ro 5.56 Jt 0 deg. Pl, Ro 5.61-5.63 Sm, Cy 5.73-5.84 Jt 40 deg. Ir, Ro
6.0			

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols

SMEC Testing Services Pty Ltd — **GEOTECHNICAL LOG - CORED BOREHOLE**

Client: Achieve Australia
Project: 74 - 78 Belmore Street, Ryde
Location: Refer to Drawing No.: 10/1335
Project / STS No.: 17900/8471B
Date : 10 November 2010
Logged: JK
Checked By:

BOREHOLE NO.: BH 8
Sheet 3 of 3

DRILLING				MATERIAL STRENGTH											DISCONTINUITIES	
						Estimated Rock Strength							Joint Spacing (mm)			
Method	Water	Recovery	Depth (m)	Rock Type (Colour, Grain Size, Structure & Minor Components)	Weathering	Extremely Low	Very Low	Low	Medium	High	Very High	Extremely High	20 40 100 300 1000	Visual	Additional Data (Joints, partings, seams, zones etc. Description, orientation, infilling, or coating, shape, roughness, thickness, other)
				SHALE: dark grey with orange brown and light grey occasional clay	MW										6.03 Jt 0 deg. Pl, Ro 6.14 Jt 0 deg. Pl, Ro, Cy/Fe 6.23 Jt 0 deg. Pl, Sm 6.34 Jt 0 deg. Pl, Sm 6.40 Jt 0 deg. Pl, Ro, 6.47 Jt 0 deg, Pl Sm 6.52 Jt 0 deg, Pl, Ro, 6.62-6.64 Jt 40 deg. Pl, Ro
				SANDSTONE: orange brown with dark grey and light grey, fine to medium grained	MW										6.64-6.73 Und. Jt 6.88-6.91 Jt 0 deg. Pl, Ro, Cy
			7.0	SANDSTONE: light grey with dark grey, fine grained	Fr										7.05 Pt 0 deg. Ir, Ro 7.26 Jt 5 deg. Pl, Sm 7.63 Pt 0 deg. Pl, Ro
			8.0												8.07 Pt 0 deg. Pl, Ro 8.33 Pt 20 deg. Pl, Ro 8.37 Jt 45 deg. 8.62 Pt 10 deg. Pl, Ro 8.86 Jt 0 deg. Pl, Sm 8.94 Pt 0 deg. Pl, Ro
			9.0												9.03 Pt 0 deg. Pl, Ro
				(9.46-9.64 shale interbedd)	Fr/St										9.47 Jt 0 deg. Pl, Ro 9.64 Jt 0 deg. Pl, Ro 9.76 Jt 0 deg. Pl, Ro
			10.0	SANDSTONE: orange brown with light grey, fine to medium grained	SW										
				BOREHOLE DISCONTINUED AT 10 M											
			11.0												
			12.0												

Notes:

Contractor: Terratest Pty Ltd
Equipment: Hydro Power
Hole Diameter (mm):
Angle from Vertical (°):

See explanation sheets for meaning of all descriptive terms and symbols


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 8
Depth (m): Start 2.50 - 7.00
Box 1 of 2
SMEC
Testing
Services
BH8
17900
START
2.50
NO CORE
3
4
5
6


Project: 74-78 Belmore Street,
RYDE
Project No: 17900/8471B
Client: Achieve Australia
Date Cored: 10/11/10
Borehole No: 8
Depth (m): 7.00 - 10.00 End
Box 2 of 2
SMEC
Testing
Services
7
8
9

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.:**	**BH 9**
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010	Sheet 1 of 1	
Location: Refer to Drawing No.: 10/1335	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
			ASPHALTIC CONCRETE/ SANDY GRAVEL: dark grey FILL	CW		D
	S7 @ 0.3 m		SILTY CLAY: dark brown with occasional orange brown, medium plasticity, occasional gravel TOPSOIL/FILL	CL		M
			SILTY CLAY: orange brown with light grey, medium plasticity, trace gravel	CL		M
		1.0	BOREHOLE DISCONTINUED AT 0.8 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 RP 70
Hole Diameter (mm): 100
Angle from Vertical (°) 0

SMEC Testing Services Pty Ltd

GEOTECHNICAL LOG - NON CORE BOREHOLE

Client: Achieve Australia	Project No.: 17900/8471B	**BOREHOLE NO.:**	**BH 10**
Project: 74 - 78 Belmore Street, Ryde	Date : 10 November 2010	Sheet 1 of 1	
Location: Refer to Drawing No.: 10/1335	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
			ASPHALTIC CONCRETE/SANDY GRAVEL: dark grey FILL	GW		D
	S8 @ 0.3 m		SILTY CLAY: dark brown with orange brown, medium plasticity, occa` TOPSOIL/FILL	CL		M
			SILTY CLAY: orange brown with light grey, medium plasticity	CL		M
			BOREHOLE DISCONTINUED AT 0.7 M			
		1.0				
		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

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.

E2 CLASSIFICATION OF ROCKS

E2.1 Uniform Rock Description

The aim of a rock description for engineering purposes is to give an indication of the expected engineering properties of the material.

In a similar manner to soil materials, the assessment of site conditions where rock is encountered has to be based on the use of a descriptive method which is uniform and repeatable. Description has to:

- provide a clear identification of the rock substance and its engineering properties, and
- include details of the features which affect the engineering properties of the rock mass.

There is no internationally accepted system for rock description but SMEC Testing Services Pty Ltd has adopted a method which incorporates terminology defined by common usage in the engineering geological profession. Most feature definitions are as recommended by the International Society of Rock Mechanics and by the Standards Association of Australia.

For uniform presentation the different features are described in order:

Rock Substance

- NAME (in block letters)
- Mineralogy
- Grain Size
- Colour
- Fabric
- Strength
- Weathering/Alteration

Rock Mass

- Defect type
- Defect orientation
- Defect features
- Defect spacing

E2.2 Rock Substance

(a) Rock name

Each rock type has a specific name which is based on:

- mineralogy
- grain size
- fabric
- origin

The only method of determining the precise rock name is by thin section petrography.

Field identification of rocks for engineering purposes should be based on the use of common, easily understood, simple, geological names. In many cases knowledge of the precise name is of little consequence in the assessment of site conditions. If required the "field name" can be qualified by reference to a petrographic report. Reference to local geological reports often provides information on the rock types which may be expected.

(b) Mineralogy

The rock description should include the identification of the prominent minerals. This identification is usually restricted to the more common minerals in medium and coarse grained rocks.

(c) Grain Size

Rock material descriptions should include general grouping of the size of the predominant mineral grains as defined in Table E2.2.1. The maximum size, or size range, of the larger mineral grains or rock fragments should be recorded.

TABLE E2.2.1. - GRAIN SIZE GROUPS

TERM	GRAIN SIZE (mm)
Very Coarse	>60
Coarse	2 - 60
Medium	0.06 - 2
Fine	0.002 - 0.06
Very Fine	<0.002
Glassy	

(d) Colour

The colour of the rock 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 by a combination of two colours, eg: grey-blue.

(e) Fabric

The fabric of a rock includes all the features of texture and structure, though the term refers specifically to the arrangement of the constituent grains or crystals in a rock. The fabric can provide an indication of the mode of formation of the rock:

- in sedimentary rocks bedding indicates depositional conditions,
- in igneous rocks the texture indicates the rate of cooling, and
- in metamorphic rocks the foliation indicates the stress conditions

Descriptions of fabric should include structure orientation, either with reference to North and horizontal, or to a plane normal to the core axis.

Tables E2.2.2, E2.2.3 and E2.2.4 list common textural features of sedimentary, igneous and metamorphic rocks with the subdivision of stratification spacing in Table E2.2.5.

TABLE E2.2.2 - COMMON STRUCTURES IN IGNEOUS ROCKS

STRATIFICATION (Planar)	STRATIFICATION (Irregular)
Bedding	Washout
Cross Bedding	Slump Structure
Graded Bedding	Shale Breccia
Lamination	
Cross Lamination	

TABLE E2.2.3 - COMMON STRUCTURES IN IGNEOUS ROCKS

	FINE GRAINED ROCKS	COARSE GRAINED ROCKS
Uniform Grain Size	Massive	Massive
	Flow Banded	Granitic
	Vesicular	Pegmatitic
Different Grain Size	Porphyritic	Porphyritic

TABLE E.2.2.4 - COMMON STRUCTURES IN METAMORPHIC ROCKS

FINE GRAINED ROCKS	COARSE GRAINED ROCKS
Slatey Cleavage	Granoblastic
Spotted	Porphyroblastic
Hornsfelsic	Lincated
Foliated	Gneissic
Mylonitic	Mylonitic

TABLE E2.2.5 - STRATIFICATION SPACING

TERM	SEPARATION (mm)
Very Thickly Bedded	>2000
Thickly Bedded	600 - 2000
Medium Bedded	200 - 600
Thinly Bedded	60 - 200
Very Thinly Bedded	20 - 60
Laminated	6 - 20
Thinly Laminated	<6

(f) Strength

Substance strength is one of the most important engineering features of a rock and every description should include at least an estimate of the rock strength class of the material. This estimate can be calibrated by test results, either by Point Loan Strength Index or by Unconfined Compressive Strength.

The rock strength class in As 1726-1981 is defined by Point Loan Strength Index I_s,(50). The relationship between Point Loan and Unconfined Strength is commonly assumed to be about 20, but can range from 4 (in some carbonate rocks) to 40 (in some igneous rocks). It is necessary to confirm the relationship for each rock type and project. classification should be based on material at field moisture content, as some rocks give a significantly higher strength when tested dry.

Table E2.2.6 defines the rock strength classes, with indicative field tests listed in Table E2.2.7 which assist in classification when testing equipment is not available.

TABLE E2.2.6 - CLASSIFICATION OF ROCK STRENGTH

SYMBOL	TERM	POINT LOAD STRENGTH (MPa)	APPROX Qu (MPa)
EL	extremely low	<0.03	<1
VL	very low	0.03 - 0.1	1 - 3
L	low	0.1 - 0.3	3 - 10
M	medium	0.3 - 1	10 - 30
H	high	1 - 3	30 - 70
VH	very high	3 - 10	70 - 200
EH	extremely high	>10	>200

TABLE E2.2.7 - FIELD TESTS FOR ROCK STRENGTH CLASSIFICATION

STRENGTH CLASS	FIELD TEST
Extremely Low	Indented by thumb nail with difficulty
Very Low	Scratched by thumb nail
Low	Easily broken by hand or pared with a knife
Medium	Broken by hand or scraped with a knife
High	Broken in hand by firm hammer blows
Very High	Broken against solid object with several hammer blow
Extremely High	Difficult to break against solid object with several hammer blows

(g) Weathering/Alteration

In addition to the description of rock substance as examined, an assessment is required of the extent to which the original rock material has been affected by subsequent events. The usual processes are:

- Weathering - Decomposition due to the effect of surface or near surface activities
- Alteration - Chemical modification by the action of materials originating from within the mantle below.

The classification of weathering/alteration presented in Table E2.2.8 is based on the extent/degree to which the original rock substance has been affected. This classification has little engineering significance, as the properties of the rock as examined may bear no relationship to the properties of the fresh rock.

TABLE E2.2.8 - CLASSIFICATION OR ROCK WEATHERING/ALTERATION

TERMS	DEFINITION
Fresh (Fr)	Rock substance unaffected.
Fresh Stained (FR St)	Rock substance unaffected. Staining of defect surfaces.
Slightly (SW)	Partial staining or discolouration of rock substance.
Moderately (MW)	Staining or discolouration extends throughout the whole rock substance.
Highly (HW)	Rock substance partly decomposed.
Completely (CW)	Rock substance entirely decomposed.

E2.3 Rock Mass

The engineering properties of rock mass reflect the effect which the presence of defects has on the properties of the rock substance. Description of the rock mass properties consists of supplementing the description covered by Section E2.2 with data on the defects which are present.

(a) Defect type

The different defect types are described in Table E2.3.1.

(b) Defect orientation

Descriptions of defects should include orientation, either of individual fractures or of groups of fractures. Orientation should be with reference to North and horizontal, or to a plane normal to the core axis.

TABLE E2.3.1 - ROCK DEFECT TYPES

TYPE	SYMBOL	DESCRIPTION
Parting	Pt	A defect parallel or subparallel to a layered arrangement of mineral grains or micro-fractures which has caused planar anistrophy in the rock substance.
Joint	Jt	A defect across which the rock substance has little tensile strength and is not related to textural or structural features with the rock substance.
Sheared Zone	SZ	A zone with roughly parallel planar boundaries or rock substance containing closely spaced, often slickensided, joints.
Crushed Zone	CZ	A zone with roughly parallel planar boundaries of rock substance composed of disoriented, usually angular, fragments of rock.
Seam	Sm	A zone with roughly parallel boundaries infilled by soil or decomposed rock.

(c) Defect features

The character of a defect is described by its continuity, planarity, surface roughness, width, and infilling.

Continuity In outcrop the extent of a joint, bedding plane or similar defect both along and across the strike can be measured. In core, continuity measurement is restricted to defects nearly parallel to the core axis.

Planarity Described as “Planar”, “Irregular”, “Curved” or “Undulose”.

Roughness Described as “Rough”, “Smooth”, “Polished” or “Slickensided”.

Width Measured in millimetres normal to the plane of nthe defect

Infilling Described as “Clean”, “Stained”, “Veneer” (<1 mm) or “Infill” (>1 mm). The coating or infilling material should be identified.

(d) Defect spacing

The spacing of defects, particularly where they occur in parallel groups or sets, provides an indication of the rock block sizes which:

- have to be supported in the face or roof of an excavation
- will be produced by the excavation operation.

It is preferable to provide measured data but discontinuity spacing is grouped as shown in Table E2.3.2.

TABLE E2.3.2 - DISCONTINUITY SPACING

DESCRIPTION	SPACING (mm)
Extremely Widely Spaced	>6000
Very Widely Spaced	2000 - 6000
Widely Spaced	600 - 2000
Medium Spaced	200 - 600
Closely Spaced	60 - 200
Very Closely Spaced	20 - 60
Extremely Closely Spaced	<20

APPENDIX B

POINT LOAD TEST RESULTS

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

Point Load Strength Index Report

Project: 74-78 Belmore Street, Ryde — Project No.: 17900/8471B
Client: Achieve Australia c/- NBRS — Report No.: 10/1501
Address: Lvl 3, 4 Glen St, Milsons Point — Report Date: 22/12/2010
Test Method: AS4233.4.1 — Page: 1 of 4

Sampling Proceedure: Geotechnical Investigation (Not covered under NATA Terms of Registration)

Date Samples Drilled / Taken: 12 Nov 2010

Borehole No. BH1

Depth	Test Type	Is(50) (Mpa)	Rock Type	Rock Structure	Moisture
8.29	D	0.13	SS	MA	M/D
	A	0.7	SS	MA	M/D
9.95	D	1.7	SS	MA	M/D
	A	3.3	SS	MA	M/D

Sampling Proceedure: Geotechnical Investigation (Not covered under NATA Terms of Registration)

Date Samples Drilled / Taken: 12 Nov 2010

Borehole No. BH2

Depth	Test Type	Is(50) (Mpa)	Rock Type	Rock Structure	Moisture
8.46	D	0.7	SS	MA	M/D
	A	1.6	SS	MA	M/D

STRUCTURE	TEST TYPE	MOISTURE CONDITION	ROCK TYPE
MA= MASSIVE	A= AXIAL	W= WET	SS= SANDSTONE
BE= BEDDED	D= DIMETRAL	M= MOIST	ST= SILTSTONE
LA= LAMINATED	I= IRREGULAR	D= DRY	SH= SHALE
CR= CRYSTALLINE	C= CUBE		YS= CLAYSTONE
			IG= IGNEOUS

Remarks:

Approved Signatory.

Technician:

Laurie Ihnativ - Manager

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

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Test Method: AS4233.4.1 —

Sampling Proceedure: Geotechnical Investigation (Not covered under NATA Terms of Registration)

Date Samples Drilled / Taken: 12 Nov 2010

Borehole No. BH3

Depth	Test Type	Is(50) (Mpa)	Rock Type	Rock Structure	Moisture
7.85	A	1.2	SH	LA	M/D
9.04	A	0.4	SH	LA	M/D

Sampling Proceedure: Geotechnical Investigation (Not covered under NATA Terms of Registration)

Date Samples Drilled / Taken: 12 Nov 2010

Borehole No. BH4

Depth	Test Type	Is(50) (Mpa)	Rock Type	Rock Structure	Moisture
8.34	D	0.5	SS	MA	M/D
	A	0.8	SS	MA	M/D
9.12	D	0.8	SS/SH	IB	M/D
	A	2.6	SS/SH	IB	M/D

STRUCTURE
MA= MASSIVE
BE= BEDDED
LA= LAMINATED
CR= CRYSTALLINE

TEST TYPE
A= AXIAL
D= DIMETRAL
I= IRREGULAR
C= CUBE

MOISTURE CONDITION
W= WET
M= MOIST
D= DRY

ROCK TYPE
SS= SANDSTONE
ST= SILTSTONE
SH= SHALE
YS= CLAYSTONE
IG= IGNEOUS

Remarks:

Approved Signatory.

Technician:

Laurie Ihnativ - Manager

SMEC Testing Services Pty Ltd
14/1 Cowpasture Place, Wetherill Park NSW 2164
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Point Load Strength Index Report

Project: 74-78 Belmore Street, Ryde — Project No.: 17900/8471B
Client: Achieve Australia c/- NBRS — Report No.: 10/1501
Address: Lvl 3, 4 Glen St, Milsons Point — Report Date: 22/12/2010
Test Method: AS4233.4.1 —

Sampling Proceedure: Geotechnical Investigation (Not covered under NATA Terms of Registration)

Date Samples Drilled / Taken: 12 Nov 2010

Borehole No. BH5

Depth	Test Type	Is(50) (Mpa)	Rock Type	Rock Structure	Moisture
7.85	D	0.1	SH	LA	M/D
	A	0.9	SH	LA	M/D
9.18	D	1.2	SH/SS	IB	M/D
	A	1.6	SH/SS	IB	M/D

Sampling Proceedure: Geotechnical Investigation (Not covered under NATA Terms of Registration)

Date Samples Drilled / Taken: 12 Nov 2010

Borehole No. BH6

Depth	Test Type	Is(50) (Mpa)	Rock Type	Rock Structure	Moisture
8.34	D	1.2	SS/SH	IB	M/D
	A	1.4	SS/SH	IB	M/D
9.12	D	1.9	SS	IB	M/D
	A	2.5	SS	IB	M/D

STRUCTURE
MA= MASSIVE
BE= BEDDED
LA= LAMINATED
CR= CRYSTALLINE

TEST TYPE
A= AXIAL
D= DIMETRAL
I= IRREGULAR
C= CUBE

MOISTURE CONDITION
W= WET
M= MOIST
D= DRY

ROCK TYPE
SS= SANDSTONE
ST= SILTSTONE
SH= SHALE
YS= CLAYSTONE
IG= IGNEOUS

Remarks:

Approved Signato .....

Technician:

Laurie Ihnativ - Manager

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14/1 Cowpasture Place, Wetherill Park NSW 2164
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Point Load Strength Index Report

Project: 74-78 Belmore Street, Ryde — Project No.: 17900/8471B
Client: Achieve Australia c/- NBRS — Report No.: 10/1501
Address: Lvl 3, 4 Glen St, Milsons Point — Report Date: 22/12/2010
Test Method: AS4233.4.1 — Page: 4 of 4

Sampling Proceedure: Geotechnical Investigation (Not covered under NATA Terms of Registration)

Date Samples Drilled / Taken: 12 Nov 2010

Borehole No. BH5

Depth	Test Type	Is(50) (Mpa)	Rock Type	Rock Structure	Moisture
7.04	D	1.3	SH/SS	IB	M/D
	A	2.9	SH/SS	IB	M/D
9.14	D	1.1	SH/SS	IB	M/D
	A	1.7	SH/SS	IB	M/D

Sampling Proceedure: Geotechnical Investigation (Not covered under NATA Terms of Registration)

Date Samples Drilled / Taken: 12 Nov 2010

Borehole No. BH6

Depth	Test Type	Is(50) (Mpa)	Rock Type	Rock Structure	Moisture
7.04	D	1.2	SS	IB	M/D
	A	1.5	SS	IB	M/D
9.08	D	1.7	SS	IB	M/D
	A	2.1	SS	IB	M/D

STRUCTURE	TEST TYPE	MOISTURE CONDITION	ROCK TYPE
MA= MASSIVE	A= AXIAL	W= WET	SS= SANDSTONE
BE= BEDDED	D= DIMETRAL	M= MOIST	ST= SILTSTONE
LA= LAMINATED	I= IRREGULAR	D= DRY	SH= SHALE
CR= CRYSTALLINE	C= CUBE		YS= CLAYSTONE
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Remarks:

Approved Signatory..

Technician: Laurie Ihnativ - Manager