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PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT:
LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT, NSW

PREPARED FOR JACFIN PTY LTD.
CES DOCUMENT REFERENCE: CES100604-JBA-AF

Authorised by: **Dr Michael Petrozzi**
Client: Jacfin Pty Ltd
Date: 18 August 2010

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3	CES100604-JBA-AE	16/08/2010	DRAFT: PRELIMINARY GEOTECHNICAL REPORT ADDRESSING DIRECTOR GENERAL COMMENTS
4	CES100604-JBA-AF	18/08/2010	FINAL: PRELIMINARY GEOTECHNICAL REPORT

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1 INTRODUCTION

Consulting Earth Scientists Pty Ltd (CES) was commissioned by Jacfin Pty Ltd, to undertake a geotechnical investigation for the site comprising Lot 5 in DP 262213 Ropes Creek Employment Precinct, New South Wales (herein referred to as 'the site'). A Preliminary Environmental Site Assessment (ESA) was also undertaken by CES and is reported separately (CES100604-01-D, 2010). Both the preliminary geotechnical report and the preliminary environmental assessment was undertaken in general accordance with our proposal dated 2 July 2010 (CES100604-JBA-AB).

It is understood by CES that the property is to be developed for industrial and employment purposes including but not limited to warehouse, storage and distribution facilities and manufacturing uses (Refer to Concept Plans "Lot 5 DP 262213, Ropes Creek Employment Precinct" JBA drawings CP001 to CP0017 dated 6 August 2010.

The purpose of this investigation is to obtain preliminary geotechnical information regarding subsurface ground and groundwater conditions. This includes provision of preliminary recommendations regarding earthworks and site preparation, excavation conditions and support, suitable foundation systems, pavement design parameters and construction recommendations. Preliminary geotechnical advice is also provided with regards to groundwater issues, soil erosion issues, assessment of soil salinity, sodicity, dispersion potential and soil aggressivity to buried structural elements and a preliminary assessment of geotechnical constraints identified during the baseline investigation.

2 THE SITE

2.1 SITE LOCATION

The site is located at Lot 5 in DP 262213, which is situated approximately 2.5km west of the intersection of Wallgrove Road and Old Wallgrove Road, Blacktown, NSW.

2.2 SITE DESCRIPTION

The following description of the site is based upon observations made during the fieldwork and information provided by JBA Pty Ltd.

The site covers an area of 105 hectares and is roughly square in shape. The western boundary is marked by Rope's Creek and the southern boundary is delineated by the easement of the Sydney Water Supply Pipeline.

The site is characterised by generally flat topography gently sloping westwards towards Rope's Creek. The site is currently cleared grazing land traversed by two ephemeral creek lines, one passing roughly east-west through the centre of the site and the other passing roughly southeast to northwest in the southwest corner of the site. A small farm dam was located within the central section of the site and high voltage transmission lines were observed to traverse the site in a west to south-west direction from the adjoining Transgrid Substation located to the east of the site. With the exception of the transmission lines, no permanent structures were observed at the time of this investigation.

2.3 REGIONAL GEOLOGY

Review of the Penrith 1:100 000 Geological Series Sheet 9030 (Department of Mineral Resources, 1991) indicates that the site is underlain by the Bringelly Shale Formation of the Wianamatta Group. The Bringelly Shale Formation comprises shale, carbonaceous claystone, siltstone and fine to medium grained sandstone as well as rare coal.

3 METHOD OF INVESTIGATION

3.1 FIELDWORK

Fieldwork was undertaken between 7 and 14 July 2010 and comprised drilling five boreholes. A CES engineering geologist was present during fieldwork to locate and log boreholes, direct sampling and testing.

Boreholes were drilled using a truck mounted drilling rig utilising solid flight augers fitted with a steel 'V' shaped bit in soil. Standard Penetration Tests (SPTs) were carried out to assess soil strength and obtain samples for logging and laboratory testing. Drilling was continued into bedrock using triple tube rotary core drilling methods. The recovered cores were boxed onsite and photographed. Borehole logs and rock core photographs are enclosed in Appendix A.

Borehole locations were recorded using a handheld Global Positioning System (GPS) unit and the approximate ground levels of the borehole locations inferred from a site survey plan supplied to CES (RPS drawing reference: Lot 5 in DP 262213 Old Wallgrove Road, Eastern Creek – Contour Plan no. 5-104650-A). Borehole depths and positions are summarised in Table 1 and shown in Figure 1.

Table 1: Borehole Locations and Depths

Borehole	Easting	Northing	Termination depth	
			(mbgl)	(mAHD)
BH1	298662	6256420	11.7	49.1
BH2	297862	6256564	14.7	40.9
BH3	298273	6256150	8.6	45.4
BH4	298569	6255737	11.8	50.3
BH5	297753	6255603	11.85	40.65

The depth to groundwater, where practicable, was recorded during drilling of each borehole and within 24hrs of completion of drilling. Field screening for potentially saline and acid sulfate soils was also carried out on selected samples.

3.2 GEOTECHNICAL LABORATORY TESTING

Soil samples obtained during fieldwork activities were tested by SGS Australia Pty Ltd (SGS), a NATA accredited testing laboratory, for Emersion Dispersion Classification, California Bearing Ratio (CBR) Tests, Atterberg Limit and Linear Shrinkage Tests and Soil Aggressivity. The laboratory test results are presented in Appendix B and summarised in Table 5.

4 RESULTS OF THE INVESTIGATION

4.1 SUBSURFACE CONDITIONS

The ground conditions, observed in the boreholes, typically comprised topsoil, underlain by alluvial and residual soils over shale bedrock of the Wianamatta Group. Based on the information from the boreholes, a geotechnical model has been developed and is presented in Table 2. For a detailed description of the subsurface conditions encountered at each borehole refer to the borehole logs in Appendix A, together with the explanatory sheets describing the terms and symbols used.

Table 2: Summary of Subsurface Conditions at Borehole Locations and Inferred Geotechnical Model

Geotechnical Unit	Depth to base of unit		Thickness (m)	Description
	(mbgl)	(mAHD)		
1. Topsoil	-	-	0.1 to 0.2	CLAY: • Medium and high plasticity; • Brown; and • Firm.
2. Alluvium	0.4 to 2.7	52.8 to 61.7	0.4 to 2.55	CLAY or sandy CLAY: • Medium and high plasticity; • Orange/brown; and • Stiff to very stiff.
3. Residual Soil	1.2 to 5.9	51.2 to 60.0	0.4 to 3.2	Sandy CLAY or gravelly CLAY: • Medium and high plasticity; • Pale grey to grey; and • Stiff to hard.
4a. Weathered Shale	2.6 to 7.55	49.2 to 58.1	1 to 2	Interbedded SHALE and SANDSTONE: • Medium plasticity; • Dark grey, grey to pale grey; • Extremely low strength to low strength; • Extremely and highly weathered; • Recovered as a hard, low plasticity gravelly CLAY or very dense clayey GRAVEL. • Relict joints are widely spaced, steeply dipping.
4b. Moderately Weathered to Fresh Sandstone and Shale	Drilled to a maximum depth 14.7	Drilled to a maximum depth of 40.6	-	Interbedded SHALE and SANDSTONE: • Medium to high strength; • Dark grey and pale grey; • Massive to distinctly bedded at 0-5^{o}; • Joints are widely spaced, steeply dipping.

Geotechnical Unit	Depth to base of unit		Thickness (m)	Description
	(mbgl)	(mAHD)		
4c. Volcanic Breccia	11.2	44.4	2.3	VOLCANIC BRECCIA • Medium to high strength; • Grey/green; • massive to indistinctly bedded at 0-5°; • Joints are widely spaced, moderately to steeply dipping.

4.2 RESULTS OF FIELD SCREENING

The results of the soil salinity and acid sulfate field screening tests are summarised in Table 3.

Table 3: Summary and Assessment of Soil Salinity and Acid Sulfate Field Screening Tests

Borehole and sample depth (m.bgl)		Soil Salinity Test			Acid Sulfate Test	
		(mS)	EC_e (dS/m)	Assessed Salinity Level	pH	Assessed Acidity Level
BH1	0.50 – 0.95	0.50	4.30	Moderate	6	Neutral
	1.50 – 1.95	0.80	6.88	High	7	Neutral
	3.00 – 3.45	0.40	3.44	Moderate	7	Neutral
BH2	0.35 – 0.40	0.10	0.86	Very slightly	7	Neutral
BH3	0.50 – 0.95	0.30	2.58	Moderate	7	Neutral
	1.50 – 1.95	1.10	9.46	High	7	Neutral
BH4	0.50 – 0.95	0.40	3.44	Moderate	6	Neutral
	1.50 – 1.95	0.20	1.72	Slightly	7	Neutral
BH5	0.50 - 0.95	0.60	5.16	Moderate	8	Neutral
	1.50 – 1.95	0.50	4.30	Moderate	8	Neutral
	3.00 – 3.45	0.40	3.44	Moderate	8	Neutral

4.3 GROUNDWATER

Groundwater seepage was not observed during drilling operations; however groundwater levels measured within 24hrs of the borehole completion are shown in Table 4.

Table 4: Summary of Groundwater Levels

Location	Observation Details			Groundwater Level	
	Date	Time	Period after drilling	(mbgl)	(mAHD)
BH1	8 July 2010	8:00am	16hrs	3.4	57.4
BH2	9 July 2010	8:00am	16hrs	5.3	50.3
BH3	12 July 2010	4:00pm	72hrs	2.1	51.9
BH4	12 July 2010	8:00am	64hrs	2.35	59.8
BH5	12 July 2010	3:30pm	4hrs	2.55	49.9

5 LABORATORY TEST RESULTS

Laboratory test results are summarised in Table 5 and provided in full in Appendix B.

Table 5: Summary of Laboratory Testing Results

Unit	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Linear Shrinkage (%)	Emerson Classification	CBR (%) (Note 1)	CBR Swell After Soaking (%)	Maximum Dry Density (Tonnes/m^3)	Optimum Moisture Content (%)	pH	Chloride (mg/kg)	Sulphate (mg/kg)	Exchangeable Sodium (Na) (%)	Exchangeable Potassium (K) (%)	Exchangeable Calcium (Ca) (%)	Exchangeable Magnesium (Mg) (%)
Unit 2 (Alluvium)	38	12	26	12	Class 5	1	3.6	1.67	18	6 to 8	500	84	N/A	N/A	N/A	N/A
Unit 3 (Residual Soil)	45	17	28	13.5	Class 5	1	4.6	1.59	20.5	6 to 7	N/A	N/A	1	1	1	1

Note 1: CBR tests carried out on 4 day soaked sample compacted to 100% Standard Maximum Dry Density Ratio.

The laboratory test results indicate that both the Unit 2 (Alluvium) and Unit 3 (Residual Soil) are soils of medium plasticity with a moderate potential for volume change. These units both have low CBR values of 1% and relatively high CBR swell values, indicating that these materials will provide a soft expansive subgrade.

The results of the Emersion Dispersion testing shows that both the Unit 2 (Alluvium) and Unit 3 (Residual Soil) have an Emerson Class of 5, indicating that these materials are not likely to be dispersive.

The Unit 2 (Alluvium) and Unit 3 (Residual Soil) have relatively neutral pH values and contain relatively low concentrations of chloride and sulphate. Unit 3 is also low with regards to exchangeable amounts of sodium, potassium, calcium and magnesium.

6 DISCUSSION AND RECOMMENDATIONS

6.1 EARTHWORKS AND SITE PREPARATION

Indicative areas of bulk earthworks are shown in Concept Plan drawing CP016 entitled "Lot 5 DP 262213, Ropes Creek Employment Precinct - Indicative Cut and Fill".

The thickness of Unit 1 (Topsoil) varied from 0.1m to 0.2m at the borehole locations and will require striping and stockpiling. Use of Unit 1 should be limited to landscaping fill.

Once vegetation and Unit 1 have been removed, Units 2 (Alluvium) and 3 (Residual Soil) will be exposed. These materials are likely to have poor trafficability characteristics when wet such as after periods of heavy rainfall. Erosion and sediment controls should be implemented during earthworks in accordance with the requirement of the Landcom publication "Managing Urban Stormwater: Soils and Construction".

6.2 EXCAVATION CONDITIONS AND SUPPORT

6.2.1 Excavatability

It is understood that cuttings will be excavated t the site which are likely to encounter all of the geotechnical units outlined in the preliminary geotechnical model (Table 2). A hydraulic excavator or bulldozer blade and bucket should be adequate for excavation in Unit 2 (Alluvium), Unit 3 (Residual Soil) and 4a (Weathered Rock). Unit 4b (Moderately Weathered Rock) is likely to require considerably more effort, such as the use of ripping and Unit 4c (Volcanic Breccia) will likely require excavators using a hydraulic breaker.

Contractors should be required to examine the engineering logs and core photographs (Appendix A) to make their own assessment of excavation plant and production rates.

6.2.2 Permanent and Temporary batter slopes

Excavations into Unit 2 (Alluvium) and Unit 3 (Residual Soil) should stand at temporary slopes of 1.5H (horizontal): 1V (vertical).

Permanent batter slopes in Unit 2 (Alluvium) and Unit 3 (Residual Soil) should not exceed 2.5H: 1V. Permanent batter slopes in Unit 4a (Weathered Rock) should not exceed 1.5H:1V unless protected. Permanent batter slopes will begin to deteriorate if left exposed and should be protected against erosion using shotcrete, vegetation, geotextile or similar. Permanent batter slopes in Units 4b (Moderately Weathered Rock) and 4c (Volcanic Breccia) may be constructed vertically. Exposed rock faces should be assessed by a geotechnical practitioner for stability.

Localised application of shotcrete and installation of rock bolts and other such stabilisation methods may be required.

CES recommends that allowance be made for laying back temporary excavations exceeding 1.5m to 1.5H:1V where workers require access. Surcharge loads should be kept well clear of the crest of cuts.

6.2.3 Excavation support

Where there is insufficient area available to form unsupported batters, Unit 2 (Alluvium) and Unit 3 (Residual Soil) will require support / retaining walls.

The design of any retaining structures should make allowance for all applicable surcharge loading including construction activities around the perimeter of the excavation and adjacent buildings. In addition to lateral earth pressures and surcharge loads, consideration should be given to the possibility of a hydrostatic pressure due to build-up of water behind the wall unless permanent subsurface drainage can be provided.

Exposed rock faces of Unit 4b (Moderately Weathered Rock) and Unit 4c (Volcanic Breccia) should be assessed by a geotechnical practitioner for excavation support. Localised application of shotcrete and installation of rock bolts and other such stabilisation methods may be required.

6.3 PAVEMENT SUBGRADE

Unit 2 (Alluvium) and Unit 3 (Residual Soil) are of variable thickness and depth across the site. Laboratory testing indicates that the materials are medium to high plasticity with a low CBR value of 1%. As a result, these units are considered a poor bearing stratum for pavements without modification. Options for subgrade improvement or replacement are outlined in sections 6.3.1 and 6.3.2. More extensive sampling and testing will be required once the requirements of the proposed development have been finalised.

6.3.1 Lime Modification

Subgrade improvement could be by lime stabilisation. The addition of 4% hydrated lime (percentage dry weight of soil) by specialist pulverising, mixing and recompacting to a maximum dry density ratio of 100% (Standard Compaction) should raise the insitu CBR value of the subgrade and a design value of 3% could be adopted. CES's previous experience of similar Unit 2 (Alluvium) and Unit 3 (Residual Soil) soil indicates that CBR values greater than this may be achievable with the addition of greater proportion of lime. The effectiveness of the lime stabilisation is dependant on many factors such as construction method, construction plant used, the degree of original soil pulverisation, the original moisture content of the soil, the type and properties of the lime and the mineralogy of the clay in the soil. The effectiveness of lime

stabilisation and the optimum percentage should be ascertained and checked by laboratory testing and field trials.

In accordance with AS3798-2007 it is recommended that Level 1 earthworks control is used during bulk earthworks and pavement construction. All pavements should be provided with long term surface and subsurface drainage to protect the subgrade from moisture ingress.

6.3.2 Subgrade Replacement

Subgrade replacement could be carried out by placing well graded, durable, non-expansive granular material of 60mm maximum size. The fill should be placed in maximum 200mm compacted layer thicknesses and compacted to 100% Standard Density Ratio at a moisture content within ±2% of Standard Optimum Moisture Content.

A preliminary assessment indicates that placing a 300mm thick layer of suitable fill with a remoulded CBR value of at least 20% should raise the insitu CBR value of the subgrade to at least 3%. Pavements should however be designed on the basis of the CBR value of the actual replacement material and the effectiveness of the subgrade replacement should be checked by laboratory testing and field trials.

Although not expected for this site, the importation of fill material onto site should be undertaken in such a manner that all obligations under the *Protection of the Environment and Operations Act 1997* and the *Environmental Planning Assessment Act 1979,* are met.

6.4 GROUNDWATER ISSUES

Groundwater was encountered in all boreholes between levels of 2.1mbgl and 5.3mbgl (RL 50mAHD and RL 60mAHD) at the interfaces between Units 2 (Alluvium) and 3 (Residual Soil), and Units 3 (Residual Soil) and 4 (Weathered Rock).

In consideration of the above it is expected that groundwater will be encountered in excavations below about 2mbgl (RL 50mAHD and RL 60mAHD), particularly after periods of heavy rain. Where the cuttings do not extend to significant depths below groundwater level such seepage is expected to be controllable by conventional sump pumping methods. However, in areas where the cuttings extend to a depth considerably below groundwater level, consideration to a formal dewatering system such as the installation of dewatering wells may be necessary.

Should earthworks be proposed at significant depths below the groundwater table, it is recommended that further investigation to adequately characterise the hydrological regime in areas of deep cuts be carried out. Measures should also be included as part of the development

to ensure that adequate drainage is in place to facilitate the controlled and environmentally responsible removal of surface and groundwater.

6.5 FOUNDATIONS

6.5.1 Shallow Footings

The bearing capacity of the ground will be dependent on the foundation type adopted for the various structures to be constructed. The choice of foundation will depend on cost, the applied loads, loading arrangement and the resulting total and differential settlements anticipated and the sensitivity of the structures to movement. As a general design guide, the following preliminary allowable bearing pressures should be able to be adopted for pad and strip footings or the edge and internal beams of raft slabs:

Table 6: Preliminary Allowable Bearing Pressures for Shallow Footings

Material	Preliminary Allowable Bearing Pressure (kPa)
Unit 2 (Alluvium)	100
Unit 3 (Residual Soil)	150
Unit 4a (Weathered Shale)	700

Settlement of up to 1% of footing width could occur for footings designed for the above bearing pressures. Where the depth to rock exceeds 1.5m it may be necessary to adopt bored piles unless footings excavations are shored or battered. The above is a preliminary assessment and specific foundation design should be carried out once the requirements of the proposed development have been finalised.

It should be noted that Units 2 (Alluvium) and Unit 3 (Residual Soil) are assessed to have a significant potential for volume change on wetting and drying (shrink/swell). Shallow footings founded in these materials should be designed to consider this soil characteristic. Furthermore, Unit 2, Unit 3 and Unit 4a (Weathered Rock) may soften in footing excavations. The footing should be dewatered, cleaned and concreted within 12 hours of excavation or a blinding layer of concrete should be placed to protect the base. An experienced geotechnical practitioner should visually inspect the footing excavations prior to blinding to confirm that the founding material is suitable for the adopted design parameters.

6.5.2 Piles

Open bored piles or continuous flight auger piles could be adopted where the depth to rock exceeds practical excavation depths for strip and pad footings. We would expect that with appropriate capacity piling rigs, piles should be able to penetrate to Unit 4b (Moderately Weathered Rock). An experienced geotechnical practitioner should observe boring of the piles

in order to assess the rock levels and to confirm that the rock is suitable for the adopted design parameters. Allowable design parameters for bored piles are provided in Table 7. The use of the recommended allowable bearing pressures would be expected to result in pile settlement of about 1% of pile diameters.

Table 7: Preliminary Foundation Design Parameters

Geotechnical Unit	Allowable Bearing Pressures (kPa)	Allowable Shaft Adhesion for Piles (kPa) [1]
Unit 4a (Weathered Rock)	700	50
Unit 4b (Moderately Weathered Rock)	3000	300

Note 1: Shaft adhesion should only be assumed where piles have a minimum embedment of at least 3 pile diameters into the nominated stratum and a rough socket (at least grooves of depth 1mm to 4mm and width greater than 5mm spacing of 50mm to 200mm). The socket should be cleaned and roughened by a suitable scraper such as a tooth, orientated perpendicular to the auger shaft.

Open bored piles may require temporary liners through Units 2 and 3 or if groundwater seepage occurs. Piles should be cleaned, dewatered and concreted without delay to prevent softening of the pile base.

For uplift capacity, the shaft adhesion value should be multiplied by 0.6. In addition to shaft adhesion, the uplift capacity should be checked for a cone pullout failure mode assuming a cone angle of 70° considering the submerged weight of the soil or rock and adopting a factor of safety of 1.0 against pullout.

This assessment is a preliminary investigation, further boreholes should be drilled at the proposed structures to assess founding levels across the footprint of the structure. Piling contractors should undertake their own assessment of rock core to assess suitability of piling plant.

6.5.3 Slab On-Ground Construction

The potential for uplift pressures and ground movements acting on the ground floor slab of the building due to shrinkage and swelling of the Unit 2 (Alluvium) and Unit 3 (Residual Soil) should be considered. This may be done by moisture conditioning through tyning and recompaction during earthworks. A sub-base of good quality crushed rock should be placed beneath floor slabs.

6.6 LOT CLASSIFICATION IN ACCORDANCE WITH AS2870

For the design of residential structures and structures with areas and loads consistent with residential structures, classifications of individual lots should be carried out in accordance with

AS2870-1996 “Residential Slabs and Footings”. A limited number of tests were carried out as part of this investigation on samples from the boreholes, which were generally located in areas underlain by Unit 2 (Alluvium) and Unit 3 (Residual soils). The Atterberg limits and linear shrinkage test results infer a high shrink swell potential, which may result in a ‘H’ Lot classification in areas underlain by Units 2 and 3.

It should be noted that the above classification is preliminary and that further, lot specific assessments should be carried out once the requirements of the proposed development have been finalised.

6.7 ASSESSMENT OF SOIL SALINITY AND SODICITY

Field screening for salinity levels within Units 2 (Alluvium) and Unit 3 (Residual Soil) indicate that these geotechnical units are typically moderately to slightly saline. The exception to the rule was a sample tested at a depth of 1.5m at BH3. This sample was assessed to be highly saline and further testing was carried out at a NATA accredited analytical laboratory to characterise the nature of the salinity. Further analysis of the selected sample indicates a low percentage of exchangeable sodium (Refer to Appendix B). The saline sample was located within the low-lying area at the centre of the site and indicates that problems associated with saline soils may occur within low-lying areas of the site.

Saline and Sodic Soils are characterised by slow rates of water infiltration (from rain or irrigation), poor water and nutrient transport within the soil, restricted vegetation growth and severe surface crusting. When wet, these soils are boggy and soft. If saline/sodic material is exposed or brought close to the surface by the development, it may prevent or retard the establishment of vegetation and where excess water enters the site, this material may also prevent or retard water from moving vertically through the soil profile. This may result in soil erosion issues and/or problematic drainage conditions.

Typical mitigation measures for saline soils include:

- Avoiding exposure and disturbance of the sodic soil e.g. minimising cutting and filling.
- Minimise the infiltration of stormwater and provide good surface and sub-surface drainage. Establish adequate drainage measures in poorly drained areas.
- Minimise water input and maintain natural water balance.
- Use of gypsum or lime to ameliorate sodic soils.
- Retain existing vegetation and planting of suitable vegetation in areas susceptible to erosion.
- Provision of damp proof membranes under slabs and foundations, typically underlain by at least 50mm of sand to allow free drainage.

Once the requirements for the proposed development is finalised, it is recommended that further assessment of the soils in low-lying areas of the site is carried out to assess whether or not a Salinity Management Plan is necessary for the proposed development.

6.8 SOIL DISPERSION POTENTIAL

The results of the Emerson classification testing indicate that Units 2 (Alluvium) and Unit 3 (Residual Soil) are both Class 5 and as such are not anticipated to have a tendency to be dispersive. This assessment is further supported by the electrical conductivity, pH and cation exchange capacity test results.

6.9 ACID SULFATE SOILS

The acid sulfate soil field screening (Table 3) indicates that acid sulfate soils are unlikely to be present at the site.

6.10 SOIL AGGRESSIVITY

The results of soil aggressivity testing of Unit 2 (Alluvium) and Unit 3 (Residual Soil) indicate that these soils may be considered non-aggressive to concrete and steel as determined with reference to Australian Standard AS 2159-1995 Piling –Design and Installation.

6.11 GEOTECHNICAL CONSTRAINTS

Based on the results of this preliminary geotechnical investigation, the following geotechnical constraints are assessed:

- Low CBR values for Unit 2 (Alluvium) and Unit 3 (Residual Soil), indicating a poor foundation for roads and pavements and a potential requirement for ground improvement (Refer to Section 6.3).
- Groundwater in areas of cutting that require further investigation and may require active groundwater management measures during and following construction (Refer to Section 6.4).
- Soils (Unit 2 and Unit 3) with a high potential for significant volume change with change in moisture content i.e. Reactive Soils (Refer to Section 6.6).
- The possible presence of Saline Soils in low-lying areas (Refer to Section 6.7).

7 RESPONSE TO DIRECTOR GENERALS REQUIREMENTS

CES has reviewed the requirements stated by the Director General of the NSW Department of Planning in his letter dated 13 August 2010. CES response to items applicable to our scope of work is as follows (items applicable to CES scope of work are shown in italics).

Section	Title	DGR Comment	CES Response
Key Issues	• Soil and Water	Including water supply and efficiency, *proposed erosion and sediment controls (during construction)*; the proposed stormwater management system for site; detailed considerations of any potential. Offsite drainage or flooding impacts; consideration of the potential for rainwater harvesting, wastewater disposal; and *soil salinity and contamination*.	Erosion and sediment controls during construction are described in Section 6.1 of this report. An assessment of soil salinity is presented in Section 6.7 of this report. A Stage 1 Preliminary Site Investigation was carried out by CES to identify and assess likely contaminants or potential environmental issues, resulting from past and/or present activities undertaken on or adjacent to the site which may affect the sites suitability for the proposed commercial/industrial land use. The results of this investigation are presented in CES document: CES100604-JBA-01-D

8 LIMITATIONS

This is a preliminary geotechnical investigation report, CES recommends further investigation for detailed design and to confirm the ground conditions at the proposed building locations once the development details are finalised.

The findings within this report are the result of discrete/specific investigations methodologies used in accordance with normal practices and standards. Subsurface conditions can change over relatively short distances and the subsurface conditions revealed at the test locations may not be representative of subsurface conditions across the site. We recommend that an experienced geotechnical practitioner be engaged during construction to confirm the subsurface conditions are consistent with design assumptions.

FIGURES

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Title

Figure 1: Site Layout Plan and Borehole Locations

CES Project ID:	Date:
CES100604-JBA	23/07/2010
Prepared By: S.Burnett	Checked By: M.Pickett

APPENDIX A

BOREHOLE LOGS, CORE PHOTOGRAPHS & EXPLANATORY NOTES

Project ID:	CES100604-JBA
Client:	Jacfin Ptd Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

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Sheet: 1 of 3

X-Coord:	298662	**Date Commenced:**	7/07/2010	**Logged by:**	M.Pickett
Y-Coord:	6256420	**Date Completed:**	7/07/2010	**Checked by:**	D.Lowe
Surface Elevation (R.L) :	60.8 m AHD	**Hole Diameter (mm):**	76		

Drilling Information				LITHOLOGY					Samples	Tests		
Depth (mBGL)	R.L. (m)	Method (Support)	Water	Symbol	USCS Symbol	Description SOIL TYPE: plasticity or particle characteristics colour, moisture, secondary and minor component	Consistency / Density	Moisture	Sample ID	SPT	Pocket Penetrometer (kPa) 100 200 300 400	Notes and additional observations
0		ADV	▽		CH	CLAY: High plasticity, brown with roots and organic matter	F	>Wp				TOPSOIL
					CL	CLAY: Medium plasticity, orange/ brown with black mottling with some fine grained sand.	ST		SPT0.5MGRCBH1	4, 5, 7 N* = 12		ALLUVIAL CLAY
1	60					1.3m becoming mottled orange, brown, grey and black.	VSt		SPT1.5MGRCBH1	5,7,9 N*=16		
2	59											
3	58				CH	CLAY: Medium to high plasticity, mottled orange and pale grey with bands of hard shale up to 50mm thick	H		SPT3.0MGRCBH1	5,11,22 N*=33		RESIDUAL SOIL
4	57				CH	CLAY: High plasticity, grey to pale grey with some extremely weathered shale bands			SPT4.5MGRCBH1	14,30/120mm N=R		
5	56											'V-Bit' Refusal
6	55	ADT				SHALE: Extremely weathered, dark grey to grey (remoulds to low plasticity clay)				10/40m-- N=R		SHALE SPT = Hammer Bouncing
7	54											
8	53					Begin Core Drilling				10/30mm -- N=R		SPT = Hammer Bouncing
9	52											
10	51											

Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt
Machine Type:	E50 - AV 08 MS		

Refer to Standard Sheets for details of abbreviations

Project ID:	CES100604-JBA
Client:	Jacfin Pty Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

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Corehole ID: BH1

Sheet: 2 of 3

X-Coord:	297862	**Date Commenced:**	7/07/2010	**Logged by:**	M.Pickett
Y-Coord:	6256420	**Date Completed:**	7/07/2010	**Checked by:**	D.Lowe
Surface Elevation (R.L):	60.8 m AHD	**Hole Diameter (mm):**	76		

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
0	60	NMLC	0%			SHALE: Dark grey, distinctly bedded at 0-5 degrees with some pale grey fine grained sandstone interbeds. 8.35 - 8.5: Disturbed bedding.	Fr			100%		Pt, 0 deg, Pl, Vw, GREY CLAY -9.3 to -9.93 = HIGHLY FRACTURED CORE. -9.98 to -10.03 = HIGHLY
1	59											
2	58											
3	57											
4	56											
5	55											
6	54											
7	53											
8	52											
9	51											
10												

Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt
Machine Type:	E50 - AV 08 MS		

Refer to Standard Sheets for details of abbreviations

Project ID: CES100604-JBA
Client: Jacfin Pty Ltd
Project: Ropes Creek
Location: Lot 5, DP 262213, Ropes Creek, Employment Precinct

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Corehole ID: BH1

X-Coord: 297862
Y-Coord: 6256420
Surface Elevation (R.L): 60.8 m AHD
Date Commenced: 7/07/2010
Date Completed: 7/07/2010
Hole Diameter (mm): 76
Logged by: M.Pickett
Checked by: D.Lowe

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
10	50		0%			11.35: Disturbed bedding with some fine grained sandstone.				95%		FRACTURED CORE Pt, 0 deg, Pl, Co, GREY CLAY SM, 0 deg, Pl, GREY CLAY, 10mm. Pt, 5 deg, Pl, Vn, GREY CLAY JT, 80 deg, Pl, CN
11						End of borehole.						
12	49											
13	48											
14	47											
15	46											
16	45											
17	44											
18	43											
19	42											
20	41											

Drill Company: Macquarie Drilling
Machine Type: E50 - AV 08 MS
Operator Name: Brett Wyatt

Refer to Standard Sheets for details of abbreviations

Date:	22/07/2010	Title:	BH1 Rope's Creek 7.55m to 11.70m
Prepared by:	M. Pickett		
Checked by:	D. Lowe	CES Project ID:	CES100604-JBA
Scale:	NTS		
Size:	A4	Client:	Jacfin Pty Ltd

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Project ID:	CES100604-JBA
Client:	Jacfin Pty Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

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LOG ID: BH2

Sheet: 1 of 3

X-Coord:	297862	**Date Commenced:**	8/07/2010	**Logged by:**	M Pickett
Y-Coord:	6256564	**Date Completed:**	8/07/2010	**Checked by:**	D.Lowe
Surface Elevation (R.L) :	55.6 m AHD	**Hole Diameter (mm):**	76		

Drilling Information				LITHOLOGY					Samples	Tests		
Depth (mBGL)	R.L. (m)	Method (Support)	Water	Symbol	USCS Symbol	Description SOIL TYPE: plasticity or particle characteristics colour, moisture, secondary and minor component	Consistency / Density	Moisture	Sample ID	SPT	Pocket Penetrometer (kPa) 100 200 300 400	Notes and additional observations
0	55	ADV			CH	CLAY: High plasticity, brown with some organic matter	Fm	>Wp				TOP SOIL
					CL		St					ALLUVIAL CLAY
1						CLAY: Medium plasticity, orange/ brown with a trace of fine grained sand	H		SPT0.5MGRCBH	5,15,18 N*=33		RESIDUAL SOIL
	54					CLAY: Medium plasticity, orange/ brown mottled pale grey/ black with some angular medium to coarse siltstone gravel			SPT1.5MGRCBH2	24,30,- N*=R		1.2m - V-bit Refused
2		ADT				SANDSTONE: Extremely weathered sandstone. fine grained, pale grey/ white mottled orange and dark grey with some ironstone nodules. estimated low strength						SANDSTONE SPT = Hammer Bouncing
	53									10/-,- N=R		'TC-BIT' Refusal
3						Begin Core Drilling						
	52											
4												
	51											
5												
	50											
6												
	49											
7												
	48											
8												
	47											
9												
	46											
10												

Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt
Machine Type:	ESO - AV 08 MS		

Refer to Standard Sheets for details of abbreviations

Project ID:	CES100604-JBA	**Corehole ID:**	
Client:	Jacfin Pty Ltd	**BH2**	
Project:	Ropes Creek		
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct	Sheet:	2 of 3

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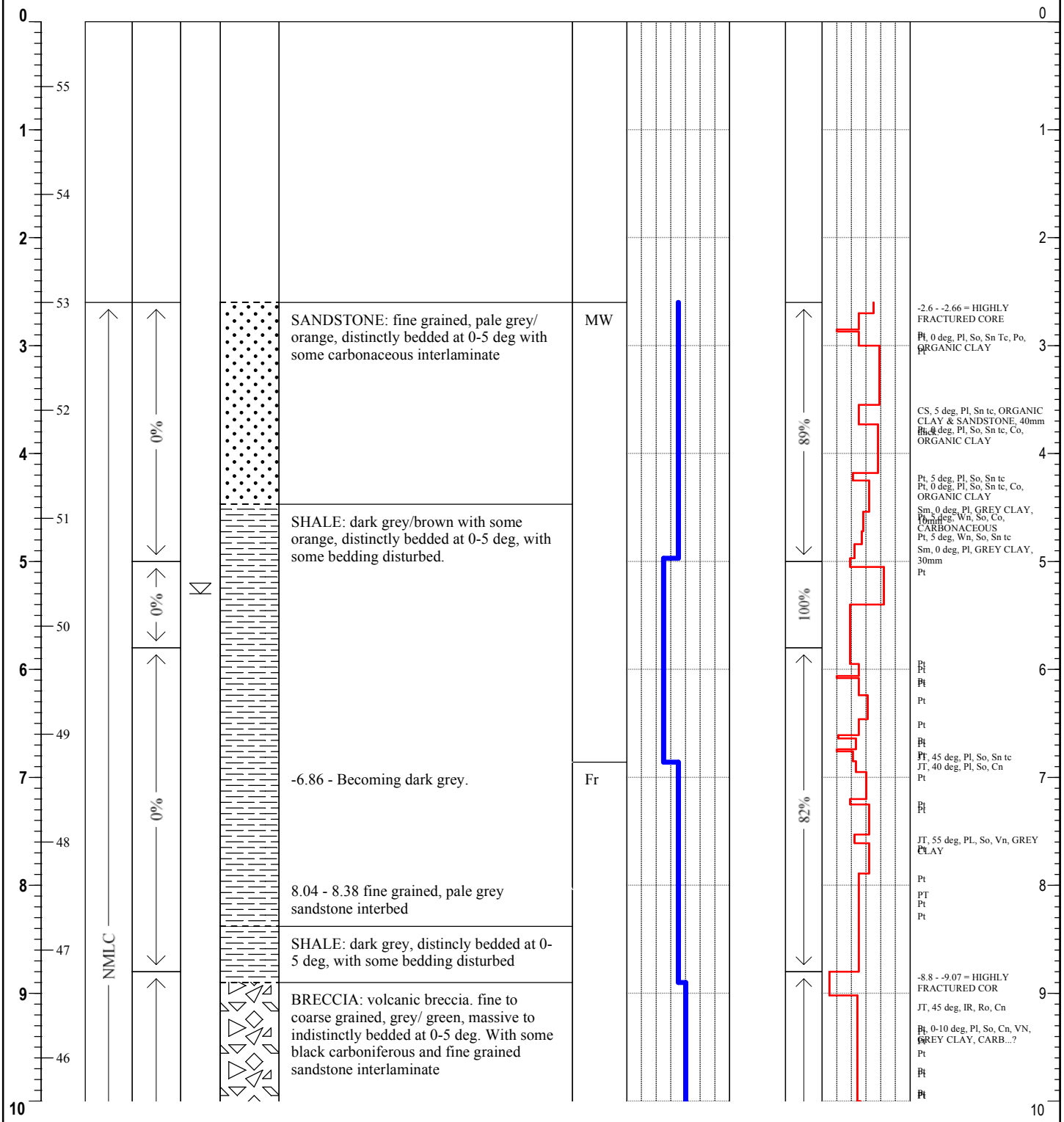
X-Coord:	297862	**Date Commenced:**	8/07/2010	**Logged by:**	M Pickett
Y-Coord:	6256564	**Date Completed:**	8/07/2010	**Checked by:**	D Lowe
Surface Elevation (R.L):	55.6 m AHD	**Hole Diameter (mm):**	76		

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description



Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt	Refer to Standard Sheets for details of abbreviations
Machine Type:	ESO - AV 08 MS			

Project ID:	CES100604-JBA
Client:	Jacfin Pty Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

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Corehole ID: BH2

X-Coord:	297862	**Date Commenced:**	8/07/2010	**Logged by:**	M Pickett
Y-Coord:	6256564	**Date Completed:**	8/07/2010	**Checked by:**	D Lowe
Surface Elevation (R.L):	55.6 m AHD	**Hole Diameter (mm):**	76		

Drilling Information | **LITHOLOGY** | **Natural Defects**

Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
10	45		0%							80%		Pt Pt Pt Pt Pt Pt, 0-10 deg, Pl, So, Cn, VN, GREY CLAY, CARBONACEOUS
11	44					SHALE: Dark grey, grey, distinctly bedded at 0 to 5 deg. With SST interbed, fine grained, grey.						Pt Pt Pt
12	43		0%							89%		Pt Pt Pt Pt Pt
13	42											Pt Pt Pt
14	41					End of borehole.						Pt
15	40											
16	39											
17	38											
18	37											
19	36											
20												

Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt
Machine Type:	ESO - AV 08 MS		

Refer to Standard Sheets for details of abbreviations

Date:	22/07/2010	Title:	BH2 Rope's Creek 2.60m to 14.70m
Prepared by:	M. Pickett		
Checked by:	D. Lowe	CES Project ID:	CES100604-JBA
Scale:	NTS		
Size:	A4	Client:	Jacfin Pty Ltd

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Project ID:	CES100604-JBA
Client:	Jacfin Pty Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

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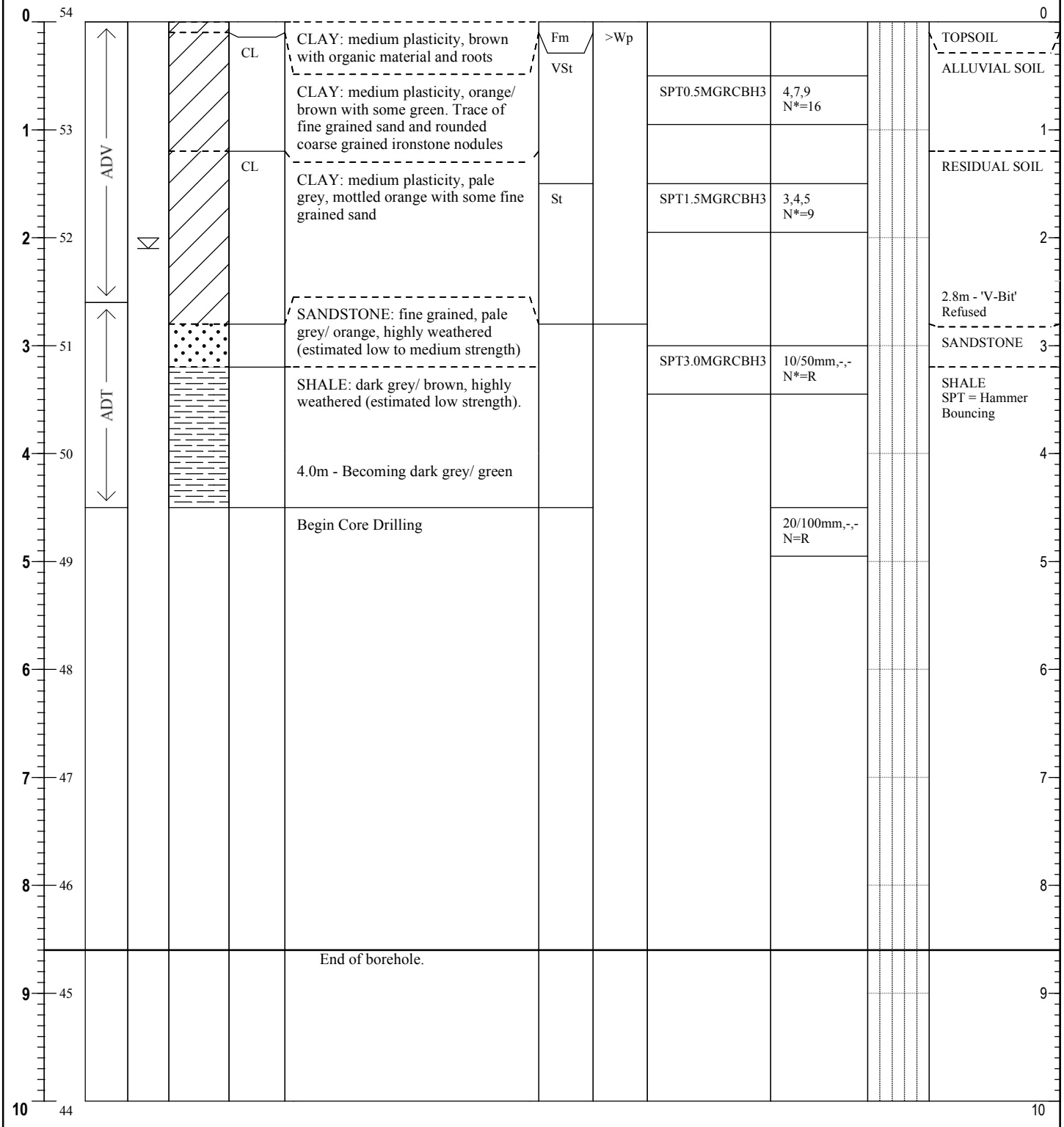
LOG ID: BH3

X-Coord:	298273	**Date Commenced:**	9/07/2010	**Logged by:**	M Pickett
Y-Coord:	6256150	**Date Completed:**	9/07/2010	**Checked by:**	D.Lowe
Surface Elevation (R.L) :	54.0 m AHD	**Hole Diameter (mm):**	76		



Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt
Machine Type:	E50 - AV 08 MS		

Refer to Standard Sheets for details of abbreviations

Project ID: CES100604-JBA
Client: Jacfin Pty Ltd
Project: Ropes Creek
Location: Lot 5, DP 262213, Ropes Creek, Employment Precinct

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Corehole ID: BH3

Sheet: 2 of 2

X-Coord: 298273
Y-Coord: 6256150
Surface Elevation (R.L.): 54.0 m AHD

Date Commenced: 9/07/2010
Date Completed: 9/07/2010
Hole Diameter (mm): 76

Logged by: M Pickett
Checked by: D Lowe

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
0	54											
1	53											
2	52											
3	51											
4	50											
5	49	NMLC	0%			SHALE: Dark grey with green, massive to indistinctly bedded at 0 to 5 deg, 4.5 to 4.68m - Remoulds to high plasticity Clay	EW / HW & MW			47%		-4.68 to -4.78 = HIGHLY FRACTURED CORE Pt, 0 deg, Pl, So, Sn tc -5.32 to -6.25 = HIGHLY FRACTURED CORE Pt, 0 to 5 deg, Pl, So, Co, GREY CLAY
6	48											
7	47		0%			SANDSTONE: fine grained, grey, massive to indistinctly bedded at 0-5 deg.	Fr			73%		Sm, 0 deg, Pl, GREY CLAY Pt, 5 deg, Pl, So, Co, GREY CLAY PT, 0 deg, Pl, So, Cn
8	46											Jt, 40 deg, Pl, So, Cn
9	45					End of borehole.						
10	44											

Drill Company: Macquarie Drilling
Machine Type: E50 - AV 08 MS
Operator Name: Brett Wyatt

Refer to Standard Sheets for details of abbreviations

Date:	22/07/2010	Title:	BH3 Rope's Creek 4.50m to 8.60m
Prepared by:	M. Pickett		
Checked by:	D. Lowe	CES Project ID:	CES100604-JBA
Scale:	NTS		
Size:	A4	Client:	Jacfin Pty Ltd

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Project ID:	CES100604-JBA
Client:	Jacfin Pty Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

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LOG ID: BH4

X-Coord:	298569	**Date Commenced:**	9/07/2010	**Logged by:**	M Pickett
Y-Coord:	6255737	**Date Completed:**	9/07/2010	**Checked by:**	D Lowe
Surface Elevation (R.L) :	62.1 m AHD	**Hole Diameter (mm):**	76		

Drilling Information				LITHOLOGY					Samples	Tests		
Depth (mBGL)	R.L. (m)	Method (Support)	Water	Symbol	USCS Symbol	Description SOIL TYPE: plasticity or particle characteristics colour, moisture, secondary and minor component	Consistency / Density	Moisture	Sample ID	SPT	Pocket Penetrometer (kPa) 100 200 300 400	Notes and additional observations
0	62				CH	CLAY: HP, brown with organic matter and roots	St	>Wp				TOPSOIL
					CH							ALLUVIAL SOIL
					CH	CLAY: high plasticity, orange/ brown			SPT0.5MGRCBH4	2,4,6 N*=10		RESIDUAL SOIL
1	61					CLAY: high plasticity, pale grey with mottled orange. at 1.40m with bands of fragmented shale and fine to coarse ironstone gravel			SPT1.5MGRCBH4	4,7,20 N*=27		
2	60		▽			SHALE: brown/ green, extremely weathered with bands of clay (estimated very low to low strength	Vst					SHALE
3	59								SPT3.0MGRCBH4	25,10/50mm, - N*=R		
4	58					Begin Core Drilling				25/130mm,-,- N=R		'V-Bit' Refusal SPT = Hammer Bouncing
5	57											
6	56											
7	55											
8	54											
9	53											
10												

Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt
Machine Type:	E50 - AV 08 MS		

Refer to Standard Sheets for details of abbreviations

Project ID:	CES100604-JBA
Client:	Jacfin Pty Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

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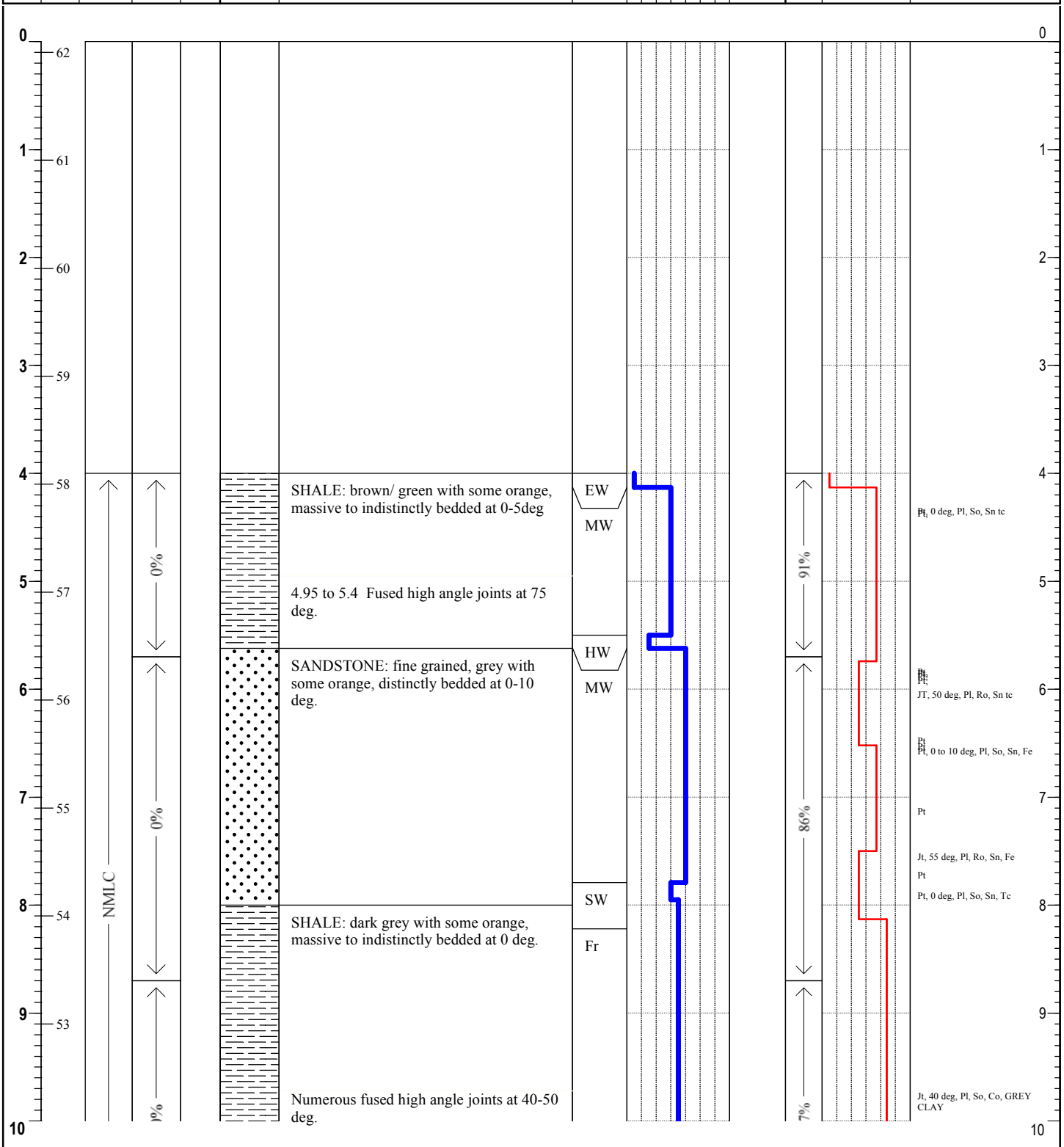
Corehole ID: BH4

X-Coord:	298569	**Date Commenced:**	9/07/2010	**Logged by:**	M Pickett
Y-Coord:	6255737	**Date Completed:**	9/07/2010	**Checked by:**	D Lowe
Surface Elevation (R.L):	62.1 m AHD	**Hole Diameter (mm):**	76		



Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt	Refer to Standard Sheets for details of abbreviations
Machine Type:	E50 - AV 08 MS			

Project ID: CES100604-JBA
Client: Jacfin Pty Ltd
Project: Ropes Creek
Location: Lot 5, DP 262213, Ropes Creek, Employment Precinct

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Corehole ID: BH4

Sheet: 3 of 3

X-Coord: 298569
Y-Coord: 6255737
Surface Elevation (R.L): 62.1 m AHD

Date Commenced: 9/07/2010
Date Completed: 9/07/2010
Hole Diameter (mm): 76

Logged by: M Pickett
Checked by: D Lowe

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
10	52											
11	51		33%			NO CORE: core loss				20%		Pt, 0 deg, Pl, So, Vn, GREY CLAY, 10.17 to 10.34 = HIGHLY FRACTURED CORE Jt, 20 deg, Pl, So, Co, GREY CLAY SM, 0 deg, Pl, GREY CLAY, 60mm, 40 kPa Pt Pt, 0 deg, Pl, So, CN Pt
						SHALE: dark grey with some orange, massive to indistinctly bedded at 0 deg.						
12	50					End of borehole.						
13	49											
14	48											
15	47											
16	46											
17	45											
18	44											
19	43											
20												

Drill Company: Macquarie Drilling
Machine Type: E50 - AV 08 MS
Operator Name: Brett Wyatt

Refer to Standard Sheets for details of abbreviations

Date:	22/07/2010	Title:	BH4 Rope's Creek 4.00m to 11.80m
Prepared by:	M. Pickett		
Checked by:	D. Lowe	CES Project ID:	CES100604-JBA
Scale:	NTS		
Size:	A4	Client:	Jacfin Pty Ltd

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Project ID:	CES100604-JBA
Client:	Jacfin Pty Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

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LOG ID: BH5

Sheet: 1 of 3

X-Coord:	297753	**Date Commenced:**	12/07/2010	**Logged by:**	M Pickett
Y-Coord:	6255603	**Date Completed:**	12/07/2010	**Checked by:**	D Lowe
Surface Elevation (R.L) :	52.5 m AHD	**Hole Diameter (mm):**	76		

Drilling Information				LITHOLOGY					Samples	Tests		
Depth (mBGL)	R.L. (m)	Method (Support)	Water	Symbol	USCS Symbol	Description SOIL TYPE: plasticity or particle characteristics colour, moisture, secondary and minor component	Consistency / Density	Moisture	Sample ID	SPT	Pocket Penetrometer (kPa) 100 200 300 400	Notes and additional observations
0	52	ADV	▽		CL Cl	CLAY: medium plasticity, brown with trace of fine grained sand and some organic material and roots	Fm Vst	>Wp				TOPSOIL ALLUVIAL
1	51					CLAY: medium plasticity, orange/ brown with trace of rounded to sub rounded ironstone nodules			SPT0.5MGRCBH5	4,7,11 N*=18		
2	50				CL	GRAVELLY CLAY: low plasticity, brown mottled orange. Gravel is fine to coarse subrounded to rounded shale and ironstone nodules			SPT1.5MGRCBH5	4,8,9 N*=17		RESIDUAL SOIL
3	49				CH	CLAY: high plasticity, orange with some grey with trace of fine grained sand. Becoming pale grey, mottled orange.				20/100mm,-,- N=R		SHALE SPT = Hammer Bouncing 'V-Bit' Refused
4	48					SHALE: brown/ green with some orange, estimated very low to low strength Begin Core Drilling						
5	47											
6	46											
7	45											
8	44											
9	43											
10												

Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt
Machine Type:	E50 - AV 08 MS		

Refer to Standard Sheets for details of abbreviations

Project ID:	CES100604-JBA	CONSULTING EARTH SCIENTISTS	**Corehole ID:**
Client:	Jacfin Pty Ltd	Jones Bay Wharf 19 - 21, Suite 121	**BH5**
Project:	Ropes Creek	26 - 32 Pirrama Road, Pyrmont, NSW 2009	Sheet: 2 of 3
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct	PH: (02) 8569 2200 FAX: (02) 9552 4399 www.consultingearth.com.au	

X-Coord:	297753	**Date Commenced:**	12/07/2010	**Logged by:**	M Pickett
Y-Coord:	6255602	**Date Completed:**	12/07/2010	**Checked by:**	D Lowe
Surface Elevation (R.L):	52.5 m AHD	**Hole Diameter (mm):**	76		

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreloss	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
0	52	NMLC	0%			SHALE: brown/ orange, distinctly bedded at 0-5 deg. Becoming grey with some orange.	HW MW SW			93%		SM, 0 deg, Pl, BROWN CLAY, 10mm SM, 0 deg, Pl, BROWN CLAY, 40mm, PP = 220 kPa CS, 0 deg, Pl, SILTSTONE GRAVEL, 20 mm
1	51											
2	50											
3	49											
4	48											
5	47						Fr					SM, 5 deg, Pl, CS, 5 mm
6	46		11%			NO CORE: core loss SHALE: dark grey, massive to indistinctly bedded at 0-10 deg with some interbeds of fine grained sandstone	Fr			85%		Pt Pt, 5 deg, Pl, So, Co, GREY CLAY Pt, 0 deg, Pl, GREY CLAY, 20 Pt, 0 deg, Pl, So, Co, GREY CLAY Pt, 0 deg, Pl, So, Co, CARBONACEOUS CS, 0 deg, Pl, GREY CLAY & SiSt, 20mm. Jt, 45 deg, IR, So, Co, GREY CLAY -8.16 to -9.00 = HIGHLY FRACTURED CORE, DRILLING INDUCED.
7	45											
8	44											
9	43					SHALE: interbedded shale and sandstone (70%,30%), dark grey/ pale grey, sandstone is fine grained, distinctly bedded at 0-10 deg				93%		SM, 0 deg, Pl, GREY CLAY,
10												

Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt	Refer to Standard Sheets for details of abbreviations
Machine Type:	E50 - AV 08 MS			

Project ID:	CES100604-JBA
Client:	Jacfin Pty Ltd
Project:	Ropes Creek
Location:	Lot 5, DP 262213, Ropes Creek, Employment Precinct

CONSULTING EARTH SCIENTISTS
Jones Bay Wharf 19 - 21, Suite 121
26 - 32 Pirrama Road, Pyrmont, NSW 2009
PH: (02) 8569 2200 FAX: (02) 9552 4399
www.consultingearth.com.au

Corehole ID: BH5

Sheet: 3 of 3

X-Coord:	297753	**Date Commenced:**	12/07/2010	**Logged by:**	M Pickett
Y-Coord:	6255602	**Date Completed:**	12/07/2010	**Checked by:**	D Lowe
Surface Elevation (R.L):	52.5 m AHD	**Hole Diameter (mm):**	76		

Drilling Information					LITHOLOGY					Natural Defects		
Depth (mBGL)	R.L. (m)	Method (Support)	% Coreless	Water	Symbol	Rock Description ROCK TYPE: grain characteristics, colour structure, minor components	Weathering	Estimated Strength MPa (0.03 EL, 0.1 VL, 0.3 L, 1 M, 3 H, 10 VH, EH)	Is (50) MPa	RQD %	Spacing (mm) (20, 60, 200, 600, 2000)	Description
10	42		0%			SHALE: dark grey, indistinctly bedded to distinctly bedded at 0 deg				70%		SM, 0 deg, Pl, GREY CLAY, 15mm, PP = 130 kPa SM, 0 deg, Pl, GREY CLAY, 10mm ST, 80 deg, Pl, So, CN CS, 0 deg, Pl, SILTSTONE, Pt DI, 0 deg, Pl, So, CN GRAVEL, 55mm CS, 0 deg, Pl, GREY CLAY, & SILTSTONE, 40mm
11	41											
12	40					End of borehole.						
13	39											
14	38											
15	37											
16	36											
17	35											
18	34											
19	33											
20												

Drill Company:	Macquarie Drilling	**Operator Name:**	Brett Wyatt
Machine Type:	E50 - AV 08 MS		

Refer to Standard Sheets for details of abbreviations

Date:	22/07/2010	Title:	BH5 Rope's Creek 3.30m to 11.85m
Prepared by:	M. Pickett		
Checked by:	D. Lowe	CES Project ID:	CES100604-JBA
Scale:	NTS		
Size:	A4	Client:	Jacfin Pty Ltd

CONSULTING EARTH SCIENTISTS
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Upper Deck, Suite 55
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ph: 02 8569 2200 fax: 02 9522 4399

SUMMARY OF SOIL LOGGING PROCEDURES (Based on AS 1726-1993 *Geotechnical Site Investigations*)

CONSULTING EARTH SCIENTISTS

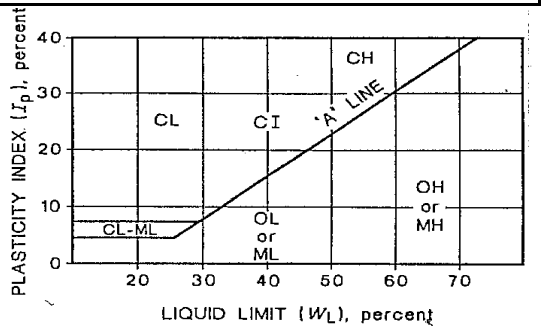
Coarse Material (Gravel and Sands): SOIL NAME: colour - grain size - particle shape - secondary components - minor constituents - moisture condition - relative density - origin - additional observations.
Example (Coarse material): Clayey SAND: dark grey, fine to medium sand, low plasticity, trace of fine gravel, moist and loose. (Alluvial)

Fine Material (Silts and Clays): SOIL NAME: colour - plasticity - secondary components - minor constituents - moisture w.r.t. plasticity - consistency - origin - additional observations.
Example (Fine Material): sandy CLAY: dark grey, low to medium plasticity,fine grained sand, MC > PL, firm to stiff (Alluvial).

Guide to the Description, Identification and Classfication of Soils

Major Divisions				USCS Symbol	Typical Names
>200mm		BOULDERS			
63 to 200mm		COBBLES			
COARSE GRAINED SOILS	More than 50% by dry mass less than 60mm is greater than 0.076m	Gravel / Gravelly Soils	More than 50% of coarse fraction > 2.36mm	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly graded gravels and gravel-sand mixtures, little or no fines, uniform gravels.
				GM	Silty gravels, gravel-sand-silt mixtures.
				GC	Clayey gravels, gravel-sand-clay mixtures.
		SANDS / Sandy Soils	More than 50% of coarse fraction <2.36mm	SW	Well-graded sands, gravelly sands, little or no fines.
				SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands.
				SM	Silty sands, sand-silt mixtures.
				SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	More than 50% by dry mass less than 60mm is less than 0.076m	Liquid Limit < 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts.
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
				OL	Organic silts and organic silty clays of low plasticity.
		Liquid Limit > 50%		MH	Inorganic silts, micaceous or diatomaneous fine sandy or silty soils, elastic silts.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium or high plasticity, organic silts.
HIGHLY ORGANIC SOILS				Pt	Peat and other highly organic soils.

Grain Sizes			
Gravel		Sand	
Coarse -	63 to 20mm	Coarse -	2.36 to 0.6mm
Medium -	20 to 6mm	Medium -	0.6 to 0.2mm
Fine -	6 to 2.36mm	Fine -	0.2 to 0.075mm



GEOLOGICAL ORIGIN:

- **Fill** - artificial soils / deposits
- **Alluvial** - soils deposited by the action of water
- **Aeolian** - soils deposited by the action of wind
- **Topsoil** - soils supporting plant life containing significant organic c
- **Residual** - soils derived from insitu weathering of parent rock.
- **Colluvial** - transported debris usually unsorted, loose and deposited by gravity towards the base of terrain of high relief

Field Identification of Fine Grained Soils - Silt or Clay?

Dry Strength - Allow the soil to dry completely and then test its strength by breaking and crumbling between the fingers.
High dry strength - Clays; Very slight dry strength - Silts.

Toughness Test - The soil is rolled by hand into a thread about 3mm in diameter. The thread is then folded and re-rolled repeatedly until it has dried sufficiently to break into lumps. In this condition inorganic clays are fairly stiff and tough while inorganic silts produce a weak and often soft thread which may be difficult to form and readily breaks and crumbles.

Dilatancy Test - Add sufficient water to the soil, held in the palm of the hand, to make it soft but not sticky. Shake horizontally, striking vigorously against the other hand several times. Dilatancy is indicated by the appearance of a shiny film on the surface of the soil. If the soil is then squeezed or pressed with the fingers, the surface becomes dull as the soil stiffens and eventually crumbles. These reactions are pronounced only for predominantly silt size material. Plastic clays give no reaction.

Descriptive Terms for Material Portions

COARSE GRAINED SOILS			FINE GRAINED SOILS	
% Fines		*Term/Modifier*	*% Coarse*	*Term/Modifier*
< 5		Omit, or use "trace"	< 15	Omit, or use "trace"
> 5, < 12		"with clay/silt" as applicab	> 15, < 30	"with sand/gravel" as applicable
> 12		Prefix soil as "silty/clayey"	> 30	Prefix as "sandy/gravelly"

Moisture Condition

Terminology		*for non cohesive soils:*	*for cohesive soils:*
Dry -		cohesionless, free running,	MC < PL. Typically hard and friable.
Moist -		Soils tend to cohere, no free water visible.	MC ~ PL. Soil can be moulded
Wet -		free water visible on soil su	MC > PL. Free water forms on hands during handling

* The plastic Limit (PL) is defined as the moisture content at which the soil crumbles when rolled into threads of 3mm dia.

Plasticity - for Clays & Silts

Low Plasticity		LL ≤ 35 %. A 3mm dia thread can barely be rolled at any water content.
Medium Plasticity		LL >35 % ≤ 50 %. The thread is easy to roll and not much time is required to reach PL. Cannot be re-rolled after reaching PL.
High Plasticity		LL > 50 %. It takes considerable time rolling and kneading to reach the PL. The thread can be rerolled several times after reaching the PL.

* Liquid Limit (LL) is defined as the moisture content (%) at which the soil begins to flow.

Consistency - for Clays & Silts

Description	*SPT "N" Value*	*UCS or q_u (kPa)* *	*Field guide to consistency*
Very Soft		<25	Exudes between the fingers when squeezed in hand
Soft		25 - 50	Can be moulded by light finger pressure
Firm		50 - 100	Can be moulded by strong finger pressure
Stiff		100 - 200	Cannot be moulded by fingers. Can be indented by thumb
Very Stiff		200 - 400	Can be indented by thumbnail
Hard		>400	Can be indented with difficulty by thumbnail

* UCS = Unconfined Compressive Strength. Can be estimated using a pocket penetrometer although it may overestimate UCS by a factor of 1.5 - 2.0

Relative Density for Gravels and Sands

Description	*SPT "N" Value*	*Relative Density %*	*Field guide (For sand)*
Very Loose	0 - 4	<15	Easily penetrated
Loose	4 - 10	15 - 35	Can be excavated
Medium Dense	10 - 30	35 - 65	Hard shoveling.
Dense	30 - 50	65 - 85	Penetrated 300mm
Very Dense	>50	>85	Penetrated only 25 - 50 mm with 13mm reinforcing rod driven

SUMMARY OF ROCK LOGGING PROCEDURES

CONSULTING EARTH SCIENTISTS

DESCRIPTION ORDER: ROCK TYPE: grain size - colour - strength - weathering - structure - defects - minor constituents - additional observations.

EXAMPLE: SANDSTONE: medium to coarse grained, grey with orange streaks, medium strength, distinctly weathered, laminated, with rare quartz gravel

Rock Type

Rock Type is described on the basis of origin (sedimentary, pyroclastic, metamorphic and igneaous). Common rock types are listed below.

Origin	Definition	Common Types
□ Sedimentary Rocks:	Formed at the Earth's surface from the weathered and eroded fragments of pre-existing rocks (ie. clastic sedimentary rocks), from the hard parts of animals or plants (organic sedimentary rocks), or from the precipitation out of solution of dissolved minerals (chemical sedimentary rocks)	Clastic - conglomerate, sandstone, siltstone*, claystone*, shale. Organic - shelley limestone, coal. Chemical - limestonerock salt, gypsum, chert.
□ Pyroclastic	Fragmented (clastic(rock material) formed by a volcanic explosion or eruption from a volcanic vent	Tuff, agglomerate, volcanic breccia
□ Metamorphic Rocks:	Formed from the mineralogical and/or textural transformation, in the solid state, of pre-existing rocks due to the action of temperature and/or pressure. Metamorphic rocks that have been subjected to deep burial typically display a foliated texture due to the parallel alignment of some constituent minerals (as in schist) or the segregation of minerals into separate bands of different composition (as in gneiss)	Slate, Gneiss, Schist, Quartzite, Phylite
□ Igneous rocks:	Formed by the cooling and solidification of magma, a hot molten material formed by localised melting within the Earth. If formed beneath the Earth's surface, the rock formed is an 'intrusive igneous rock. Magma extruded at the Earth's surface is known as lava which gives rise to extrusive igneous or volcanic rocks.	Intrusive - Granite, Dolerite, Porphyrite, Diorite. Extrusive - Basalt, Andesite.

* Both siltstone and claystone are also known as mudstone and commonly called shale if thinly laminated with a tendancy to split in parallel planes

Grain Size

Grain size is often only provided for conglomerate and sandstone sedimentary rocks.

* It is noted that the limit of unaided vision is 0.06mm.

Conglomerate		Sandstone	
Coarse -	> 20 mm	Coarse -	0.6 to 2mm
Medium -	6 to 20 mm	Medium -	0.2 to 0.6 mm
Fine -	2 to 6 mm	Fine -	0.06* to 0.2 mm

Colour

Colour is usually described in the as-received moisture condition (ie. wet). Although both wet and dry colours descriptions may be appropriate if significantly different.

Strength

The strength of rock based on point load testing is presented below. Note: the field guide assessment should be confirmed by point load testing when used in earthworks and foundation ir

Rock Strength Descriptions			
Term	Letter Symbol	Point load index (Mpa) Is (50) *	Field Guide
Extremely Low	EL	≤ 0.03	Easily remoulded by hand to a material with soil properties.
Very Low	VL	0.03 - 0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low	L	0.1 - 0.3	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium	M	0.3 - 1.0	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.
High	H	1.0 - 3	A piece of core 150 mm long x 50 mm dia core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
Very High	VH	3.0 - 10	A piece of core 150 mm long x 50 mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.
Extremely High	EH	≥ 10	A piece of core 150 mm long x 50 mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.

* rock strength defined by point load strength (Is 50) in direction normal to bedding

Weathering

The classification system for weathering in accordance with AS1726-1993 is provided below.

Weathering		
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a change in volume but the soil has not significantly transported.
Extremely Weathered	EW	Rock is weathered to such an extent that it has "soil" properties; i.e. it either disintegrates or can be remoulded, in water.
Highly Weathered	HW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron-staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly Weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

Structure

The structure of the rock mass (as opposed to the rock 'material') should be describbed using the following common terms:

- □ Sedimentary Rocks: Bedded (ie. layers greater than 20 mm thick on average); or Laminated (ie. layers less than 20mm thick on average)
- □ Metamorphic Rocks: Foliated, Banded or Cleaved.
- □ Igneous rocks: Massive or Flowbanded

Defects

Defects are 'natural' fractures in the rock mass and include: joints, faults, sheared planes, seams, bedding partings and veins. They do not include fractures caused by the drilling process or subsequent handling. Defects are an important feature which can have a significant bearing on the engineering behaviour of a rock mass. As such, they should be individually described including: orientation, infilling (eg. clay, Iron oxide, clean etc), shape, roughness and whether the defect is open or tight.

Defect spacing in accordance with P.J.N. Pells et al, 1998, is described below.

Defect Spacing (P.J.N. Pells et al, 1998)*	
Defect Spacing (mm)	Description
>2000	Very Widely Spaced
600 - 2000	Widely Spaced
200 - 600	Moderately Spaced
60 -200	Closely Spaced
20 - 60	Very Closely Spaced
0 - 20	Extremely Closely Spaced

* Spacing relates to of all types of natural fractures, but not artificial breaks, in cored bores

Rock Quality Designation (RQD):

The fracture spacing is shown where applicable and the Rock Quality Designation is

$$\text{RQD (\%)} = \frac{\text{sum of unbroken core pieces 100 mm or longer}}{\text{Length of Core}}$$

RQD provides information on the extent of fracturing and hence the competency of the rock mass.

Borelog Symbols and Notes

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Telephone: 02 88569 2200 • Fax: 02 9552 4399 •

DRILLING INFORMATION:

Support		Method		Water	
None	No support provided	HA	HAND AUGER		Inflow of water
Mud	Drilling mud used	RR	ROCK ROLLER		Water Loss
NQ	NQ size drilling pipe (69.9 mm ODia)	ADV	Auger 'V'-STEEL BIT		Water Level during drilling / excavation
HQ	HQ size drilling pipe (88.9 mm ODia)	ADTC	Auger 'TUNGSTEN-CARBIDE' BIT		Stabilised Water Level
		NMLC	DIAMOND CORING		

SAMPLING:

Sample ID

ddmmyy-01-SM Date-Sample Number-Initials of Sampler

Note: Sample Depth is indicated by horizontal lines which define the start and end depths

Type

D	Small Disturbed Sample
U50	Undisturbed 50mm dia. tube sample
B	Bulk Disturbed Sample
PT	Geoprobe Push Tube Sample in
J	Environmental Sample collected in a laboratory supplied glass jar
SPT	SPT Split Tube Sampler

FIELD TESTS:

Standard Penetration Test (SPT)

2 / 3 / 4	Number of blows per 150mm over a depth of 450mm
N = 7	SPT "N" number = sum of last two blow counts
R	Refusal. SPT not able to penetrate

Vane Shear

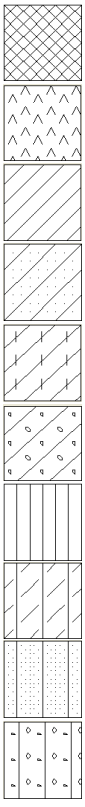
VS=30	Vane Shear Reading of 30 kPa

Pocket Penetrometer

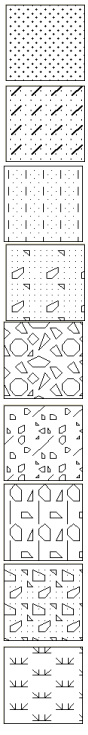
PP=100	Pocket Penetrometer Reading of 100 kPa

SYMBOLS:

Soils

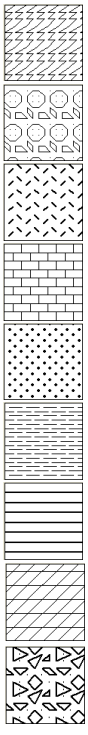


FILL
TOPSOIL
CLAY
SANDY CLAY
SILTY CLAY
GRAVELLY CLAY
SILT
CLAYEY SILT
SANDY SILT
GRAVELLY SILT



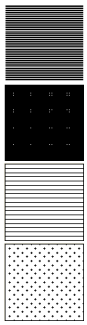
SAND
CLAYEY SAND
SILTY SAND
GRAVELLY SAND
GRAVEL
CLAYEY GRAVEL
SILTY GRAVEL
SANDY GRAVEL
PEAT

Rocks



BASALT
CONGLOMERATE
GRANITE
LIMESTONE
SANDSTONE
SILTSTONE, MUDSTONE
SHALE
SHALEY CLAY (Extremely Weathered Shale)
VOLCANIC BRECCIA

Other



ASPHALT
BENTONITE PLUG
WELL SCREEN
WELL BACKFILL SAND

NATURAL ROCK DEFECTS:

Description Order:

Fracture Type, Orientation, Infilling, Shape, Roaghness, Other

Fracture Type

JT	Joint
BP	Bedding Plane Parting
SM	Seam
FZ	Fragmented Zone
SZ	Shear Zone
VN	Vein

Orientation

VT	Vertical
HZ (or 0o)	Horizontal
X o	X' degrees from Horizontal

Infilling

CN	Clean
X	Carbonaceous
CLAY	Clay
CA	Calcite
FE	Iron Oxide
MI	Micaceous
QZ	Quartz

Shape

PLN	Planar
CU	Curved
UN	Undulose
ST	Stepped
IR	Irregular

Roughness

POL	Polished
SLK	Slickensided
SO	Smooth
RF	Rough
VR	Very

Others

DIS	Discontinuous
TI	Tight

APPENDIX B

LABORATORY TESTING RESULTS

TEST CERTIFICATE

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24 Bermill Street (PO Box 2014)
Rockdale DC NSW 2216
Australia

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fax: +61 (0)2 9597 3442

EMERSON CRUMB TEST

CLIENT: Consulting Earth Scientists
Suite 55 Upper Level, 26-32 Pirrama Road Pyrmont NSW 2009
PROJECT: Jacfin Pty Ltd, Ropes Creek CES100604-JBA

Laboratory Number: 59466

Sample Source: BH1 1.50 - 1.95m

Sample Description: SILTY CLAY: red-brown, medium plasticity, trace of fine to coarse sand.

1. IMMERSION

Does not slake	→	Class 7 swells (Organic Soils)	
Slakes	YES	Class 8 does not swell (Laterised)	

2. COMPLETE DISPERSION

Class 1 complete	
Class 2 partial	
No Dispersion	YES

3. REMOULDING

Class 3 disperses	
Does not disperse	YES

4. CARBONATE & GYPSUM (Acid Indicator)

Class 4 present	
Absent	YES

5. VIGOROUS SHAKING

Class 5 disperses	YES
Class 6 no dispersion	

EMERSION CLASS NO.: 5

Water used:	Distilled water at 20°C	Date Tested:	22.07.10
Tested By:	SM	Sampled By:	Client
Test Procedure:	AS 1289 3.8.1	Job Number:	133-085

Approved Signatory: Chris Lloyd **Date:** 23.7.10

This document is issued in accordance with NATA's accreditation requirements

Accreditation No. 1459

File C:\Electronic Excel Reports\AS 1289 3.9.1 Emerson Crumb Test, Issue 2, May 2010, JL

TEST CERTIFICATE

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EMERSON CRUMB TEST

CLIENT: Consulting Earth Scientists
Suite 55 Upper Level, 26-32 Pirrama Road Pyrmont NSW 2009
PROJECT: Jacfin Pty Ltd, Ropes Creek CES100604-JBA

Laboratory Number: 59470

Sample Source: BH4 1.50 - 1.95m

Sample Description: SILTY CLAY: grey/red-brown, medium plasticity, with fine to coarse sand, trace of fine to medium gravel.

1. IMMERSION

Does not slake	→	Class 7 swells (Organic Soils)	
Slakes	YES	Class 8 does not swell (Laterised)	

2. COMPLETE DISPERSION

Class 1 complete	
Class 2 partial	
No Dispersion	YES

3. REMOULDING

Class 3 disperses	
Does not disperse	YES

4. CARBONATE & GYPSUM (Acid Indicator)

Class 4 present	
Absent	YES

5. VIGOROUS SHAKING

Class 5 disperses	YES
Class 6 no dispersion	

EMERSION CLASS NO.: 5

Water used:	Distilled water at 20°C	Date Tested:	22.07.10
Tested By:	SM	Sampled By:	Client
Test Procedure:	AS 1289 3.8.1	Job Number:	133-085

Approved Signatory: Chris Lloyd **Date:** 23.7.10

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CALIFORNIA BEARING RATIO

CLIENT: **Consulting Earth Scientists**
Suite 55, Upper Level Jones Bay Wharf, 26-32 Pirrama Road Pyrmont NSW 2009

PROJECT: **Jacfin Pty Ltd, Rope's Creek**

Sample Source:	BH2 0.50-0.75m	
Sample Description:	SILTY CLAY: brown/ grey, medium plasticity, with fine to coarse sand.	
Job Number:	133-085	
Laboratory Number:	59467	
CBR Value @ 2.5mm	1.0	(%)
CBR Value @ 5.0mm	1.0	(%)
Sample Data		
Compaction Specification	100% of MDD at OMC	
Maximum Dry Density (MDD)	1.59	(t/m^3)
Optimum Moisture Content (OMC)	20.5	(%)
Mass of Surchages	4.5	(kg)
Number of Days Soaked	4	
Sample Preparation		
Dry Density - Before Soaking	1.58	(t/m^3)
Dry Density - After Soaking	1.51	(t/m^3)
Retained on 19mm Sieve	0	(%)
Moisture Content - Before Soaking	21.4	(%)
Laboratory Density Ratio	99.0	(%)
Laboratory Moisture Ratio	104.0	(%)
Moisture Content - After Soaking		
Top 30mm of Test Sample	33.0	(%)
Remainder of Test Sample	29.8	(%)
Swell After Soaking	4.6	(%)
Compactive Effort	Standard	
Number of Layers	3	
Blows per Layer	53	
Mass of Rammer	2.7	(kg)
Drop of Rammer	300	(mm)
Comments		
Date Tested:	19.7.10	

Tested in accordance with AS1289.6.1.1 Determination of the California Bearing Ratio of a soil Standard Laboratory Method for a remoulded specimen.

Approved Signatory: Chris Lloyd **Date:** 23.7.10

This document is issued in accordance with NATA's accreditation requirements

Accreditation No. 1459

TEST CERTIFICATE

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24 Bermill Street (PO Box 2014)
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CALIFORNIA BEARING RATIO

CLIENT: **Consulting Earth Scientists**
Suite 55, Upper Level Jones Bay Wharf, 26-32 Pirrama Road Pyrmont NSW 2009

PROJECT: **Jacfin Pty Ltd, Rope's Creek**

Sample Source:	BH3 0.30-0.50m	
Sample Description:	SILTY CLAY: brown, medium plasticity, with fine to coarse sand.	
Job Number:	133-085	
Laboratory Number:	59468	
CBR Value @ 2.5mm	1.0	(%)
CBR Value @ 5.0mm	1.0	(%)
Sample Data		
Compaction Specification	100% of MDD at OMC	
Maximum Dry Density (MDD)	1.67	(t/m^3)
Optimum Moisture Content (OMC)	18.0	(%)
Mass of Surchages	4.5	(kg)
Number of Days Soaked	4	
Sample Preparation		
Dry Density - Before Soaking	1.68	(t/m^3)
Dry Density - After Soaking	1.62	(t/m^3)
Retained on 19mm Sieve	0	(%)
Moisture Content - Before Soaking	17.2	(%)
Laboratory Density Ratio	101.0	(%)
Laboratory Moisture Ratio	95.0	(%)
Moisture Content - After Soaking		
Top 30mm of Test Sample	29.1	(%)
Remainder of Test Sample	25.1	(%)
Swell After Soaking	3.6	(%)
Compactive Effort	Standard	
Number of Layers	3	
Blows per Layer	53	
Mass of Rammer	2.7	(kg)
Drop of Rammer	300	(mm)
Comments		
Date Tested:	19.7.10	

Tested in accordance with AS1289.6.1.1 Determination of the California Bearing Ratio of a soil Standard Laboratory Method for a remoulded specimen.

Approved Signatory: Chris Lloyd **Date:** 23.7.10

This document is issued in accordance with NATA's accreditation requirements

Accreditation No. 1459

TEST CERTIFICATE

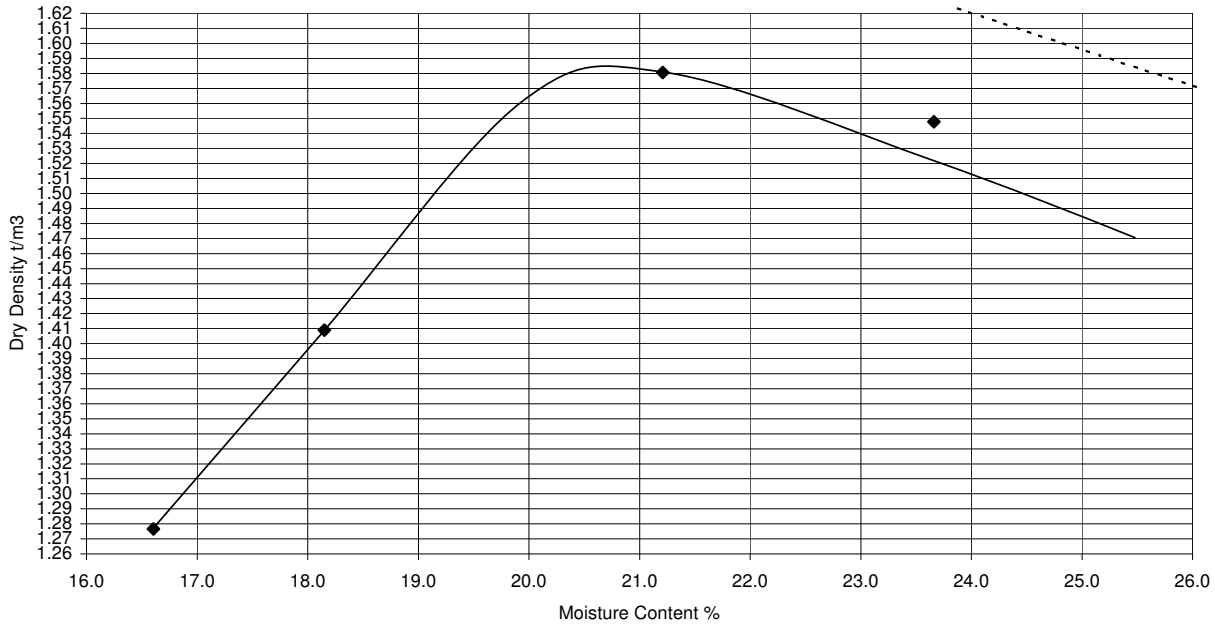
SGS Australia Pty Ltd
24 Bermill Street (PO Box 2014)
Rockdale DC NSW 2216
Australia

ABN 44 000 964 278
ph: +61 (0)2 9597 5599
fax: +61 (0)2 9597 3442

DRY DENSITY/MOISTURE CONTENT RELATION

CLIENT: Consulting Earth Scientists
Suite 55, Upper Level Jones Bay Wharf, 26-32 Pirrama Road Pyrmont NSW 2009

PROJECT: Jacfin Pty Ltd, Rope's Creek



Job Number:	133-085	
Laboratory Number:	59467	
Sample Source:	BH2 0.50-0.75m	
Sample Description:	SILTY CLAY: brown/ grey, medium plasticity, with fine to coarse sand.	
Maximum Dry Density:	1.59	t/m^3
Optimum Moisture Content:	20.5	%
Oversize Material:	19	mm
% Oversize:	0	%
Date Tested:	18.07.10	
Sampled By:	Client	
Compactive Effort:	Standard	
Test Method:	**AS 1289 5.1.1**	
No. of Layers:	3	
Blows per Layer:	25	
Mass of Rammer:	2.7	kg
Drop of Rammer:	300	mm
Zero Air Voids Line - Particle Density:	2.65	t/m^3
Comments:		

Approved Signatory: Chris Lloyd **Date:** 23.7.10

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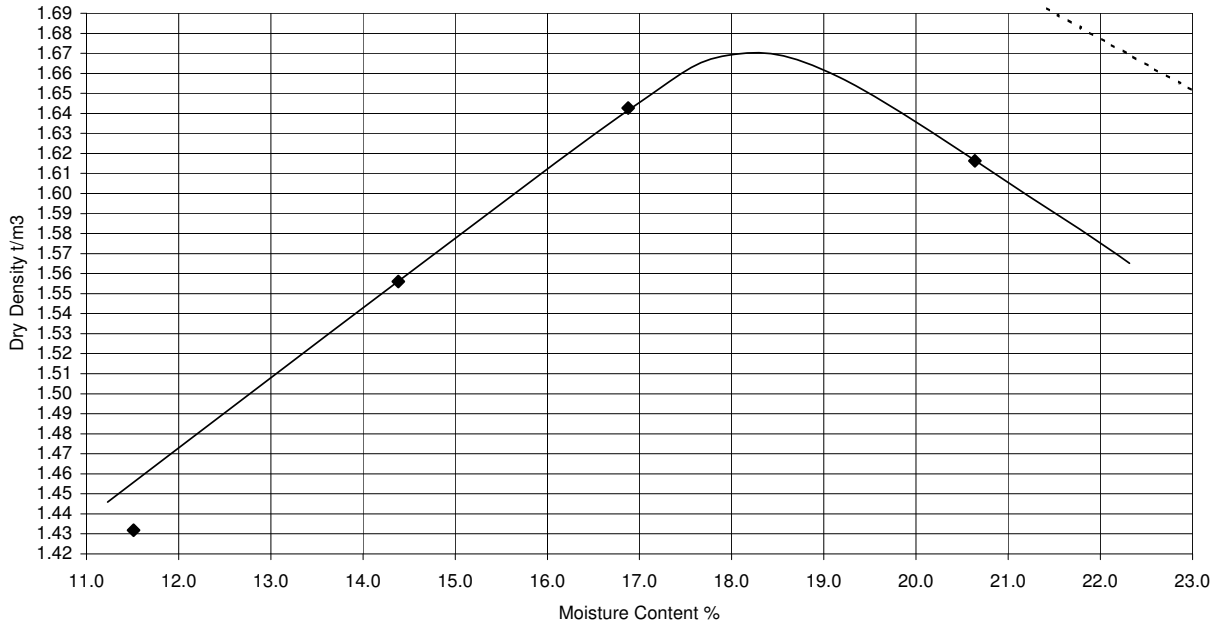

Job Number:	133-085	
Laboratory Number:	59468	
Sample Source:	BH3 0.30-0.50m	
Sample Description:	SILTY CLAY: brown, medium plasticity, with fine to coarse sand.	
Maximum Dry Density:	1.67	t/m^3
Optimum Moisture Content:	18.0	%
Oversize Material:	19	mm
% Oversize:	0	%
Date Tested:	18.07.10	
Sampled By:	Client	
Compactive Effort:	Standard	
Test Method:	**AS 1289 5.1.1**	
No. of Layers:	3	
Blows per Layer:	25	
Mass of Rammer:	2.7	kg
Drop of Rammer:	300	mm
Zero Air Voids Line - Particle Density:	2.65	t/m^3
Comments:		

Approved Signatory: Chris Lloyd **Date:** 23.7.10

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SOIL CLASSIFICATION TEST DATA

CLIENT: **Consulting Earth Scientists**
Suite 55 Upper Level, 26-32 Pirrama Road Pyrmont NSW 2009

PROJECT: **Jacfin Pty Ltd, Ropes Creek CES100604-JBA**

LAB NO.	SAMPLE SOURCE	SAMPLE DESCRIPTION	MOISTURE CONTENT (%) 1	DRY DENSITY (t/m^3)	LIQUID LIMIT 2	PLASTIC INDEX 3	PREPAR-ATION & HISTORY 4	LINEAR SHRINK. (%) 5
59466	BH1 0.5 - 0.95m	SILTY CLAY: red-brown, medium plasticity, trace of fine to coarse sand.	-	-	38	26	N N	12.0
59470	BH4 1.50 - 1.95m	SILTY CLAY: grey/red-brown, medium plasticity, with fine to coarse sand, trace of fine to medium gravel.	-	-	45	28	DS AD	13.5

NOTES TO TESTING

1 Test Method: AS 1289 2.1.1
2 Test Method: AS 1289 3.1.2
3 Test Method: AS 1289 3.2.1, 3.3.1
4 Preparation: DS = Dry Sieved
WS = Wet Sieved
N = Natural State With No Sieving
Sample History: AD = Air Dried
OD = Oven Dried at 50°C
N = Natural State As Received
5 Test Method: AS 1289 3.4.1
Mould Size: 125mm
Dry State: Linear/ Curling/ Crumbling

Sampled By: Client
Job Number: 133-085
Date Tested: 22.07.10

Approved Signatory: Chris Lloyd Date: 23.7.10

This document is issued in accordance with NATA's accreditation requirements

Accreditation No. 1459

ANALYTICAL REPORT

26 July 2010

SGS Industrial CMT Eastern Sydney
24 Bermill Street
PO Box 2014
ROCKDALE
NSW 2216

Attention: **Alex Bell**

Your Reference: CES - ROPES CK - 133-085

Our Reference: SE80058 Samples: 2 Soils
Received: 22/7/10

Preliminary Report Sent: 26/07/10

These samples were analysed in accordance with your written instructions.

PLEASE NOTE : This is an INTERIM REPORT
Preliminary results supplied as advance advice only and await final QA/QC clearance

For and on Behalf of:
SGS ENVIRONMENTAL SERVICES

Sample Receipt:	Angela Mamalicos	AU.SampleReceipt.Sydney@sgs.com
Production Manager:	Huong Crawford	Huong.Crawford@sgs.com

Results Approved and/or Authorised by:

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Inorganics Our Reference: Your Reference Sample Matrix	UNITS ---------- ----------	SE80058-1 BH1 0.50-0.95 Soil	SE80058-2 BH3 1.50-1.95 Soil
Date Extracted- (pH 1:5 soil: Water)		26/07/2010	[NA]
Date Analysed (pH 1:5 Soil: Water)		26/07/2010	[NA]
pH 1:5 soil:water	pH Units	6.5	[NA]
Date Extracted Salinity		[NA]	26/07/2010
Date Analysed Salinity		[NA]	26/07/2010
Salinity as NaCl in Soil *	mg/kg	[NA]	2,087

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Anions in soil		
Our Reference:	UNITS	SE80058-1
Your Reference	----------	BH1
		0.50-0.95
Sample Matrix	----------	Soil
Date Extracted		26/07/2010
Date Analysed		26/07/2010
Sulphate, SO4 1:5 soil:water	mg/kg	84
Chloride, Cl 1:5 soil:water	mg/kg	500

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Exchangeable Sodium Percent Our Reference: Your Reference Sample Matrix	UNITS ---------- ----------	SE80058-2 BH3 1.50-1.95 Soil
Date Extracted		
Date Analysed		
Sodium (Na)	mg/kg	
Na	meq%	
Exchangeable Na	%	
Potassium (K)	mg/kg	
K	meq%	
Exchangeable K	%	
Calcium (Ca)	mg/kg	
Ca	meq%	
Exchangeable Ca	%	
Magnesium (Mg)	mg/kg	
Mg	meq%	
Exchangeable Mg	%	
Cation Exchange Capacity*	meq%	

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Moisture Our Reference: Your Reference Sample Matrix	UNITS ---------- ----------	SE80058-1 BH1 0.50-0.95 Soil	SE80058-2 BH3 1.50-1.95 Soil
Date Analysed (moisture)		23/07/2010	23/07/2010
Moisture	%	14	17

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Method ID	Methodology Summary
AN101	pH - Measured using pH meter and electrode based on APHA 21st Edition, 4500-H+. For water analyses the results reported are indicative only as the sample holding time requirement specified in APHA was not met (APHA requires that the pH of the samples are to be measured within 15 minutes after sampling).
AN106	Conductivity and TDS by Calculation (cTDS) - Conductivity is measured using a conductivity cell and dedicated meter, in accordance with APHA 21st Edition, 2510. TDS is calculated by TDS(mg/L)=0.6 x Conductivity(µS/cm).
SEI-038	Water Soluble Chloride After carrying out a 1:5 soil:water extraction, an aliquot of the extract is reacted with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference NEPM, Schedule B(3), 401 and APHA 4500Cl- Water Soluble Sulphate After carrying out a 1:5 soil:water extraction ,sulphate in the extract is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulphate concentration in the sample. Reference NEPM, Schedule B(3), 401 and APHA 4500-SO42-.
Ext-002	Analysis subcontracted to SGS Environmental Services Cairns, NATA Accreditation No. 2562, Site No. 3146.
AN002	Preparation of soils, sediments and sludges undergo analysis by either air drying, compositing, subsampling and 1:5 soil water extraction where required. Moisture content is determined by drying the sample at 105 ± 5°C.

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QUALITY CONTROL Inorganics	UNITS	LOR	METHOD	Blank
Date Extracted- (pH 1:5 soil: Water)				[NT]
Date Analysed (pH 1:5 Soil: Water)				[NT]
pH 1:5 soil:water	pH Units	0	AN101	[NT]
Date Extracted Salinity				[NT]
Date Analysed Salinity				[NT]
Salinity as NaCl in Soil *	mg/kg	1	AN106	[NT]

QUALITY CONTROL Anions in soil	UNITS	LOR	METHOD	Blank	Duplicate Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Matrix Spike % Recovery Duplicate + %RPD
Date Extracted				26/07/2010	[NT]	[NT]	LCS	26/07/2010
Date Analysed				26/07/2010	[NT]	[NT]	LCS	26/07/2010
Sulphate, SO4 1:5 soil:water	mg/kg	0.5	SEI-038	<0.5	[NT]	[NT]	LCS	100%
Chloride, Cl 1:5 soil:water	mg/kg	0.25	SEI-038	<0.2	[NT]	[NT]	LCS	100%

QUALITY CONTROL Exchangeable Sodium Percent	UNITS	LOR	METHOD	Blank
Date Extracted				
Date Analysed				
Sodium (Na)	mg/kg	2	Ext-002	<2.0
Na	meq%	0.01	Ext-002	<0.01
Exchangeable Na	%	1	Ext-002	<1.0
Potassium (K)	mg/kg	2	Ext-002	<2.0
K	meq%	0.01	Ext-002	<0.01
Exchangeable K	%	1	Ext-002	<1.0
Calcium (Ca)	mg/kg		Ext-002	
Ca	meq%	0.01	Ext-002	<0.01
Exchangeable Ca	%	1	Ext-002	<1.0
Magnesium (Mg)	mg/kg	2	Ext-002	<2.0
Mg	meq%	0.01	Ext-002	<0.01
Exchangeable Mg	%	1	Ext-002	<1.0
Cation Exchange Capacity*	meq%	1	Ext-002	<1.0

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QUALITY CONTROL Moisture	UNITS	LOR	METHOD	Blank
Date Analysed (moisture)				
Moisture	%	1	AN002	<1

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Result Codes

[INS] : Insufficient Sample for this test
[NR] : Not Requested
[NT] : Not tested
[LOR] : Limit of reporting
[RPD] : Relative Percentage Difference
* : Not part of NATA Accreditation
[N/A] : Not Applicable

Report Comments

Samples analysed as received. Solid samples expressed on a dry weight basis.
Date Organics extraction commenced:
NATA Corporate Accreditation No. 2562, Site No 4354
Note: Test results are not corrected for recovery (excluding Air-toxics and Dioxins/Furans*)
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Quality Control Protocol

Method Blank: An analyte free matrix to which all reagents are added in the same volume or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. A method blank is prepared every 20 samples.
Duplicate: A separate portion of a sample being analysed that is treated the same as the other samples in the batch. One duplicate is processed at least every 10 samples.
Surrogate Spike: An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. Surrogates are added to samples before extraction to monitor extraction efficiency and percent recovery in each sample.
Internal Standard: Added to all samples requiring analysis for organics (where relevant) or metals by ICP after the extraction/digestion process; the compounds/elements serve to give a standard of retention time and/or response, which is invariant from run-to-run with the instruments.
Laboratory Control Sample: A known matrix spiked with compound(s) representative of the target analytes. It is used to document laboratory performance. When the results of the matrix spike analysis indicates a potential problem due to the sample matrix itself, the LCS results are used to verify that the laboratory can perform the analysis in a clean matrix.
Matrix Spike: An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

Quality Acceptance Criteria

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-09.pdf

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