Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
ABN 17 003 550 801

Principals
E H FLETCHER BSc (Eng) ME
P STUBBS BSc MICE FGS
D TREWEEK Dip Tech
B F WALKER BE DIC MSc
Consultant: R P JEFFERY BE DIC

Senior Associates
L J SPEECHLEY BE(Hons) MEngSc
F A VEGA BSc(Eng) GDE
P C WRIGHT BE(Hons) MEngSc
A ZENON BSc(Eng) GDE

Associates
D BLISS BE(Hons) MEngSc
A JACKAMAN BE MEngSc
A KINGSWELL BSc(Hons) MSc
A B WALKER BE(Hons) MEngSc

115 WICKS ROAD
MACQUARIE PARK NSW 2113
POSTAL ADDRESS: PO BOX 976
NORTH RYDE BC NSW 1670
Tel: 02 9888 5000
Fax: 02 9888 5001

REPORT

TO

CRONULLA SUTHERLAND DISTRICT RUGBY LEAGUE FOOTBALL CLUB

ON

GEOTECHNICAL INVESTIGATION

FOR

PROPOSED SOUTHERN STAND, LIFT TO ET STAND AND FOOTBRIDGE WIDENING

AT

TOYOTA PARK, CAPTAIN COOK DRIVE, WOOLOOWARE

14 November 2006 **Ref: 20345SPrpt2**

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1 EXECUTIVE SUMMARY

Jeffery and Katauskas Pty Ltd have completed several investigations within the Toyota Park site dating back to 1978. That information has been used in this current study for the proposed upgrade of Toyota Park, as well as additional information obtained during recent investigations, to provide preliminary comments and recommendations for the current proposed Toyota Park redevelopment.

The works covered by this report comprise a new southern grandstand and gymnasium, a new passenger lift to the existing western grandstand and a revision of access from the western car park adjacent to Captain Cook Drive.

The subsurface conditions can be summarised as several metres of poorly compacted fill over several metres of very soft and soft organic clay, then stiff to very stiff clays (with sand bands) and sandstone bedrock at depths of 10m to 20m.

We consider that the proposed upgrading is feasible from a geotechnical perspective. The geotechnical issues which must be addressed include:

- the presence of poorly compacted fill containing rubble and other obstructions with associated settlement problems and piling difficulties;
- methane generation potential of the fill and organic soils;
- settlement and negative skin friction (piles) associated with soft and very soft organic clays;
- acid sulfate generation potential of the fill and organic clays (refer to the EIS report);
- high groundwater table; and
- relatively deep bedrock.

Footing systems will range from high level footings for light/flexible and settlement tolerant structures to piles founded in the soils for relatively light loads, and piles to the bedrock for heavily loaded piles.

2 INTRODUCTION

This report presents the results of a geotechnical investigation for the proposed redevelopment of Toyota Park which is located adjacent to Captain Cook Drive in Woolooware, NSW.

Parts of the proposed upgrading of geotechnical interest include:

- the construction of a new entry plaza and grandstand on the southern side of the field;
- a new passenger lift to the western grandstand; and
- a widening of the footpath over the drainage canal between Toyota Park and the western car park.

The purpose of the investigation was to obtain additional geotechnical information from the proposed development areas, and to use this in conjunction with existing information as a basis for providing comments and recommendations for the design of the proposed structures.

Preliminary geotechnical information has been forwarded to DBL Property Pty Ltd and to Jones Nicholson Pty Ltd (Engineers) at several stages during the investigation period.

Environmental Investigation Services (EIS) has undertaken environmental site screening and acid sulphate soil assessment, and reference should be made to their report (Ref: E20345FJ) for details of these issues.

3 EXISTING INFORMATION

Jeffery and Katauskas Pty Ltd have completed four previous investigations within the proposed redevelopment area. A summary of these investigations is provided below.

- Reference 581 dated 27 July 1978 for the proposed western grandstand – the investigation comprised two augered boreholes drilled into the underlying sandstone (BH1 and 2).
- Reference 8309K dated 25 July 1991 for a proposed amenities block – the investigation comprised drilling three augered boreholes to depths ranging from 3.8m to 4.8m below existing ground levels (BH301 to 303).
- Reference 11630SV dated 1 February 1996 for the proposed southern stand – the investigation comprised 7 augered boreholes to depths between 1.3m and 6.0m below existing ground levels (BH401 to BH407).
- Reference 15009JTP dated 17 April 2000 for proposed redevelopment of the Toyota Park area – the investigation comprised eight EFCP tests to refusal of the equipment (depths between 5.8m and 20.6m), four of which (EFCP 806 to 809 inclusive) have been included with this report.

Several of the reports referred to obstructions and voids within the fill, and that metal, bricks and concrete were often encountered, though this seemed to be most prominent in the area to the east of the existing club building. We also understand that there was considerable loss of grout from CFA piles installed for the previous extensions to the Club.

Copies of the relevant borehole logs and EFCP test results are provided in Appendix A. The approximate locations of the boreholes and tests are shown on the attached Figure 1; the locations have been scaled from the plans contained in the previous reports and the plotted locations could be in error by about 10m or so. It should also be noted that recorded depths were from existing ground level at the time of the fieldwork, and surface levels may have subsequently changed following excavations or the placement of additional fill.

4 INVESTIGATION PROCEDURE

Due to the variable nature in loading for the different structures, and different portions of the structures, it was important to investigate both the soil profile and the bedrock.

The soil profile was investigated by ten Electronic Friction Cone Penetrometer tests, one at the proposed eastern stand lift, one at the future proposed football training centre, two for the proposed footpath widening from the western carpark, and six along the length of the proposed southern grandstand. At several of the test locations, shallow refusal of the EFCP equipment occurred on obstructions within the fill; additional EFCP tests were then completed nearby and the test number suffixed with an 'a'. EFCP testing comprises pushing a 35mm diameter steel rod into the ground at a standard rate, while using sensitive strain gauges to measure the resistance on a pointed cone at the base of the rods and the friction on a cylindrical sleeve just above the cone. These values are then plotted and the soil type and strength are assessed by interpretation from published correlations.

To obtain additional information on the bedrock below the proposed southern grandstand area, two boreholes were auger drilled through the soil (without detailed sampling and testing) adjacent to two of the EFCP test locations. Casing was installed and the sandstone bedrock diamond cored using NMLC equipment and water flush. The sandstone recovered from the coring was placed in boxes and returned to a NATA registered laboratory where it was colour photographed and where Point Load Strength Index tests were completed. Copies of the core photographs are provided with the logs, and the results of the Point Load Strength Index tests are provided in the attached Table A.

The fieldwork was completed in the full-time presence of geotechnical engineers who nominated the sampling and testing locations, and prepared logs of the strata encountered. The logs and EFCP data traces are attached with this report, together with a glossary of the terms and symbols used on the logs. The surface reduced levels shown on the borehole logs have been estimated by interpolation between spot levels shown on the unreferenced survey plan extract.

Laboratory testing of the soils was beyond the agreed scope of the investigation.

5 RESULTS OF INVESTIGATION

5.1 Site Description

The site is located to the north of Captain Cook Drive, Woolooware and is generally flat with a slight slope (less than 1°) down to the north to Woolooware Bay. The regional topography also falls gently toward the bay apart from the golf course to the south of Captain Cook Drive that is generally at a lower level than the site.

A large multi-storey brick building used as the leagues club is located to the east of the playing field; this appeared to be in good external condition from a brief inspection of the exterior.

The main multi-storey grandstand is at the western side of the field. At the north and south ends of the field are landscaped mounds (approximately 4m and 2m respectively above the general site level) used as spectator viewing areas. To the west of the large stand are several single-storey concrete and brick buildings used as the current gymnasium, amenities block and media facilities.

A drainage channel passes from south to north on the western side of these buildings. Mangroves line this channel and the water level was approximately 1m to 1.5m below the general site level at the time of inspection.

Two football fields are located to the west of the main football ground, with an asphaltic concrete car parking area on the southern side of the fields.

Woolooware Golf Course lies beyond Captain Cook Drive to the south of the site. Solander Playing Fields and then industrial land lie to the west. Woolooware Bay lies beyond an easement for transmission lines to the north.

5.2 Subsurface Conditions

In general terms, the testing on the site has disclosed poorly compacted fill over soft and very soft bay deposits of organic silty clays over stiff to very stiff clayey soils. There are bands of sand and silty sand within the predominantly clayey soils, and these are often of very loose, but sometimes of medium dense to very dense relative density. Sandstone or inferred sandstone bedrock was encountered at depths ranging from 11.5m to 20.5m below existing ground level in the proposed works areas.

Within the proposed works area, the fill had a thickness between 1.6m and 3.6m. The fill was often logged as silty sand and sandy clay with varying proportions of metal, timber, sandstone cobbles and demolition rubble; the more rubbly fill appeared to be to the south of the playing field. It must be noted that assessment of fill composition from small diameter augered boreholes is potentially unreliable and much larger excavations are necessary to properly evaluate fill composition. The fill was generally assessed as being poorly compacted.

The organic clays with some areas of clayey silt were encountered below the fill at depths between 1.6m and 3.6m. These were generally of very soft to soft strength and had thicknesses of about 1.5m to 3.0m. In some of the EFCP test locations, this clay was so soft that there was no measurable resistance on either the cone or friction sleeve.

Silty clays of at least stiff strength (and usually of very stiff strength) were encountered below the organic clays. There were also bands of silty sand, with relative densities varying from very loose to very dense. There was often a band of medium dense to very dense sand at a depth of about 6m.

The sandstone bedrock (or inferred bedrock) was encountered at depths ranging from 8.9m to 20.5m below existing ground level. The sandstone bedrock in the two cored boreholes in the southern grandstand area has a capping of extremely weathered rock with clay seams over medium and high strength sandstone.

Groundwater was encountered at depths between 0.4m and 3.8m during previous investigations within the vicinity of the works. Groundwater levels measured in the two deeper boreholes drilled during this investigation have indicated groundwater at depths of 1.3m to 1.5m currently. No long term groundwater monitoring has been undertaken during any of the investigations.

6 COMMENTS AND RECOMMENDATIONS

6.1 Potential Site Difficulties

There are several difficulties associated with the development at this site. These include:

- The presence of the deep, poorly compacted fill providing potentially poor trafficability, poor foundation conditions and poor pavement subgrade; these issues can be overcome by appropriate design and construction techniques as evidenced by the existing paving in the car parks and Captain Cook Drive.

- The presence of obstructions and voids in the fill resulting in difficult piling conditions and the use of excess grout in auger grout injected piles.

- The existence of methane which has been encountered during investigations by EIS. This will require the adoption of a methane drainage blanket and extraction system below proposed structures and pavements. Other gases often found with methane are corrosive and hence copper pipes would not be recommended for underground services.

- The very soft and soft organic clay layer which will undergo additional consolidation settlements if additional load is placed upon it. This consolidation would also give rise to negative skin friction effects on piles.

- The organic clays and some of the fill were found during the recent investigation by EIS to have an acid sulphate generation potential. As a result, if these soils are disturbed by excavation or are removed during pile construction, treatment of the soil for potential acid generation will be required. Reference should be made to the EIS report for details on acid sulphate management.

- The relatively high groundwater which will make earthworks such as replacement of fill, proof rolling and additional fill compaction difficult. This may require dewatering (which could be very expensive considering there could be contamination or acid sulfate soil issues associated with this) or the adoption of bridging layers.

- The generally deep sandstone bedrock which will require deep piled footings to be adopted.

These difficulties on the site require that good planning, design and construction techniques are used.

6.2 Southern Grandstand

We understand that the southern grandstand will be a steel framed building, with pre-cast concrete tiered seating, and function rooms below. The general subsurface conditions in the area (comprising several metres of poorly compacted fill over organic clays) are not suitable for the support of such a structure, even for the lightly loaded floor slabs, and it will therefore be necessary to use piles. We understand from Jones Nicholson Pty Ltd that piles would have to support design loads ranging between 100kN and 450kN.

Based upon the results of this investigation, we expect that rock depths within the southern grandstand area will range from about 10m to 20m. Due to the expected high loads in this area, the option of higher capacity and self-proving driven or G-Piles (pushed into the soil under high static loads) are likely to be preferred. While steel screw piles founded within the very stiff clays may be suitable for lighter loads (groups of piles may be required for the higher loads), there are issues of penetration difficulty due to obstructions in the fill (considerable pre-digging of the fill and replacement with clean material would likely be required) and corrosion due to acid sulfate soil conditions. While some replacement of fill may be required for driven piles, they have a far better capacity to penetrate rubble. Vibration induced effects on nearby structures must be anticipated with conventional driven piles.

Previous projects at the site have required very large volumes of grout for CFA piles due to voids within the fill. With large grout losses, there is doubt as to the quality of the constructed pile due to possible necking (localised reduction of the pile diameter) of the pile. Therefore we do not recommend bored or CFA piles on this project without some method of permanent lining of the shaft. These augered piles also produce relative large amounts of spoil compared to driven steel screw piles, and this spoil may need to be treated for acid sulfate conditions prior to disposal.

Piles founded with sockets of at least four pile diameters into the clayey soils of at least stiff to very stiff strength may be designed for an allowable bearing pressure of 300kPa. Where driven piles are adopted, an allowable shaft adhesion of 20kPa may also be adopted for the stiff to very stiff clayey soils, though the upper two pile diameters in these materials must be ignored due to the drawdown of the organic clays during driving.

Where piles are driven or pushed to the medium or high strength bedrock, an allowable bearing pressure of at least 3000kPa should be achievable and this could be confirmed from the results of the pile driving. It may not be possible for timber piles to get all the way to the medium or high strength sandstone as they may refuse on hard clay bands or on layers of more weathered rock. Therefore, steel or precast concrete piles will be preferred where these higher bearing pressures are required.

We recommend the EFCP tests and borehole logs be provided to the piling contractors for a design and construct tender.

6.3 Lift To ET Stand

The proposed lift to the ET stand will be in the vicinity of EFCP A110. There are three options with regard to the lift, namely:

- excavating below the proposed lift and having the plant room below the existing surface levels;
- having the plant room below the lift but ramping up to the lift to avoid the excavation; or
- having the plant room beside the lift also eliminating the need for deep excavation.

Where excavation extends below the proposed lift, it may extend close to or into the soft organic clays, and below the groundwater level. To allow localised dewatering within the lift pit excavation, it would be necessary to form a cut-off wall to several metres below the proposed excavation. While secant piles could be used for this, we expect that a better system would be to use vibrated sheet piles. We assume the existing grandstand is constructed on piled footings.

It would be necessary to laterally restrain the sheet pile wall during the construction and the subsurface profile of poorly compacted fill over organic clays provide challenging anchoring conditions. Therefore, we recommend installing a series of ring beams inside the sheet piles as excavation progresses to provide the lateral restraint. Adequate clearances around the footprint of the lift must be incorporated at the initial planning stage to allow construction of the shoring system.

The latter two options of raising the base of the lift or having the plant room beside the lift would of course avoid the need for the cut-off walls, shoring and dewatering.

The conditions in the vicinity of the lift comprise about 2m of fill, over about 2m of soft then firm to stiff organic clay. Below the organic clay is is about 2m of medium dense silty sand, then stiff clay to about 11m depth and then very stiff to hard clay to refusal at 17.2m depth. The upper level soils directly below the lift will not provide a suitable foundation, and it will be necessary to have a pile below each corner of the lift. We expect that piles in the soil could support the lift, though they may need to extend to a depth of the order of 10m or so. These could possibly be steel screw piles, CFA piles, precast driven piles or Franki 'Forum' piles, the latter requiring only low headroom for installation. Consideration will need to be given to access and headroom constraints when choosing the pile system. The piles could provisionally be designed on the same basis as those in the southern grandstand. The piling contractor should install the piles on a design and construct basis.

6.4 Footbridge Widening

Part of the works comprise the widening of the existing footbridge from the western carpark over the drain adjacent to Toyota Park. The footbridge to be widened is adjacent to Captain Cook Drive.

There are two main options for this footbridge widening, namely a high level box culvert, or a piled deck structure.

It may be feasible to undertake minor excavation works in the base of the drain to create a small gravel pad, and then place a box culvert on this prepared pad. In this case, the soil removed may be acid sulphate soil which would require treatment prior to disposal. If the widening were undertaken in this manner, it would have to be accepted that there could be minor settlements of the culvert that would result in an uneven footpath surface which may require periodic topping up to keep the footpath in a safe condition.

The alternative would be to install piled footings on both sides of the drain, and have a deck spanning between these piles. While this would be a more expensive option, there would be a much lower risk of inadequate performance. While the piles would be expected to be lightly loaded, the soils near the footbridge are very poor, even in comparison to the rest of the site, and the piles would need to be relatively deep. We expect that a self proving system would be needed and even then it is likely that the piles would need to extend down to the refusal depth of the EFCP test on the eastern side of the drain (about 10m on EFCPA107), while on the western side of the drain, it may be possible to stop the piles on the medium dense sand band. Again we recommend that the EFCP tests be provided to the piling contractors for a design and construct tender.

6.3 Negative Skin Friction

When additional loads are applied above the organic clay layer, there is the potential for long term consolidation of the clay and settlement of the soil above. Where there are piles installed through these soils, the soil 'grips' the pile and produces additional vertical compression loads on the pile. These loads can be a large percentage of the load capacity of the pile, and so it will be important to avoid surcharging the surface adjacent to piled footings. If placing surcharge loads near piles is unavoidable, we should be contacted for further advice regarding negative skin friction design parameters. It could be necessary to construct piles within soft bentonite slurry or case the pile shaft to avoid negative skin friction; such options are generally very expensive.

7 GENERAL COMMENTS

The recommendations presented in this report include further investigation and specific issues to be addressed during the construction phase of the project. In the event that any of the design and construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and Jeffery and Katauskas Pty Ltd accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

The subsurface soil conditions between and beyond the completed tests and boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the preliminary civil and structural design. As part of the documentation stage of this project, Contract

Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. Copyright in this report is the property of Jeffery and Katauskas Pty Ltd. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

Should you have any queries regarding this report, please do not hesitate to contact the undersigned.

P Wright

P Wright
Senior Associate

Reviewed by:

P Wright per

P Stubbs
Principal
For and on behalf of
JEFFERY AND KATAUSKAS PTY LTD.

115 Wicks Road
Macquarie Park, NSW 2113
PO Box 976
North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES
ABN 43 002 145 173

TABLE A
SUMMARY OF POINT LOAD STRENGTH INDEX TEST RESULTS

BOREHOLE NUMBER	DEPTH m	$I_{S\,(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)
A101a	12.48-12.51	2.4	48
	13.00-13.03	0.3	6
	14.30.-14.33	0.7	14
	15.08-15.11	1.8	36
A102	18.06-18.09	0.8	16
	18.89-18.92	1.0	20
	19.30-19.33	2.6	52
	20.11-20.14	2.3	46
	21.04-21.07	1.6	32

NOTES:

1. In the above table testing was completed in the Axial direction.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RTA T223.
4. The Estimated Unconfined Compressive Strength was calculated from the point load Strength Index by the following approximate relationship and rounded off to the nearest whole number :
   U.C.S. = 20 $I_{S\,(50)}$

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
A101
1/1

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP2 **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 2.5m
Date: 9-10-06 **Datum:** A.H.D.
Logged/Checked by: Z.B./PW

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to medium grained, with root fibres, with a trace of rock fragments and fine grained ironstone gravel.	M			GRASS COVER APPEARS POORLY COMPACTED
						1			FILL: Clayey sand, fine to medium grained.				
									FILL: Silty clay, high plasticity, with shale gravel and cobbles and brick fragments.	MC>PL			
						2							
									END OF BOREHOLE AT 2.7m				'TC' BIT REFUSAL ON RUBBLE IN FILL
						3							
						4							
						5							
						6							
						7							

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Borehole No.
A101a

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP2 **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 2.5m
Date: 9-10-06 **Datum:** A.H.D.
Logged/Checked by: Z.B./PW

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to medium grained, grey, with root fibres.	M			GRASS COVER APPEARS POORLY COMPACTED
ON COMPLETION OF AUGERING						1			FILL: Sandy clay, medium plasticity, fine to medium grained sand, dark grey, with a trace of silt, with brick fragments.	MC>PL			
						2		OH	ORGANIC CLAY: high plasticity, dark grey.	MC>PL	S-F	-	
						3 4 5		SM	SILTY SAND: fine to medium grained, dark grey, with silty clay bands.	W	L		
						6 7							

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CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **A101a**

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED

Project: PROPOSED DEVELOPMENT

Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP2 **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 2.5m

Date: 9-10-06 **Datum:** A.H.D.

Logged/Checked by: Z.B./PW

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								CL	SILTY CLAY: medium plasticity, dark grey and grey.	MC>PL	F-St		
						8					(St-VSt)		
						9							
						10							
									REFER TO CORED BOREHOLE LOG				
						11							
						12							
						13							
						14							


Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
JOB #20345SP2 BOREHOLE # A101a START CORING AT 10.40m
10
10.4m
CORE LOSS 0.35m
11
12
13
14
15
END AT 15.40m

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. **A101a** 3/3

CORED BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP2 **Core Size:** NMLC **R.L. Surface:** ≈ 2.5m
Date: 9-10-06 **Inclination:** VERTICAL **Datum:** A.H.D.
Drill Type: JK550 **Bearing:** - **Logged/Checked by:** N.E.S./PW

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT SPACING (mm)	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific	General
		10		START CORING AT 10.4m						
FULL RETURN				CORE LOSS 0.35m						
		11		SANDSTONE: fine to medium grained, light grey, with clay bands.	XW	EL				
				SANDSTONE: fine to medium grained, purple/red.	DW	M				
		12		SILTY CLAY: medium to high plasticity, light grey and orange brown, with ironstone bands.	RS	-				
		13		SANDSTONE: fine to medium grained, brown, cross bedded at 5-20°.	DW	M	× ×		- Be, 0°, P, S	
		14							- Be, 10°, P, S	
		15		SANDSTONE: fine to medium grained, light grey, with grey laminae, cross bedded at 15-25°.			× ×			
		16		END OF BOREHOLE AT 15.4m						

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BOREHOLE LOG

Borehole No.
A102
1/4

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP2
Date: 10-10-06
Method: SPIRAL AUGER JK550
R.L. Surface: ≈ 2.2m
Datum: A.H.D.
Logged/Checked by: Z.B./PW

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
						0			FILL: Silty sand, fine to medium grained, light brown, with a trace of root fibres.	D			GRASS COVER
▼ ON COMPLETION OF AUGERING						1			FILL: Clayey sand, fine to medium grained, light brown mottled grey, with a trace of brick fragments.	M			
						2			FILL: Sandy clay, high plasticity, dark grey, with fine to medium grained sand.	MC>PL			
								OH	ORGANIC CLAY: high plasticity, dark grey.	MC>PL	VS	-	
						3							
						4							
						5							
						6		SM	SILTY SAND: fine to medium grained, grey, with clay seams.	W	L	-	
						7							

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
A102

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP2
Date: 10-10-06
Method: SPIRAL AUGER JK550
Logged/Checked by: Z.B./ PW
R.L. Surface: ≈ 2.2m
Datum: A.H.D.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
								SM	SILTY SAND: fine to medium grained, grey, with clay seams.	W	L		
						8		CH	SILTY CLAY: high plasticity, yellow mottled brown.	MC>PL	S-F		
						9					St		
						10					VSt		
						11							
						12							
						13			REFER TO CORED BOREHOLE LOG				
						14							


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JOB #20345SP2 - BORE HOLE #A102
12
START DEPTH: 12.28m
CORE LOSS : 0.54m
13
14
15
CORR LOSS: 0.30m
16
17
18
19
20

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Borehole No.
A102
3/4

CORED BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP2 **Core Size:** NMLC **R.L. Surface:** ≈ 2.2m
Date: 10-10-06 **Inclination:** VERTICAL **Datum:** A.H.D.
Drill Type: JK550 **Bearing:** - **Logged/Checked by:** N.E.S./fw

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ (EL VL L M H VH EH)	DEFECT SPACING (mm) (500 300 100 50 30 10)	DEFECT DETAILS DESCRIPTION: Type, inclination, thickness, planarity, roughness, coating. Specific	General
		12		START CORING AT 12.28m						
				CORE LOSS 0.54m						
		13		SILTY CLAY: medium to high plasticity, grey and red.	RS					
		14								
		15								
				CORE LOSS 0.30m						
		16		SILTY CLAY: high plasticity, dark grey mottled brown.	RS					
		17		SANDSTONE: fine to medium grained, light grey mottled orange brown.	XW	EL				
		18		SANDSTONE: fine to medium grained, light grey.	DW	M-H	×			
				as above, but cross bedded at 20°.			×		- XWS, 20mm.t	


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21
END AT 21.07m

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CORED BOREHOLE LOG

Borehole No. **A102**
4/4

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP2 **Core Size:** NMLC **R.L. Surface:** ≈ 2.2m
Date: 10-10-06 **Inclination:** VERTICAL **Datum:** A.H.D.
Drill Type: JK550 **Bearing:** - **Logged/Checked by:** N.E.S./PW

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$ EL VL L M H VH EH	DEFECT SPACING (mm) 500 300 100 50 30 10	DEFECT DETAILS – DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific	General
				SANDSTONE: fine to medium grained, light grey, cross bedded at 20°.	DW	M-H	×			
		20					×		- J, 90°, P, R - XWS, 10mm.t	
		21					×			
				END OF BOREHOLE AT 21.07m						
		22								
		23								
		24								
		25								

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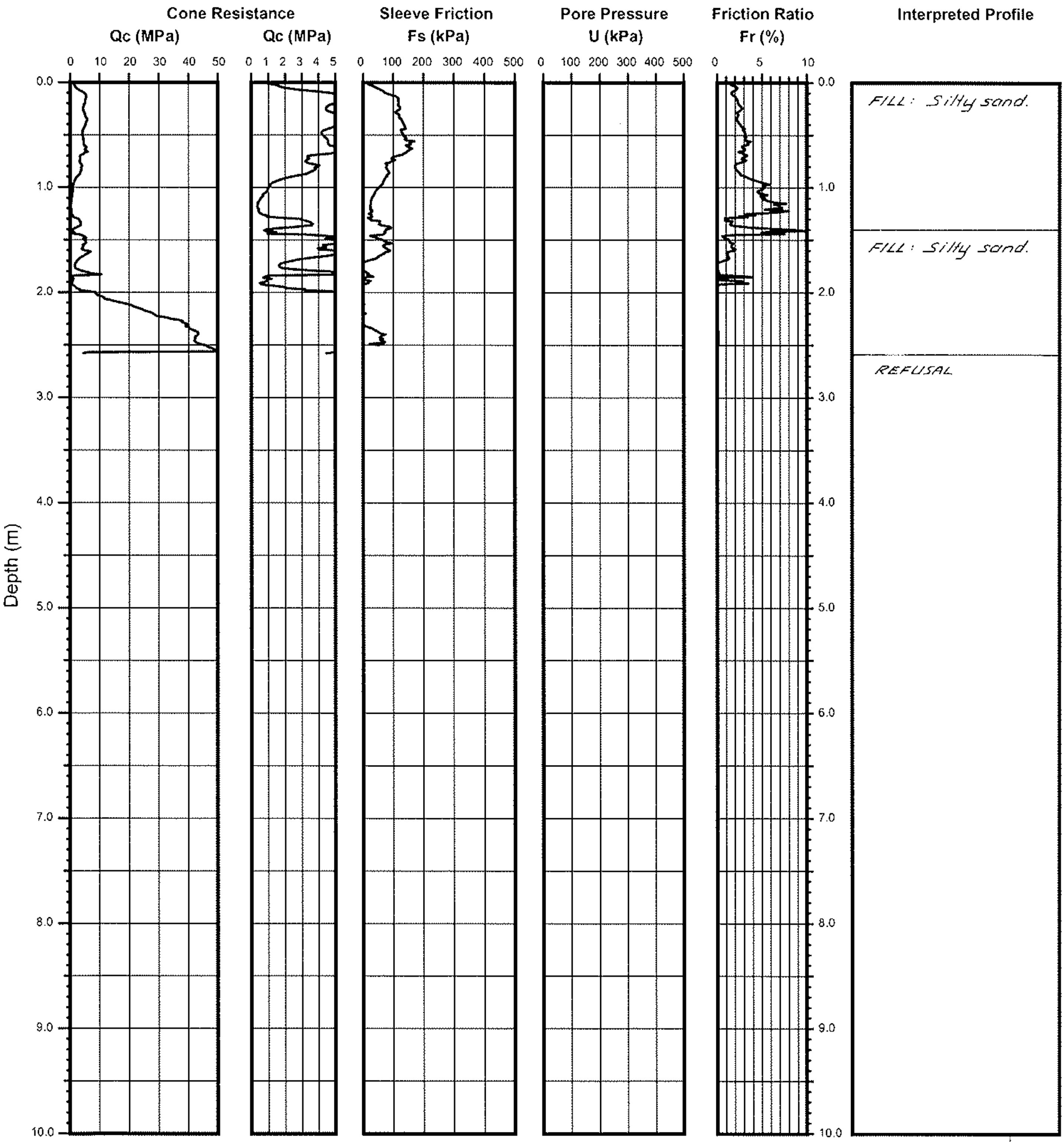
EFCP No.
A101
1/1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~2.5m	**Data File:**	20345SP2cptA101.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [illegible]

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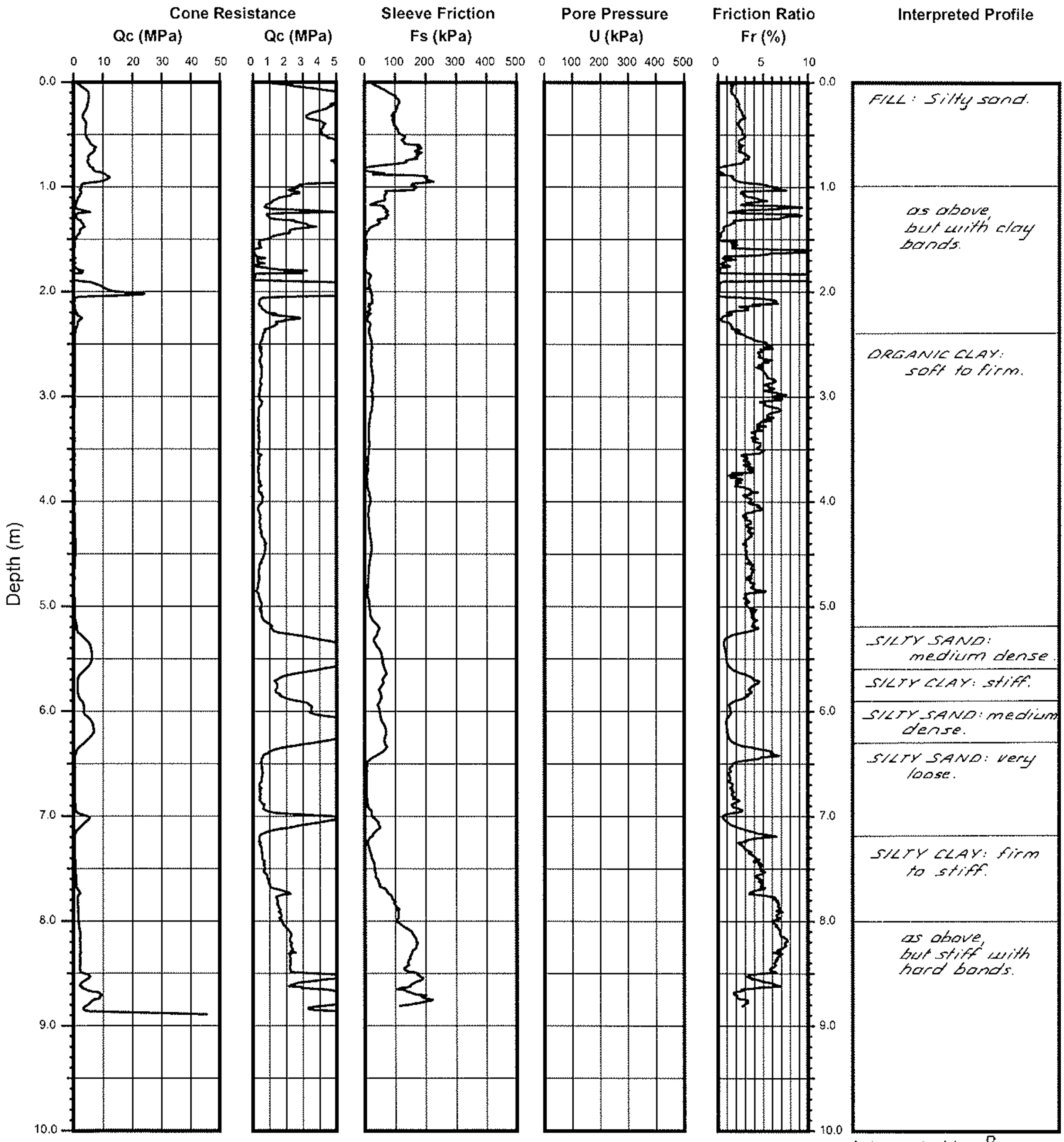
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A101a
1/1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~2.5m	**Data File:**	20345SP2cptA101a.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: KS.

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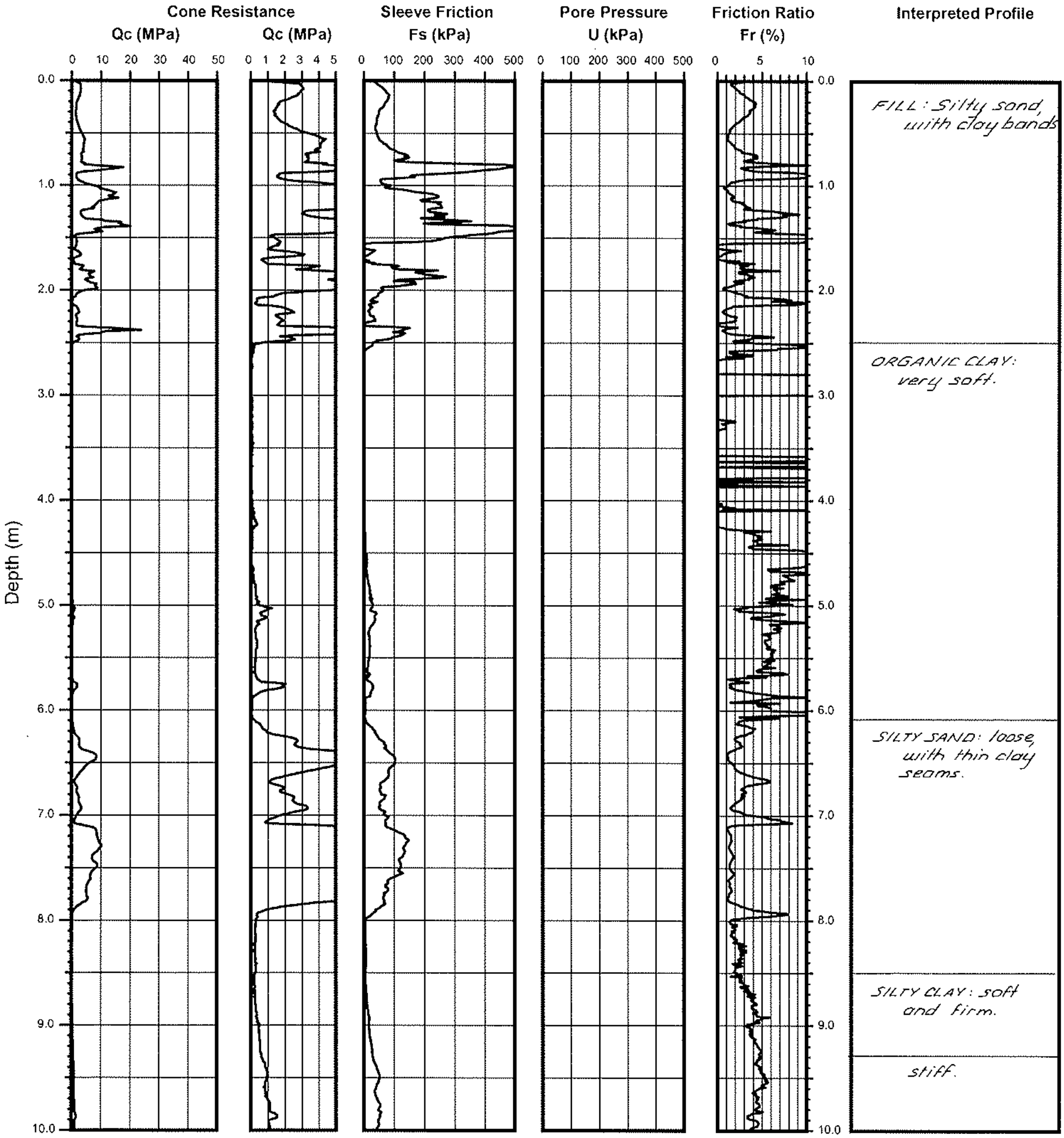
EFCP No.
A102
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project:	PROPOSED DEVELOPMENT
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~2.2m	**Data File:**	20345SP2cptA102.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [signature]

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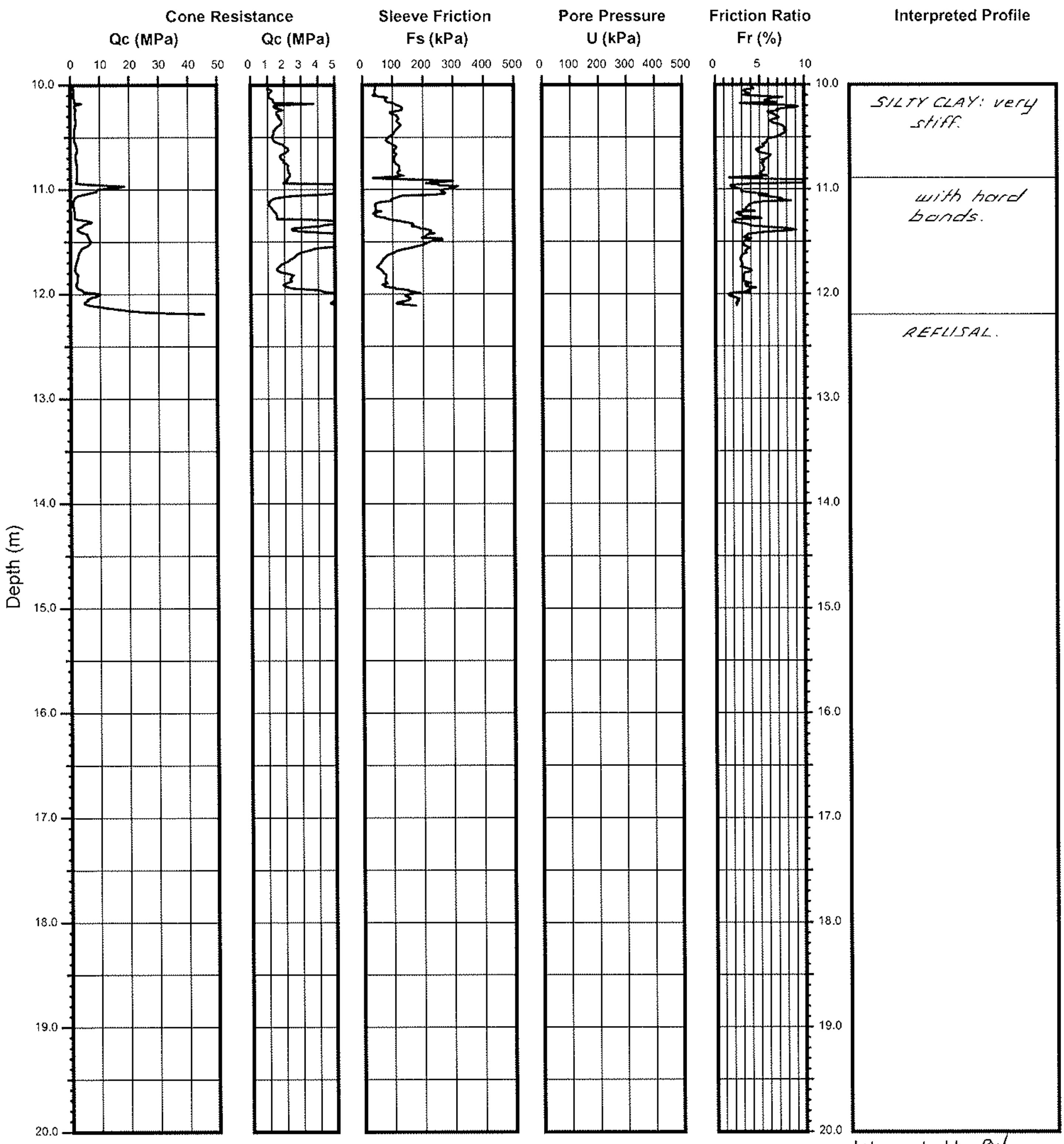
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A102
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~2.2m	**Data File:**	20345SP2cptA102.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [signature]

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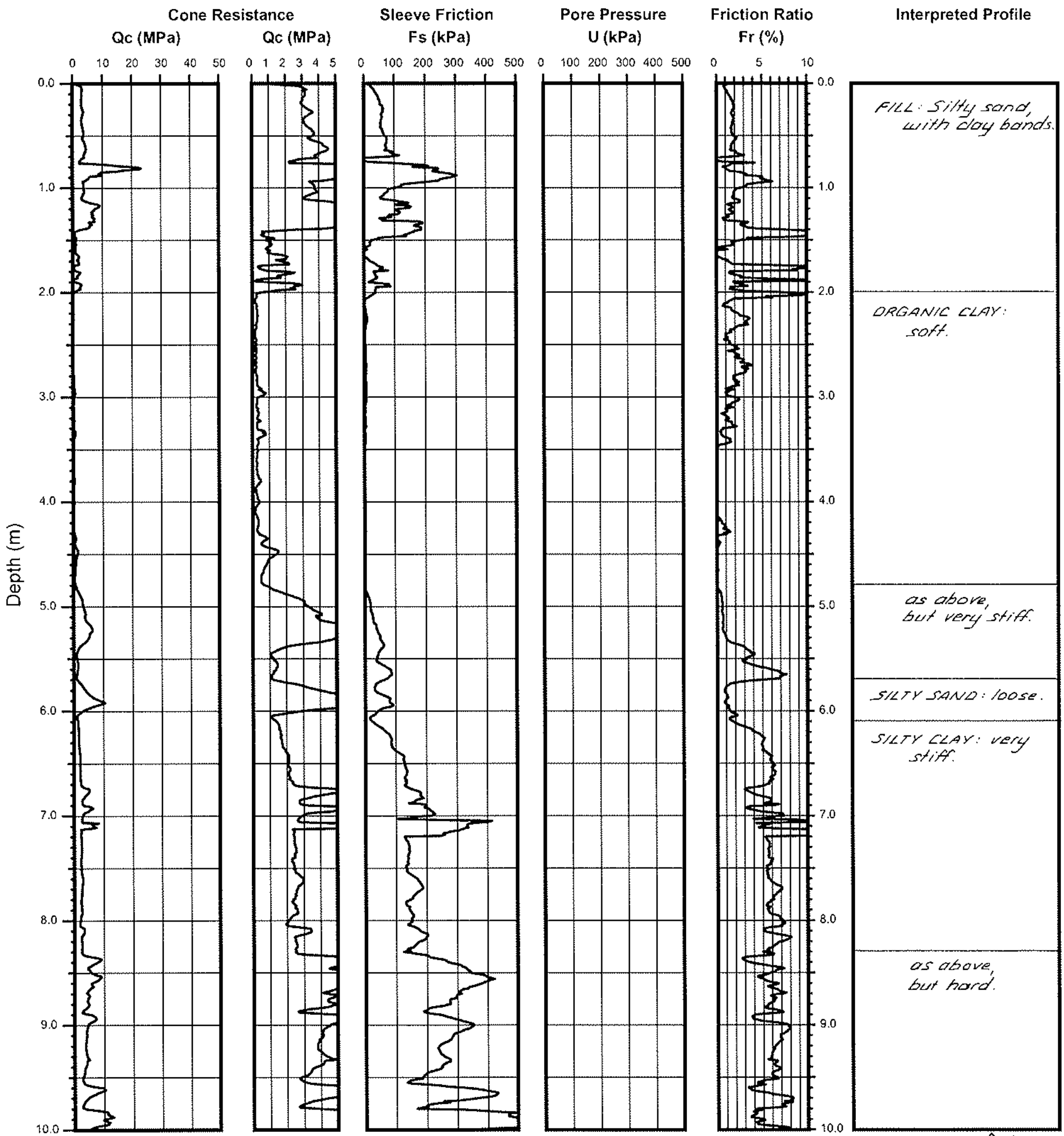
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **A103** 1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project:	PROPOSED DEVELOPMENT
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~2.5m	**Data File:**	20345SP2cptA103.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [signature]

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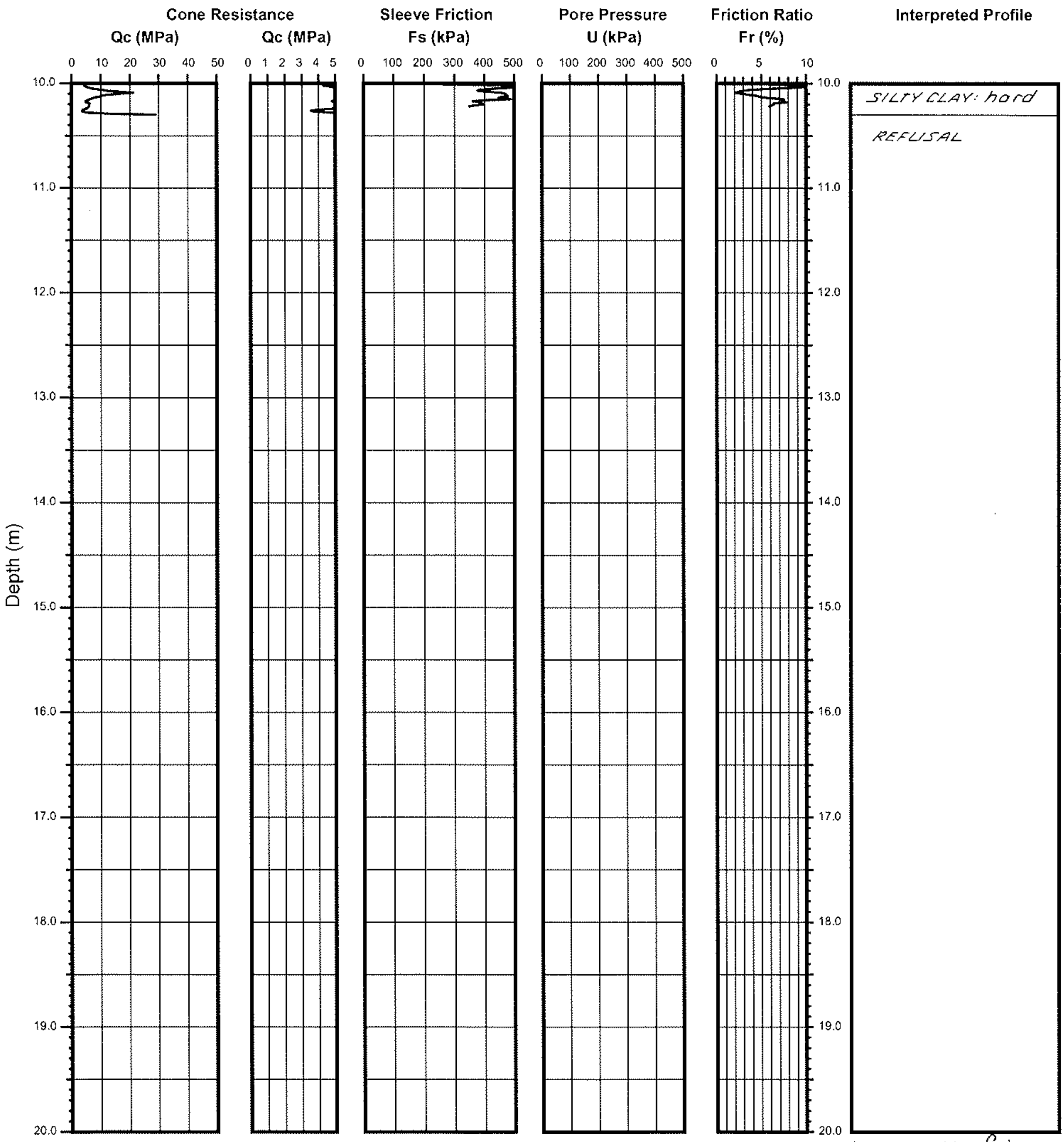
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A103
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project:	PROPOSED DEVELOPMENT
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~2.5m	**Data File:**	20345SP2cptA103.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [signature]

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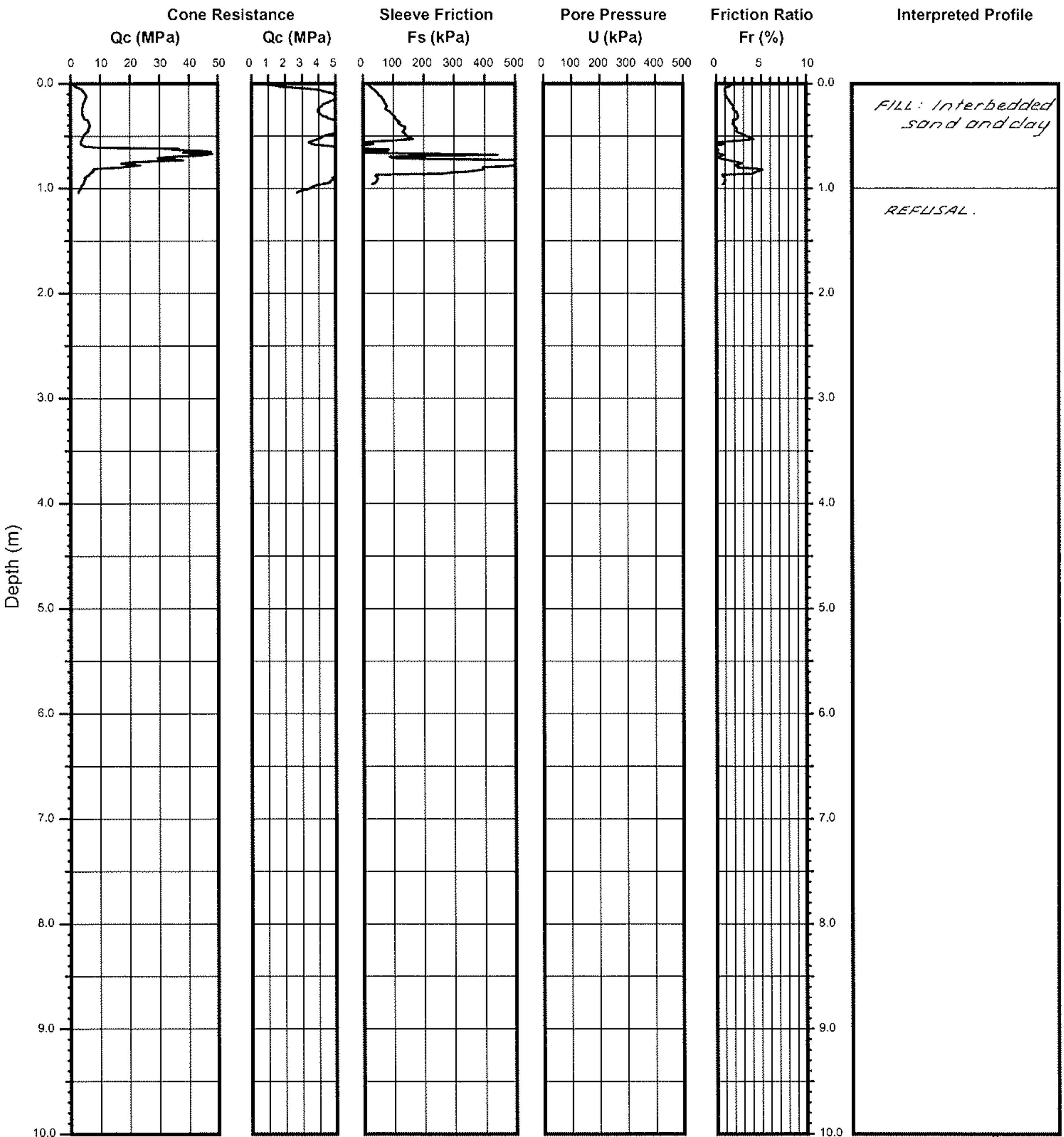
EFCP No.
A104
1/1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~2.3m	**Data File:**	20345SP2cptA104.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [signature]

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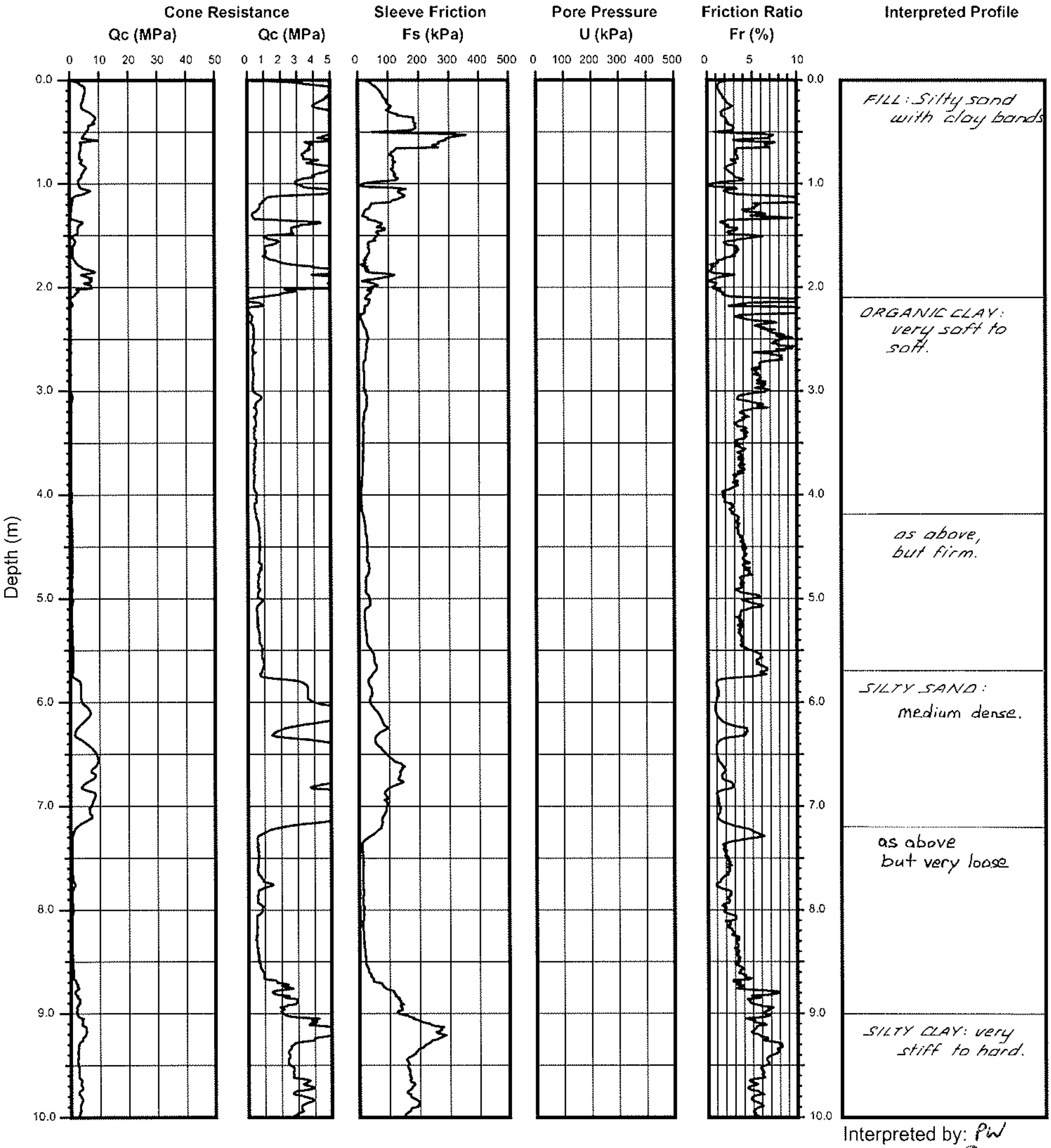
EFCP No.
A104a
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project:	PROPOSED DEVELOPMENT
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~2.3m	**Data File:**	20345SP2cptA104a.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [signature]

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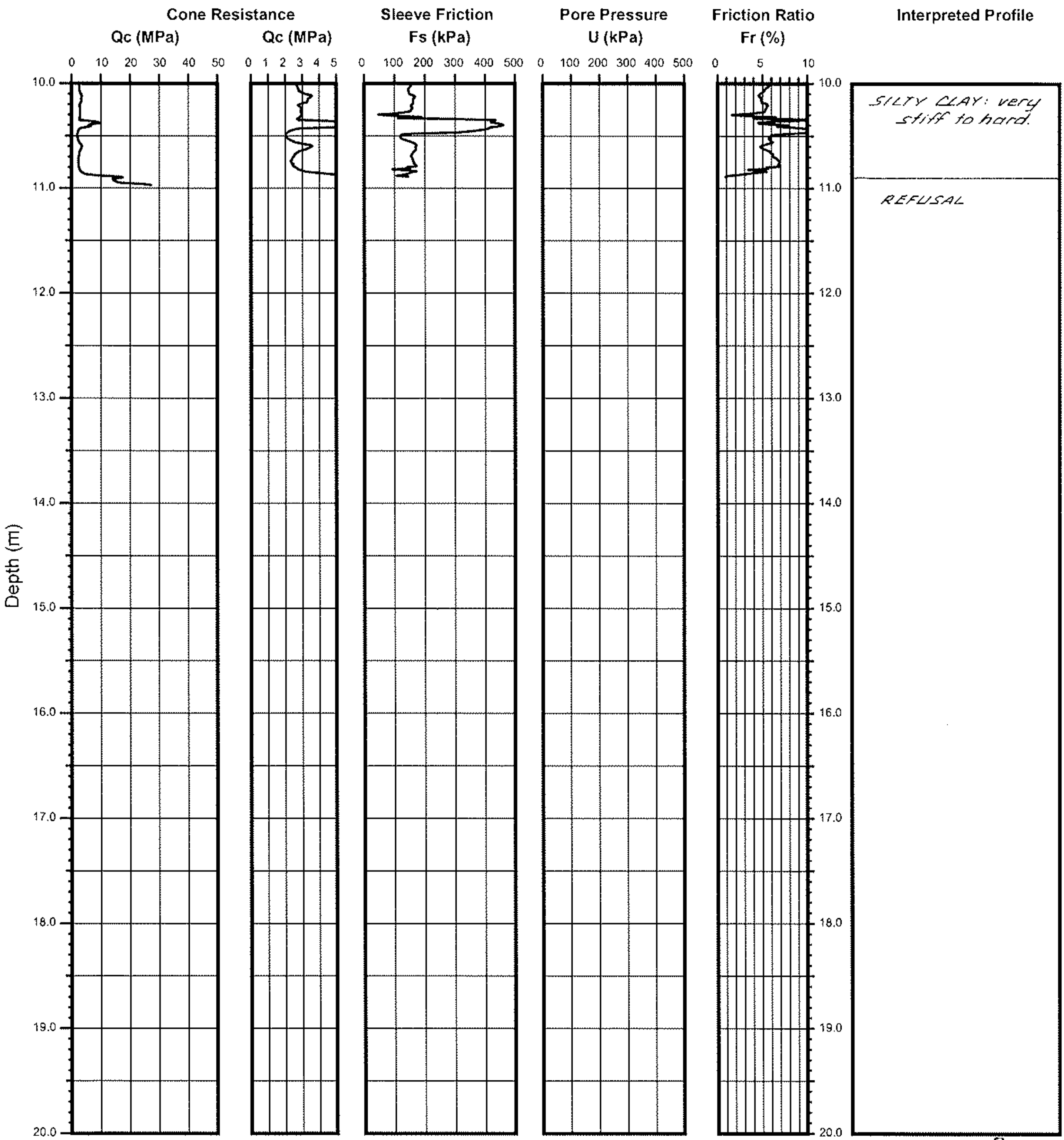
EFCP No.
A104a
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.: 20345SP2 **RL Surface:** ~2.3m **Data File:** 20345SP2cptA104a.cpt
Test Date: 10/9/2006 **Datum:** AHD **Operator:** NES



Interpreted by: PW
Checked by: [illegible]

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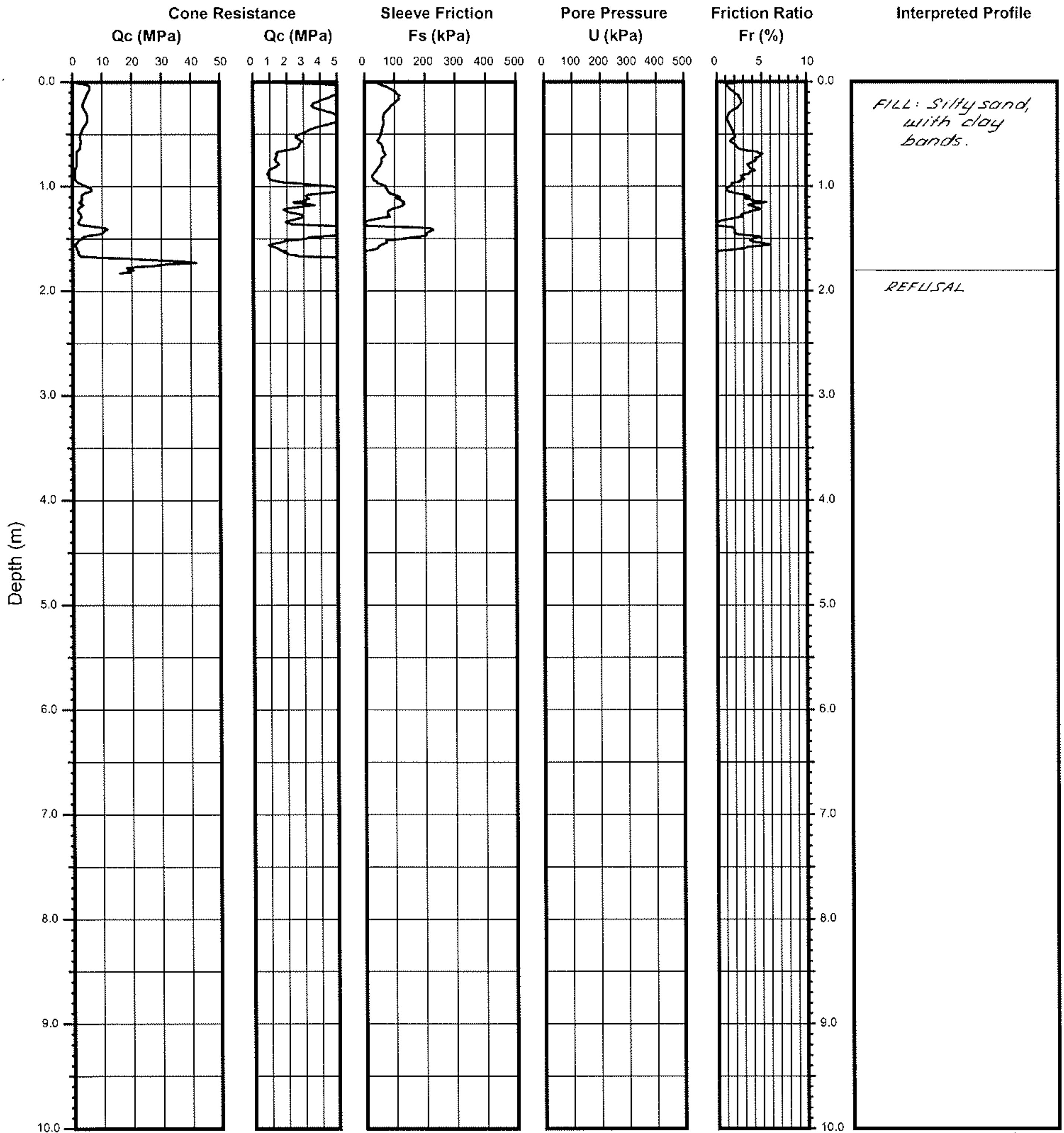
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **A105** 1/1

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~2.3m	**Data File:**	20345SP2cptA105.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [signature]

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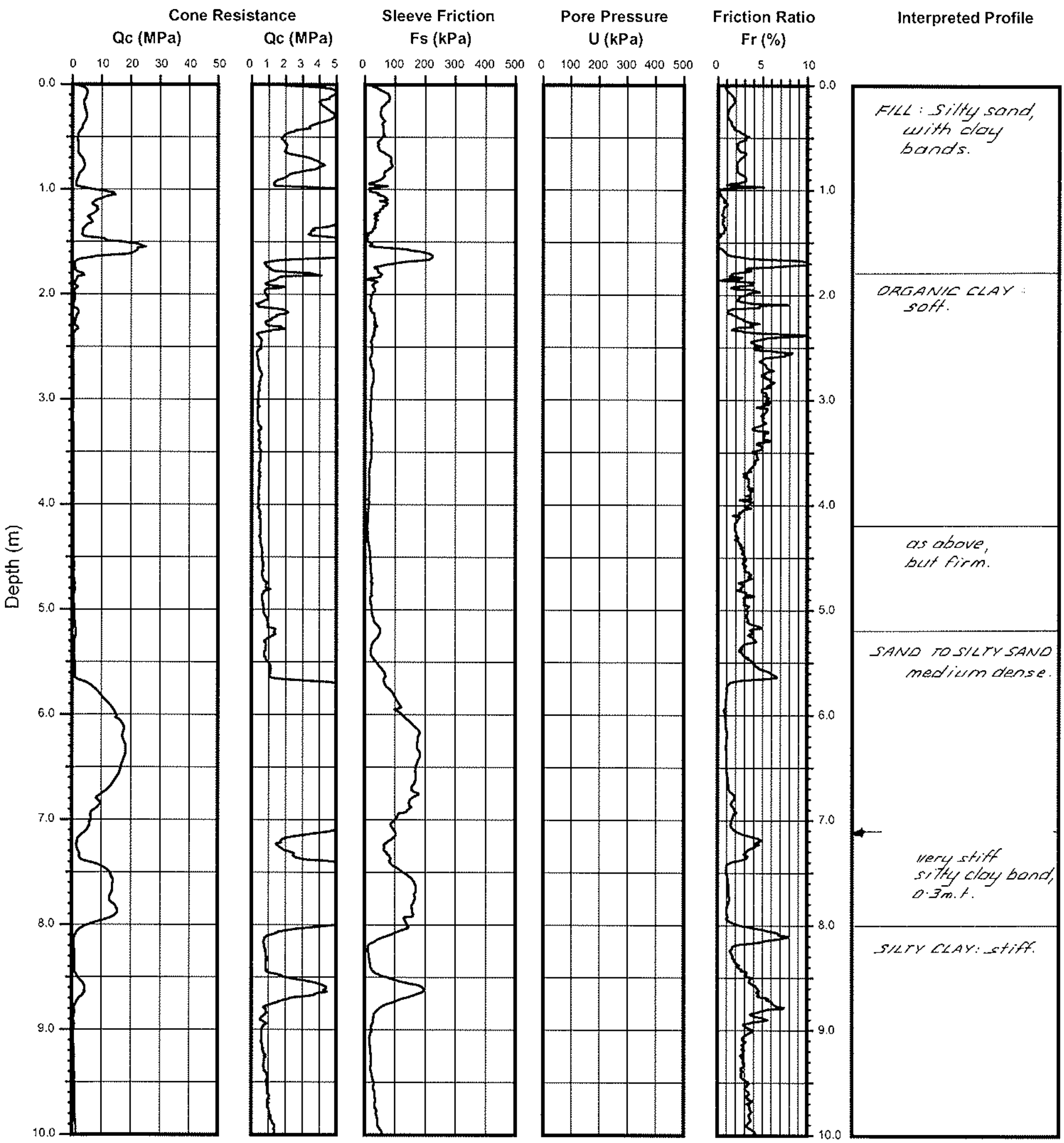
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **A105a** 1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project:	PROPOSED DEVELOPMENT
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~2.3m	**Data File:**	20345SP2cptA105a.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [illegible]

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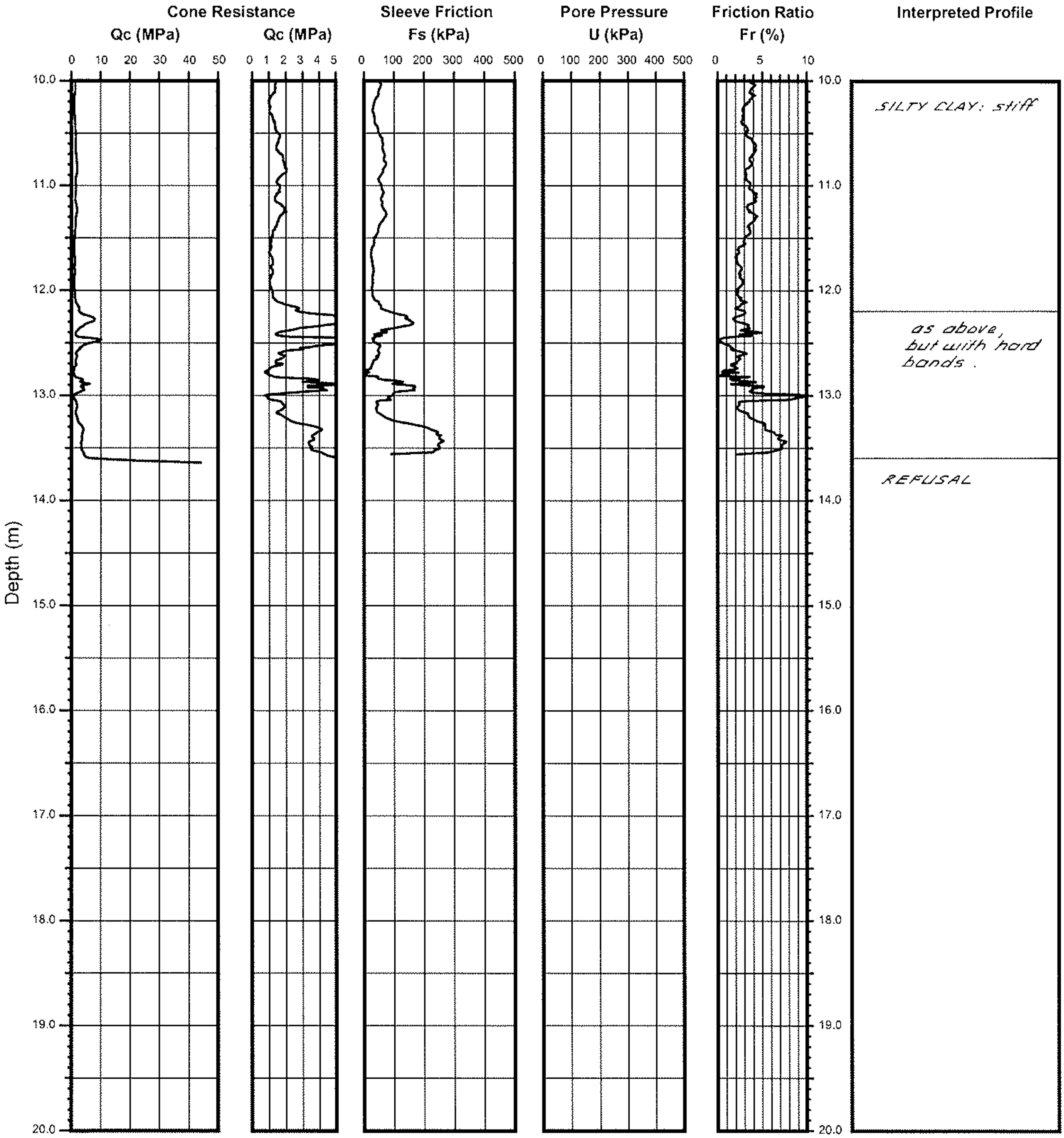
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A105a
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~2.3m	**Data File:**	20345SP2cptA105a.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: RS

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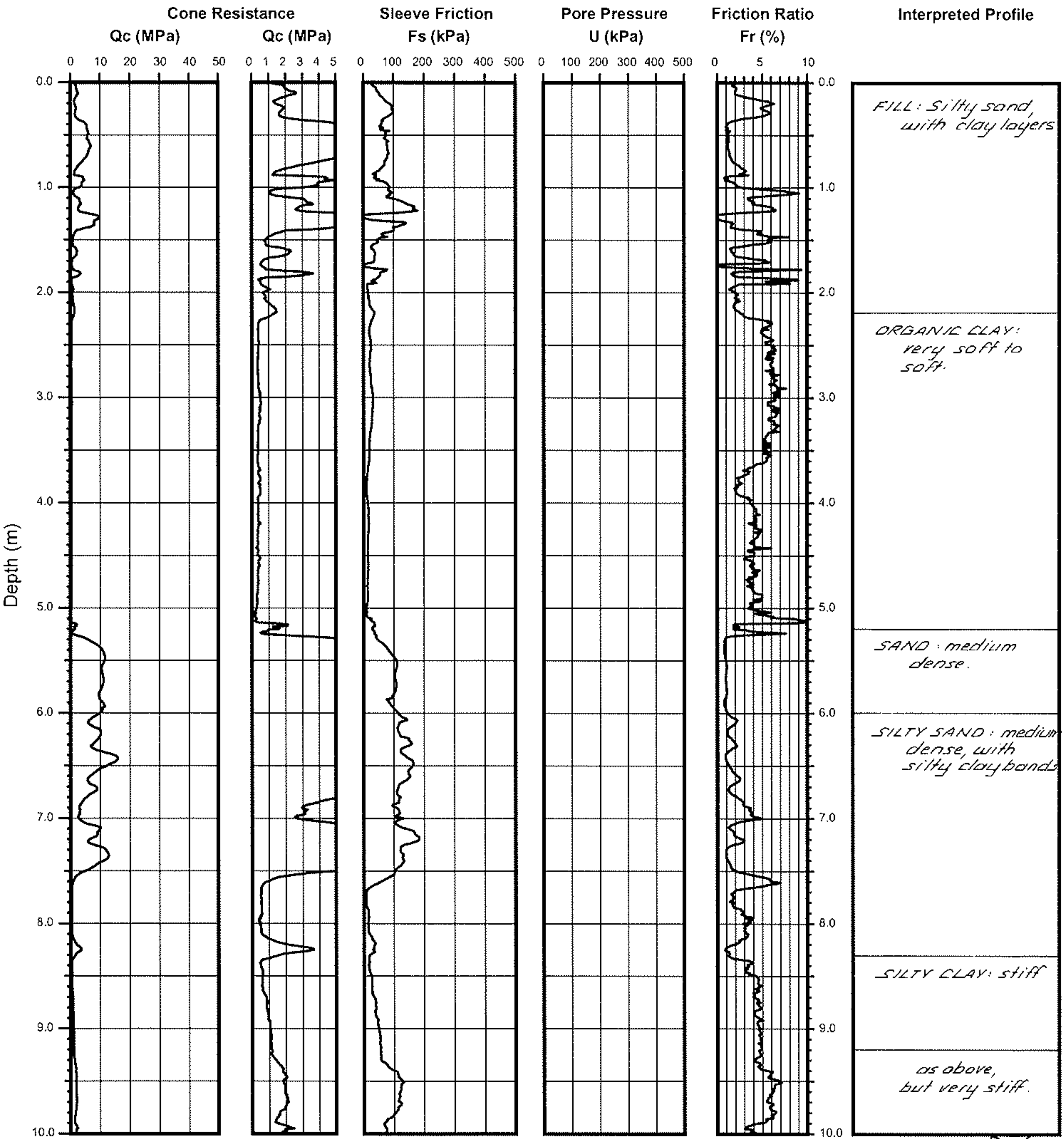
EFCP No.
A106
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project:	PROPOSED DEVELOPMENT
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~2.1m	**Data File:**	20345SP2cptA106.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: GB

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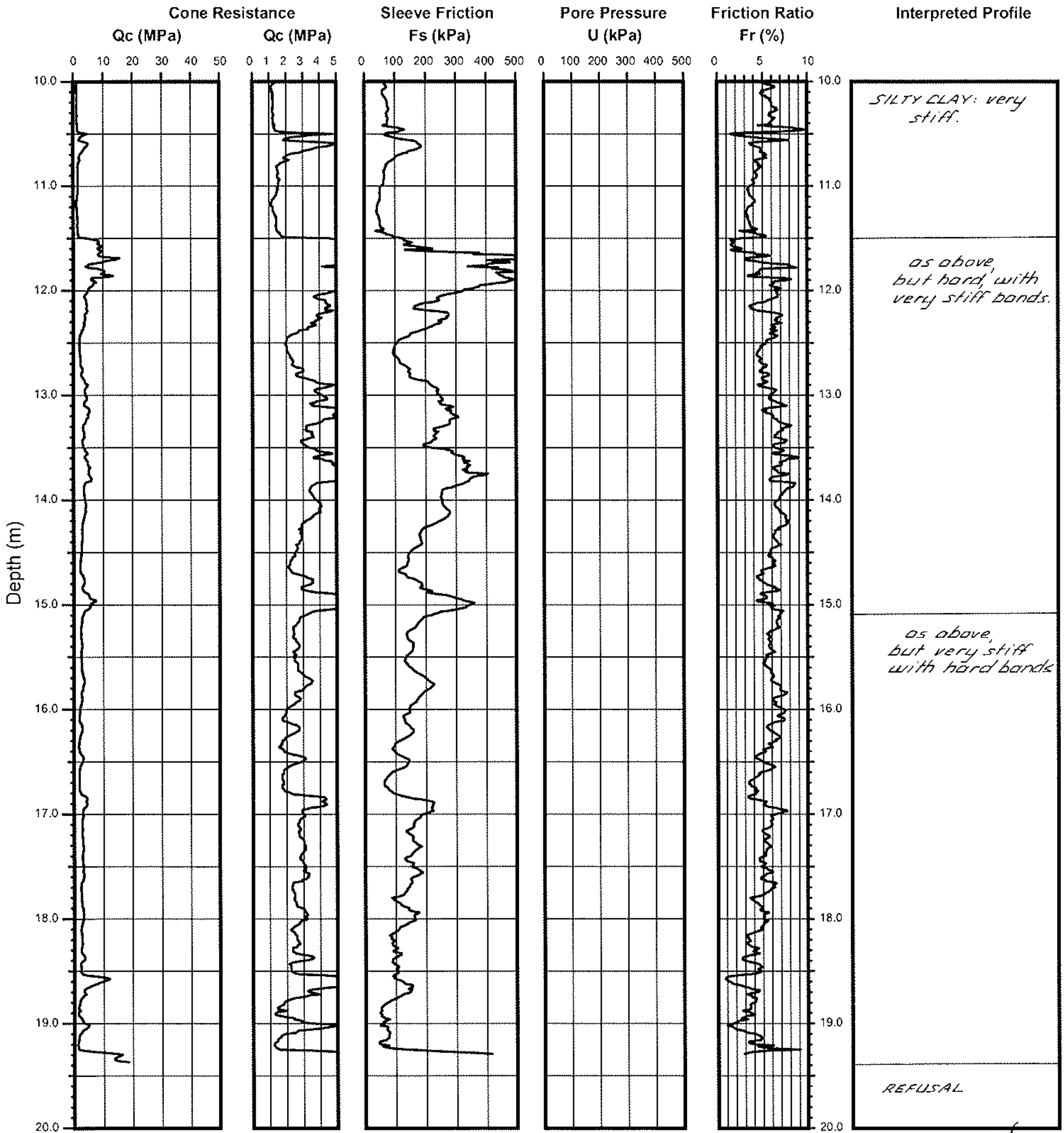
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A106
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~2.1m	**Data File:**	20345SP2cptA106.cpt
Test Date:	10/9/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [illegible]

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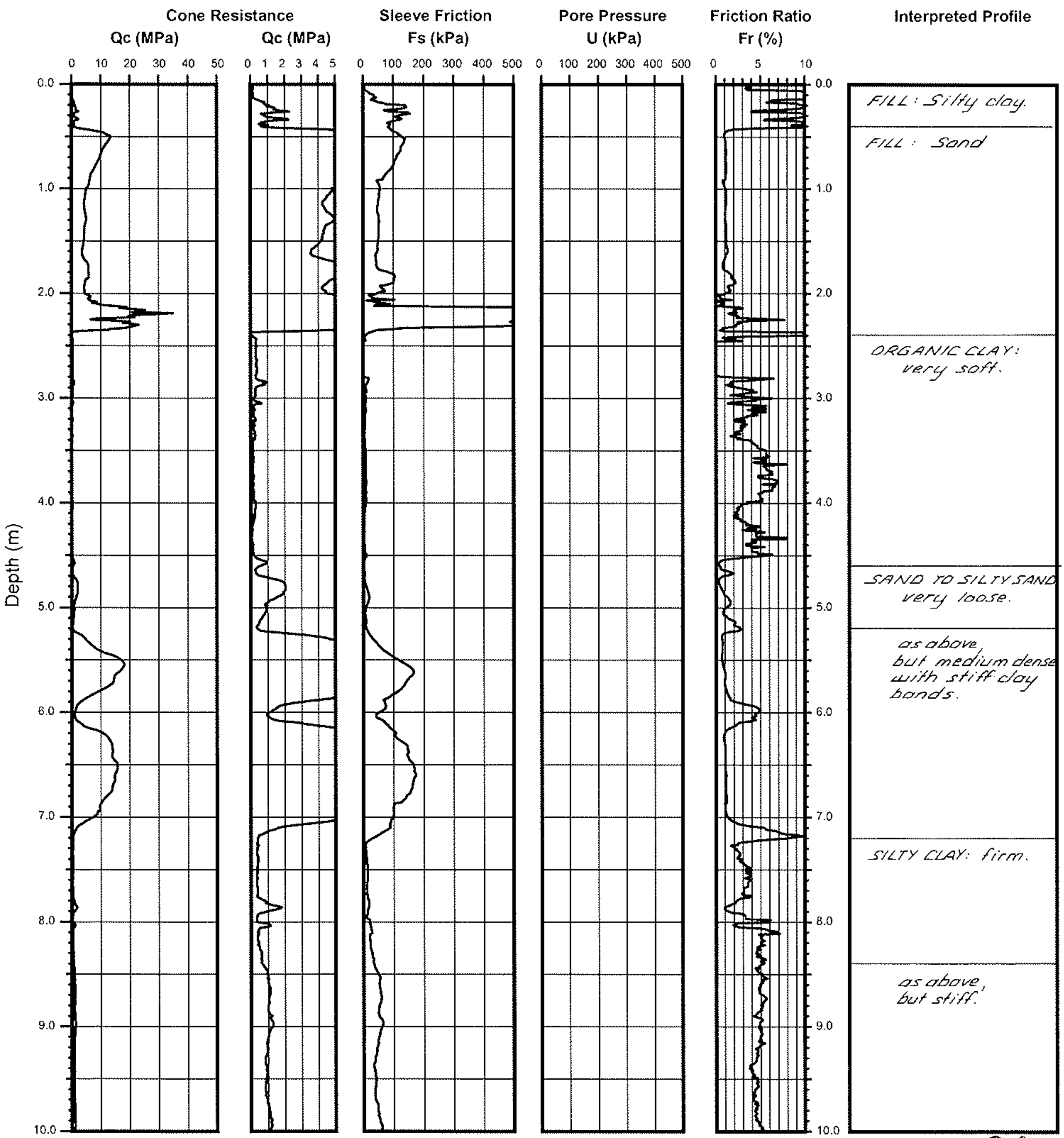
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A107
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~1.5m	**Data File:**	20345SP2cptA107.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by:

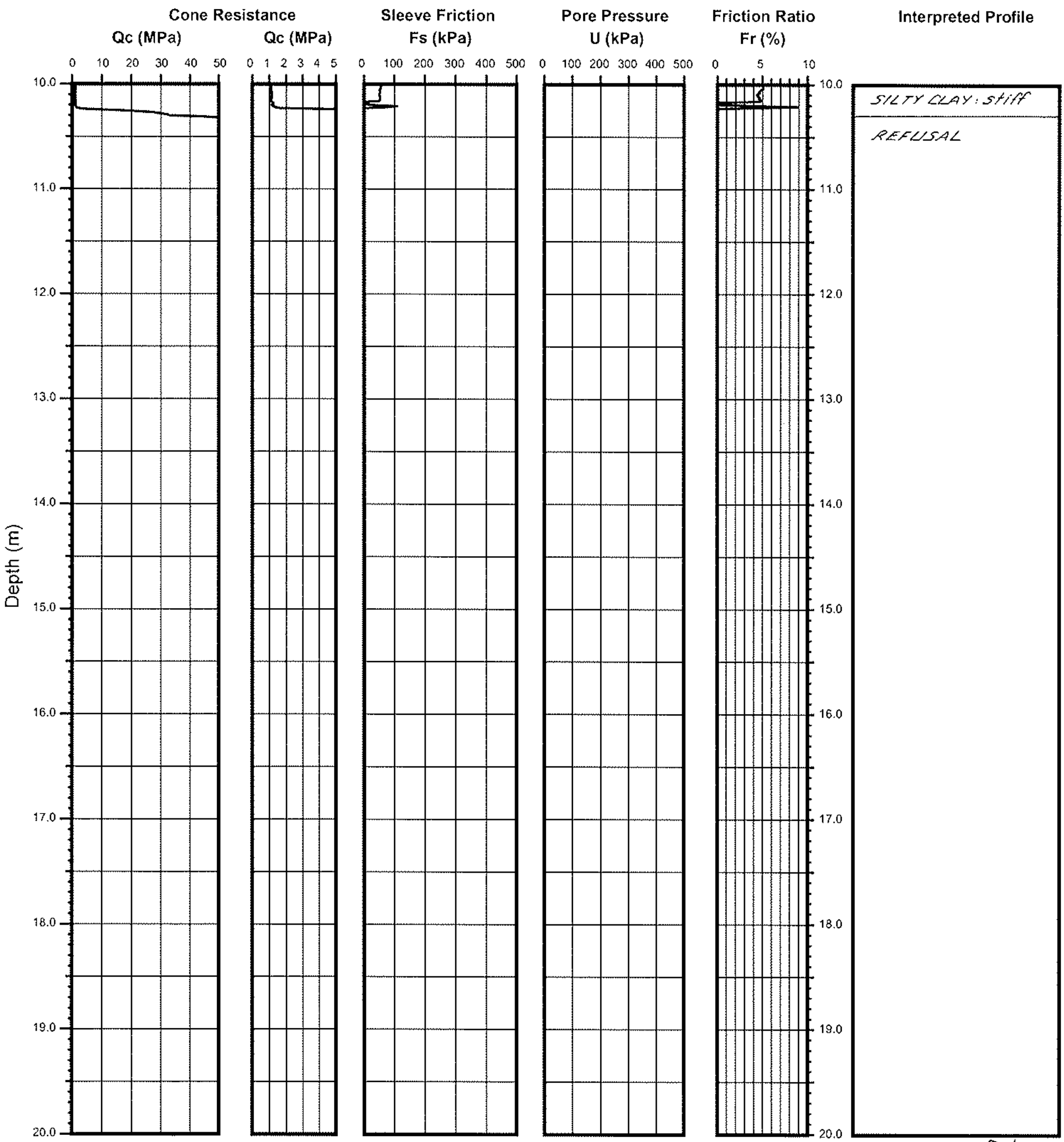
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A107
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~1.5m	**Data File:**	20345SP2cptA107.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: [illegible]

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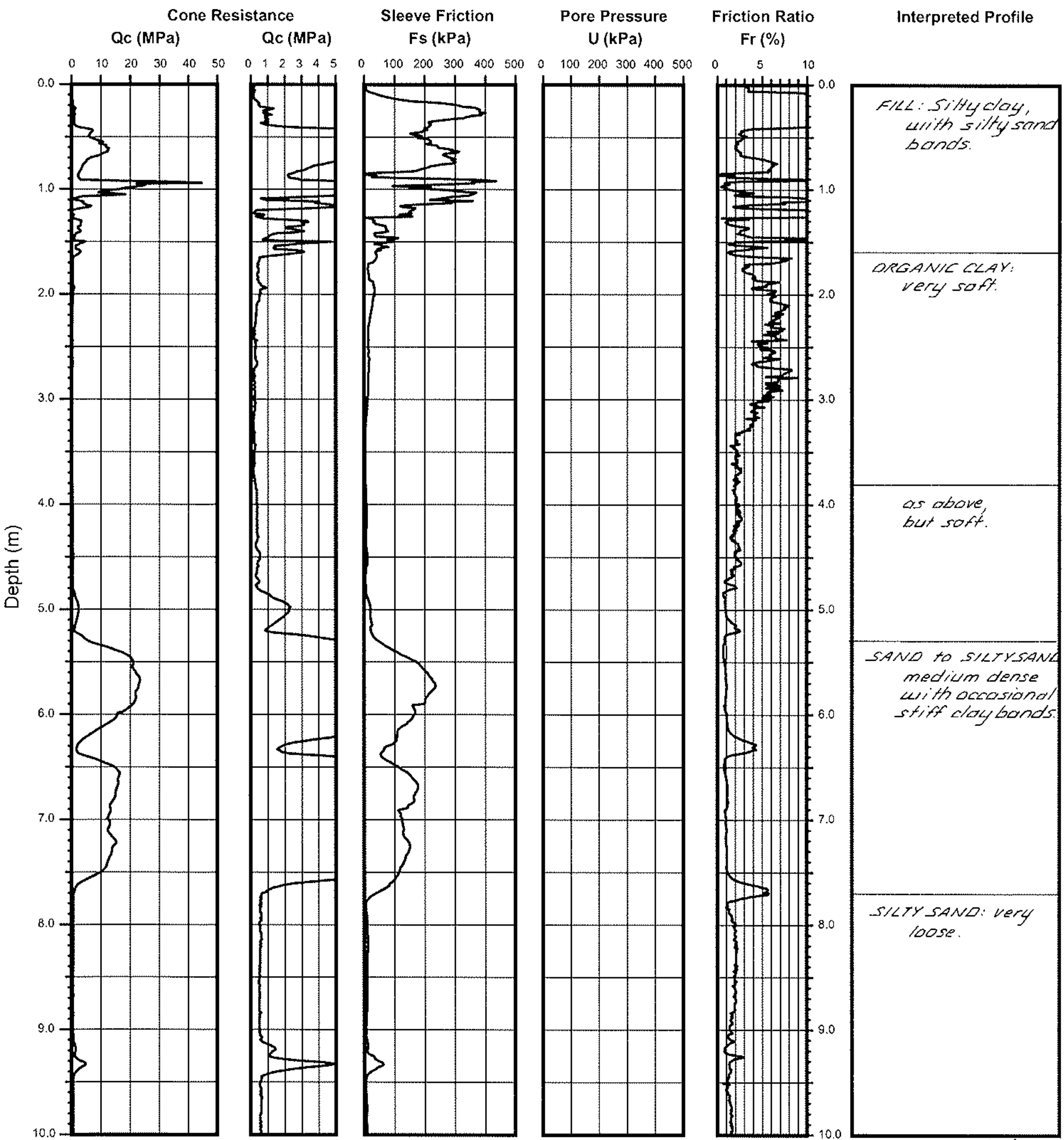
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A108
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~1.7m	**Data File:**	20345SP2cptA108.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by:

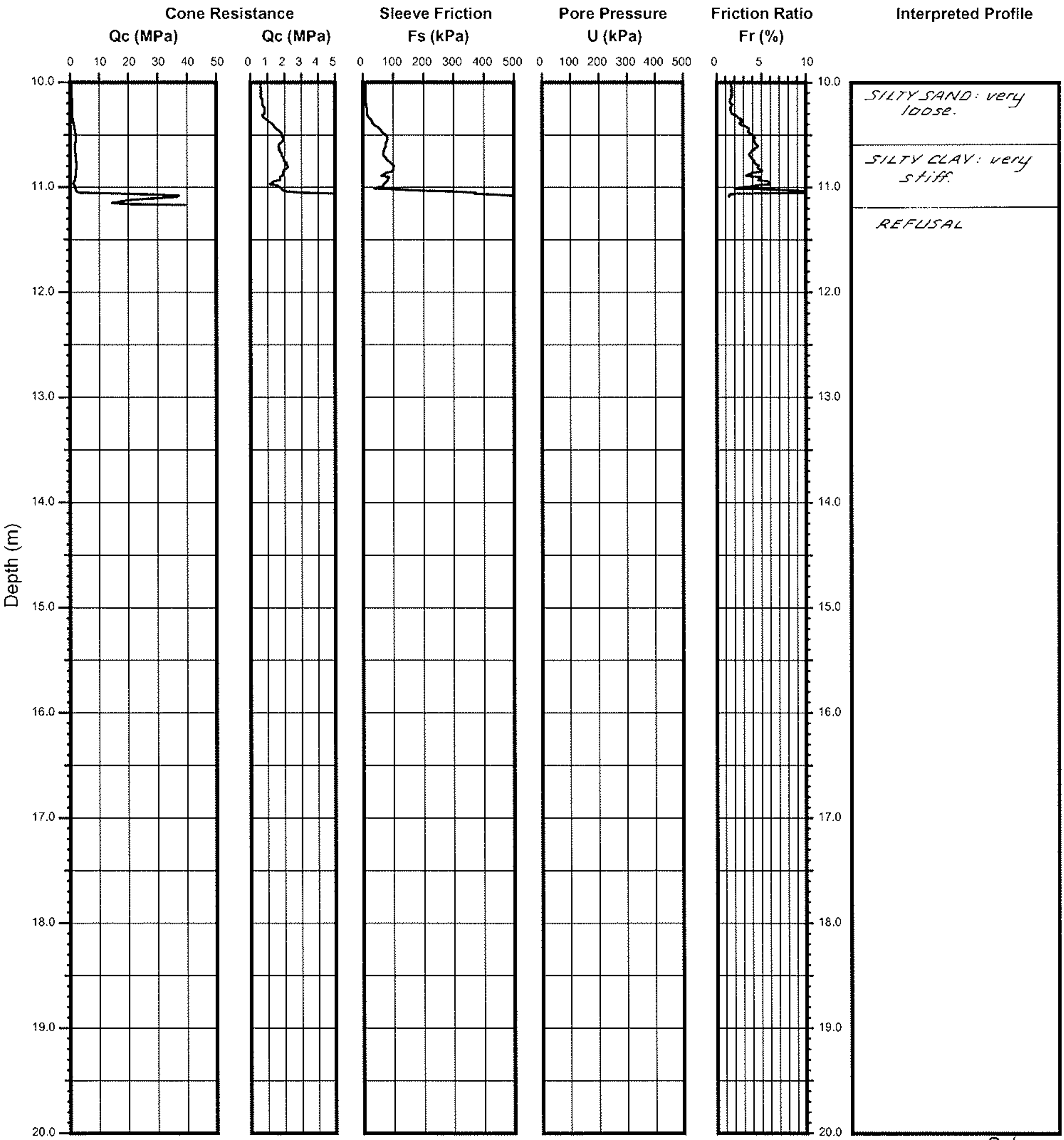
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A108
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~1.7m	**Data File:**	20345SP2cptA108.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by:

Jeffery and Katauskas Pty Ltd

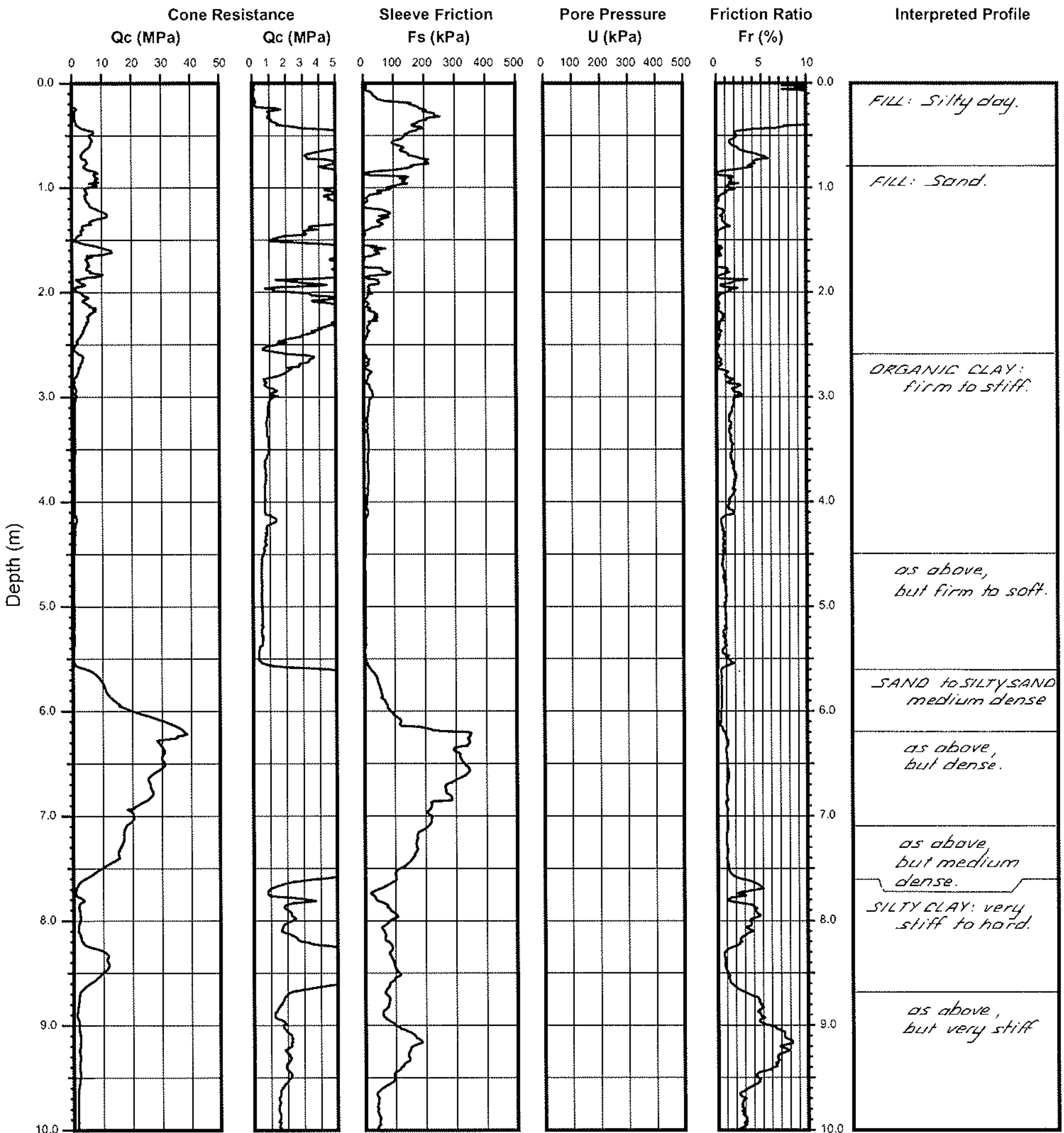
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A109
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client: CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project: PROPOSED DEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~2.4m	**Data File:**	20345SP2cptA109.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by: RS

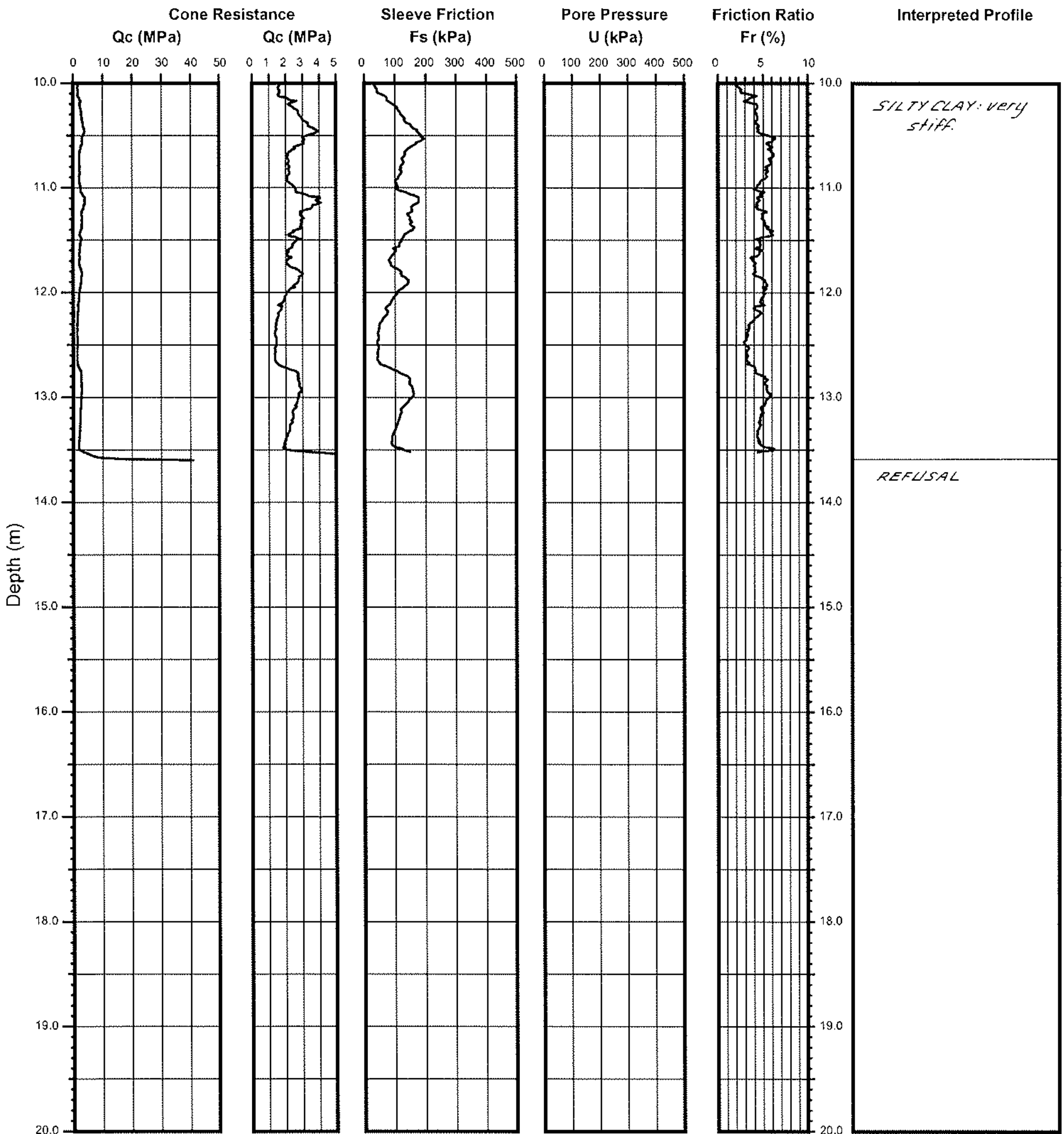
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A109
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~2.4m	**Data File:**	20345SP2cptA109.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



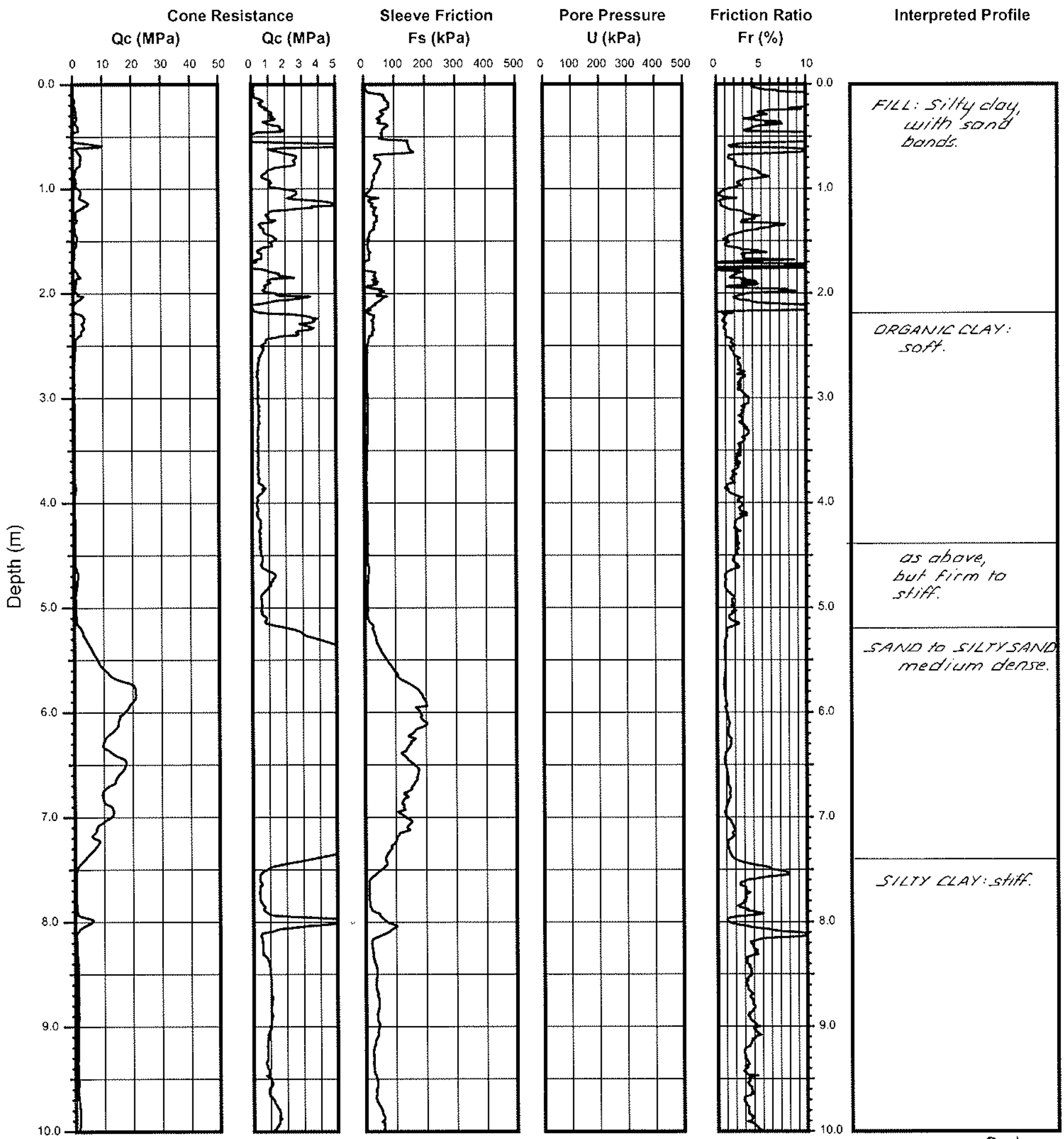
Interpreted by: PW
Checked by: PB

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
A110
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED				
Project:	PROPOSED DEVELOPMENT				
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW				
Job Ref.:	20345SP2	**RL Surface:**	~1.8m	**Data File:**	20345SP2cptA110.cpt
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by:

Jeffery and Katauskas Pty Ltd

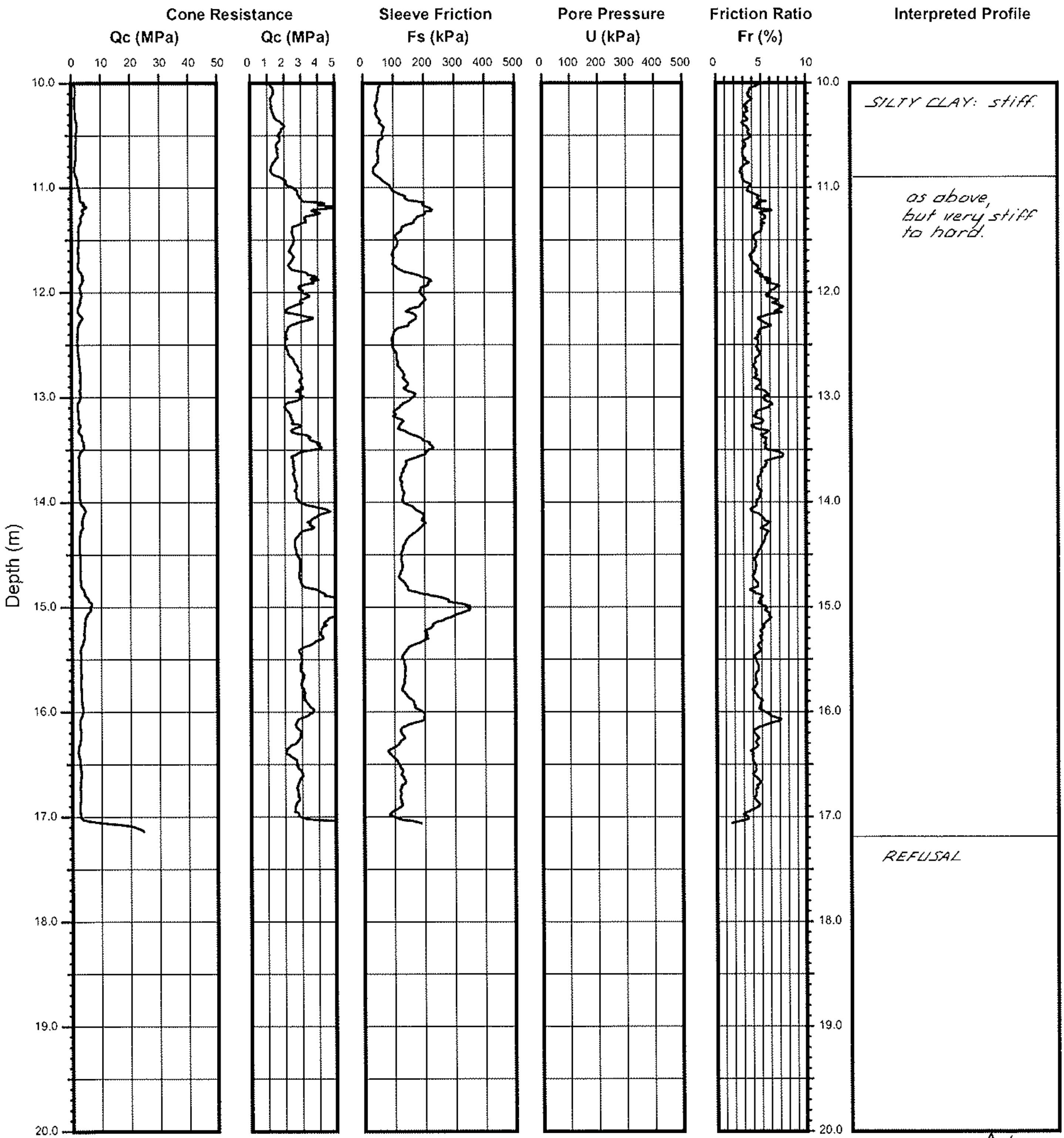
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **A110** 2/2

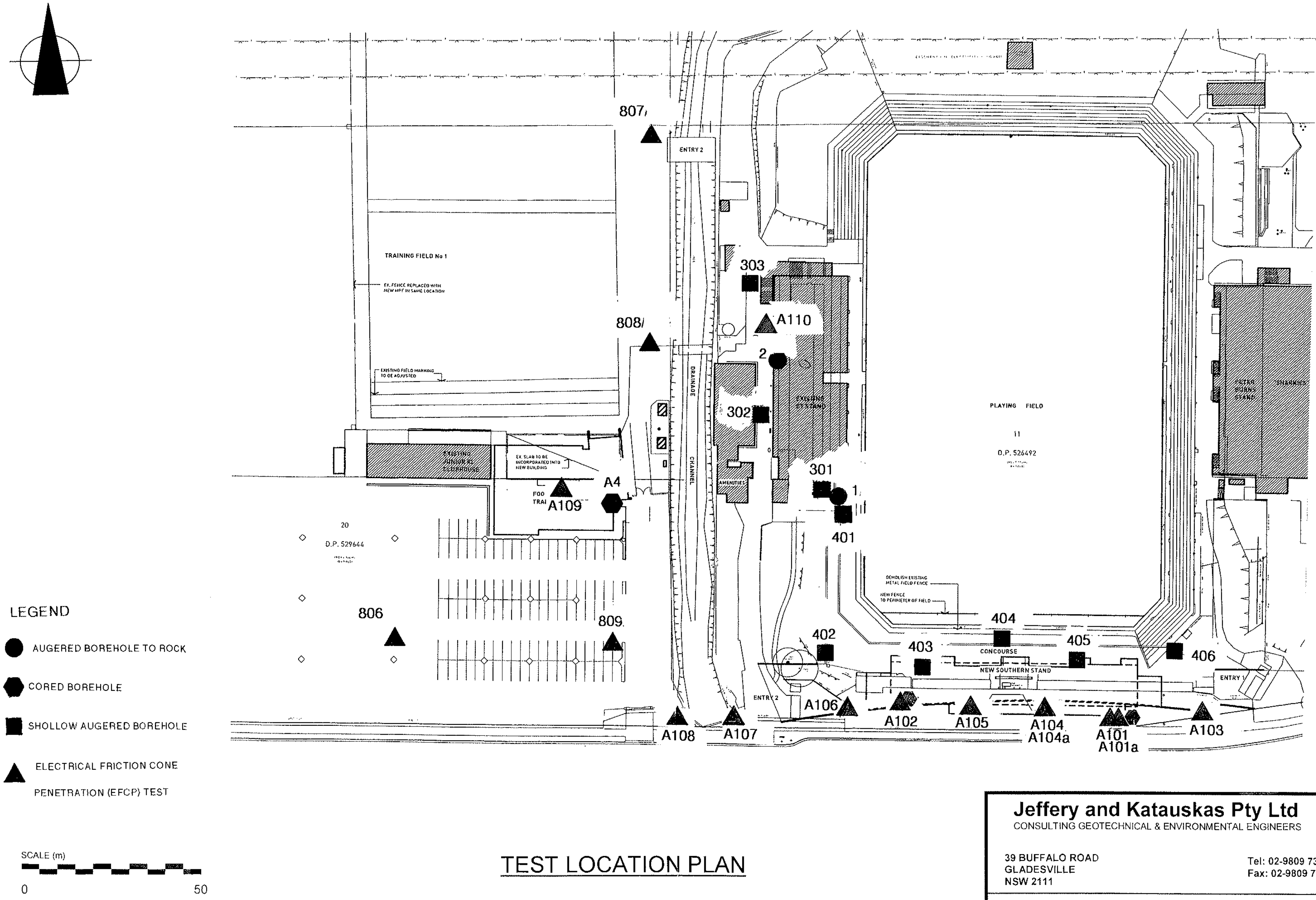
ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	CRONULLA SUTHERLAND LEAGUES CLUB LIMITED
Project:	PROPOSED DEVELOPMENT
Location:	CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job Ref.:	20345SP2	**RL Surface:**	~1.8m	**Data File:**	20345SP2cptA110.cp
Test Date:	10/10/2006	**Datum:**	AHD	**Operator:**	NES



Interpreted by: PW
Checked by:



TEST LOCATION PLAN

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL & ENVIRONMENTAL ENGINEERS

39 BUFFALO ROAD
GLADESVILLE
NSW 2111

Tel: 02-9809 7322
Fax: 02-9809 7626

Report No. 20345SP2 **Figure No.** 1

Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
ABN 17 003 550 801

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (eg sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, "Shale" is used to describe thinly bedded to laminated siltstone.

SAMPLING

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table. Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term "mud" encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test F3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N>30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "N_c" on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation: Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

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

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

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

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

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

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg to a twenty storey building). If this happens, the company will be pleased to review the report and the sufficiency of the investigation work.

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

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

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

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. License to use the documents may be revoked without notice if the Client is in breach of any objection to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed <u>or</u> where only a limited investigation has been completed <u>or</u> where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

SITE INSPECTION

The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to
ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or
iii) full time engineering presence on site.

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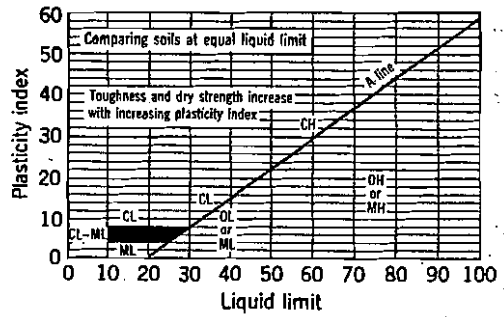
UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 µm and basing fractions on estimated weights)				Group Symbols[a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria	
Coarse-grained soils More than half of material is *larger* than 75 µm sieve size[b] (The 75 µm sieve size is about the smallest particle visible to naked eye)	Gravels More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than 75 µm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines			Not meeting all gradation requirements for *GW*
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics		Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures			Atterberg limits above "A" line, with *PI* greater than 7
	Sands More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)		$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines			Not meeting all gradation requirements for *SW*
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures			Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures			Atterberg limits below "A" line with *PI* greater than 7

Identification Procedures on Fraction Smaller than 380 µm Sieve Size		Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Fine-grained soils More than half of material is *smaller* than 75 µm sieve size	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

NOTE: 1) Soils possessing characteristics of two groups are designated by combinations of group symbols (e.g. GW-GC, well graded gravel-sand mixture with clay fines).

2) Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

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GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CH)
- SILTY CLAY (CL, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML)
- PEAT AND ORGANIC SOILS

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE
- SILTSTONE, MUDSTONE, CLAYSTONE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

DEFECTS AND INCLUSIONS

- CLAY SEAM
- SHEARED OR CRUSHED SEAM
- BRECCIATED OR SHATTERED SEAM/ZONE
- IRONSTONE GRAVEL
- ORGANIC MATERIAL

OTHER MATERIALS

- CONCRETE
- BITUMINOUS CONCRETE, COAL
- COLLUVIUM

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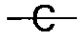
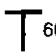
A.B.N. 17 003 550 801 A.C.N. 003 550 801

LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record		Standing water level. Time delay following completion of drilling may be shown.
		Extent of borehole collapse shortly after drilling.
		Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY - runs freely through fingers.
	M	MOIST - does not run freely but no free water visible on soil surface.
	W	WET - free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT - Unconfined compressive strength less than 25kPa
	S	SOFT - Unconfined compressive strength 25-50kPa
	F	FIRM - Unconfined compressive strength 50-100kPa
	St	STIFF - Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF - Unconfined compressive strength 200-400kPa
	H	HARD - Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose <15 0-4
	L	Loose 15-35 4-10
	MD	Medium Dense 35-65 10-30
	D	Dense 65-85 30-50
	VD	Very Dense >85 >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

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A.B.N. 17 003 550 801 A.C.N. 003 550 801

LOG SYMBOLS

ROCK MATERIAL WEATHERING CLASSIFICATION

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

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL		Easily remoulded by hand to a material with soil properties.
		0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
		0.1	
Low:	L		A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
		0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
		1	
High:	H		A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
		3	
Very High:	VH		A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
		10	
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	

APPENDIX A

Unit 3, 39 Buffalo Road
Gladesville, NSW 2111
Telephone: 02 9809 7322
Facsimile: 02 9809 7626
Email: dtreweek@jkgroup.net.au

SOIL TEST SERVICES
ABN 43 002 145 173

Ref No: 20345SP

TABLE A
SUMMARY OF POINT LOAD STRENGTH INDEX TEST RESULTS

BOREHOLE NUMBER	DEPTH m	$I_{S(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)
A1	26.06-26.09	0.01	<1
	26.81-26.84	0.02	<1
	27.10-27.13	0.03	<1
	27.57-27.59	0.2	4
A3	13.86-13.89	0.4	8
	14.21-14.24	0.2	4
	14.73-14.75	0.3	6
	15.43-15.46	0.4	8
	16.16-16.18	0.8	16
	16.55-16.57	0.9	18
A4	14.43-14.46	0.5	10
	15.27-15.29	0.3	6
	15.81-15.83	0.4	8
	16.23-16.26	0.4	8
	17.81-17.84	0.4	8
	18.57-18.60	1.9	38
	19.35-19.37	1.0	20
A5	12.20-12.22	0.9	18
	13.09-13.12	1.1	22
	13.15-13.18	3.1	62
	13.77-13.79	0.8	16
	14.21-14.23	0.6	12
	15.10-15.13	0.8	16
	15.90-15.93	0.4	8
	16.54-16.57	2.7	54
	17.67-17.70	1.6	32

NOTES:

1. In the above table testing was completed in the Axial direction.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RTA T223.
4. The Estimated Unconfined Compressive Strength was calculated from the point load Strength Index by the following approximate relationship and rounded off to the nearest whole number :
   U.C.S. = 20 $I_{S(50)}$

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Borehole No. **A4**

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LTD

Project: SPECTATOR ACCESS UPGRADE WORKS

Location: TOYOTA PARK, 461 CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ≈ 2.4m

Date: 22-6-06 **Datum:** AHD

Logged/Checked by: V.B./FW

Groundwater Record	Field Tests	Depth (m)	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0	-	ASPHALTIC CONCRETE: 60mm.t				
	N = 10 2,3,7 PID = 0			FILL: Silty clay, medium to high plasticity, brown mottled grey, with igneous, ironstone and sandstone gravel and traces of ash, concrete cobbles, timber and shale gravel.	MC<PL	-	-	APPEARS POORLY COMPACTED CH4 = 0 CO2 = 0 O2 = 21.0
AFTER 1.5 HRS	N = 3 1,2,1 PID = 0	1		FILL: Silty sandy clay, medium to high plasticity, brown mottled grey, with igneous and ironstone gravel, metal pieces, fine to coarse grained sand and sandstone cobbles.	MC≈PL			CH4 = 0 CO2 = 0 O2 = 21.2
	N = 0 1,0,0	2 – 3		FILL: Silty sand, fine to medium grained, grey brown, with glass fragments, tiles, wood chips and sandstone cobbles.	W			CH4 = 7.6 CO2 = 2.8 O2 = 6.6
		4	OL	ORGANIC CLAY: medium plasticity, fine to medium grained, brown.	MC>PL	(VS)	-	
	N = 0 1,0,0 PID = 0	5	SC	SILTY CLAYEY SAND; fine to medium grained, grey brown, high plasticity clay nodules.	W	VL		CH4 = 6.2 CO2 = 1.6 O2 = 7.5
	N = 0 1,0,0	6 – 7						CH4 = 0 CO2 = 0 O2 = 21.0

SAMPLES: ES, ASB, ASS, DS

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Borehole No.
A4

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LTD
Project: SPECTATOR ACCESS UPGRADE WORKS
Location: TOYOTA PARK, 461 CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP
Date: 22-6-06
Method: SPIRAL AUGER JK550
R.L. Surface: ≈ 2.4m
Datum: AHD
Logged/Checked by: V.B./RW

Groundwater Record	SAMPLES (ES, ASB, ASS, DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
					SC	SILTY CLAYEY SAND: fine to medium grained, grey brown, high plasticity clay nodules.	W	VL		
					CL	SILTY SANDY CLAY: medium plasticity, grey mottled red, with a trace of sandstone gravel.	MC>PL	(St-VSt)		CH4 = 0 CO2 = 0 O2 = 21.1
			8							
			9							CH4 = 0 CO2 = 0 O2 = 21.0
			10							CH4 = 0 CO2 = 0 O2 = 21.1
			11			as above but red mottled brown, with ironstone gravel.				
			12							CH4 = 0 CO2 = 0 O2 = 22.0
			13							CH4 = 0 CO2 = 0 O2 = 21.6
			14							

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Borehole No. **A4**
3/4

BOREHOLE LOG

Client: CRONULLA SUTHERLAND LEAGUES CLUB LTD
Project: SPECTATOR ACCESS UPGRADE WORKS
Location: TOYOTA PARK, 461 CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP
Date: 22-6-06
Method: SPIRAL AUGER JK550
R.L. Surface: ≈ 2.4m
Datum: AHD
Logged/Checked by: V.B./ PW

Groundwater Record	SAMPLES (ES / ASB / ASS / DS)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ASS				CH	SILTY SANDY CLAY: high plasticity, red mottled brown, with ironstone gravel.	MC>PL	(St-VSt)		
					-	SANDSTONE: fine to medium grained, red mottled brown, with iron staining.	XW	EL	-	
						REFER TO CORED BOREHOLE LOG				
			15							
			16							
			17							
			18							
			19							
			20							

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CORED BOREHOLE LOG

Borehole No. **A4**

Client: CRONULLA SUTHERLAND LEAGUES CLUB LTD
Project: SPECTATOR ACCESS UPGRADE WORKS
Location: TOYOTA PARK, 461 CAPTAIN COOK DRIVE, WOOLOOWARE, NSW

Job No. 20345SP | **Core Size:** NMLC | **R.L. Surface:** ≈ 2.4m
Date: 21-6-06 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: JK550 | **Bearing:** - | **Logged/Checked by:** J.S.K./PW

Depth (m)	Core Description (Rock Type, grain characteristics, colour, structure, minor components)	Weathering	Strength	Point Load Strength Index $I_s(50)$	Defect Description – Specific
14	START CORING AT 14.23m				
14.23–15.0	SANDSTONE: fine to medium grained, red and pale grey, with occasional orange laminae, bedded at 5-15°.	DW / XW	M / EL	×	6xBe, 5-15°, P, R, IS
15.0–17.3	SANDSTONE: fine to medium grained, red brown and pale grey, with occasional orange laminae, bedded at 10-20°.	DW	M	× × ×	XWS, 30mm.t; XWS, 35mm.t; J, 60-90°, Un, R; 2xBe, 0-2°, Un, R
17.3–19.84	SANDSTONE: fine to medium grained, pale grey with dark grey laminae, bedded at 0-10°.	SW	M / H	× × ×	XWS, 1mm.t; CS, 2mm.t; XWS, 15mm.t
19.84	END OF BOREHOLE AT 19.84				

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FIELD LOG

Location No. BH1

1/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009JTP
Date: 24 & 25 . 7 . 78
Method: AUGER & WASHBORE
R.L. Surface: NT
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer x100kPa 1 2 3 4	Structure & Geology
▼ (approx. 1.5 m)	N=11 (3,4,7)	0–2.5			FILL silt, sand with metal, construction rubble, wood, sandstone dark grey		loose		
	N<1	2.5–5.8		OL	SILT AND CLAY, organic some shell pieces, pungent odour dark grey	MC>PL	V.Soft		
		5.8–6.0		CL	SANDY CLAY brown	MC>PL	V.Soft		
	NC=20	6.0–7.2		SM	SAND light grey fine to medium grained		M.Dense		
	NC=14	7.2–8.5		CL	SILTY CLAY, some sand layers grey.		Stiff		
	N=13 (10,9,4)	8.5–10.0		SC	CLAYEY SAND some clay layers & shell pieces grey		loose		
NX CASING To 10.5m	N=8 (2,4,4); N=25 (5,9,16)	10.0–15		CH	CLAY high plasticity greenish grey then mottled grey and brown then mottled red and grey	MC>PL	Stiff	x	

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FIELD LOG

Location No. BH1

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009-JTP
Date: 24&25.7.78
Method: AUGER & WASHBORE
R.L. Surface: N.T
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetro-meter 1 2 3 4	Structure & Geology
		15							
		16		CH	as above				
		17							
		18		CL	SANDY CLAY mottled brown and grey, some dark grey with depth				
		19							
		20							
		21			SANDSTONE				
					END BOREHOLE 21.0m.				

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FIELD LOG

Location No. BH2

1/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009 JTP
Date: 24 & 25 · 7 · 78

Method: AUGER & WASHBORE

R.L. Surface: NT
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer x100 KPa 1 2 3 4	Structure & Geology
▼ (approx. 1.8 m)	N<1; N<1	0–2			FILL silt, sand, bands of ?ironed sandstone, with metal, wood and rubble, dark grey		V.Loose		
	N=1; N<1; N<1	2–5.3		OL	SILT AND CLAY organic, fibrous bands, pungent odour dark grey	Mc>>PL	V.Soft		Natural Moisture Content 160%; 100%; 31%
		5.3–6		CL	SANDY CLAY, brown then bluish grey	Mc>>PL	V.Soft		
	NC=20	6–7.6		SM	SAND, silty, some shell fragments grey		M.Dense		
	N=1	7.6–10		CL-CH	SILTY CLAY and CLAY medium to high plasticity some shell fragments slightly organic, dark grey	Mc>PL	V.Soft		
	N>26 (4, 16, 10/100-07)	10–11.8		SC	CLAYEY SAND some clay bands, some shell pieces and charcoal fragments		M.Dense		
NX Casing to 12m.	N=9 (2, 4, 5)	11.8–15		CH	CLAY high plasticity light grey then grey with red mottling.	Mc>PL	Stiff	[illegible]	

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FIELD LOG

Location No: BH2

2/2

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE.

Job No: 15009JTP
Date: 24 & 25 · 7 · 78

Method: AUGER & WASHBORE

R.L. Surface: NT
Datum: N.T

Water Level	Samples and Field Tests	Depth (m.)	Graphic Log	Unified Classif.	Soil Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetro-meter 1 2 3 4	Structure & Geology
	N=16 (4,6,10)	15		CH	CLAY as above	M>PL	Stiff		
		16							
		17		CL	SANDY CLAY medium plasticity mottled grey and brown	M>PL	Stiff		
	N=7 (3,3,4)	18							
		19							
		20			SANDSTONE				
					END BOREHOLE 20.4m				

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Borehole No. 301 & 301A

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP	Method: SPIRAL AUGER	R.L. Surface: 2·4m.
Date: 16 - 7 - 91	G.C.H. RIG.	Datum: A.H.D.

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel Density	Hand Penetrometer Readings kPa.	Remarks
			0 – 3.2			FILL: Clayey Sand with some gravel, glass, cobbles, broken tile, metal pieces, grey.				1A MEET REFUSAL AT 1M ON COBBLY FILL. POORLY COMPACTED.
	DS	N = 4 4, 2, 2	1							
▼			2							
		SUNK UNDER WEIGHT OF RODS								
	DS	N > 12 1, 6, 11/50mm								
		BOUNCING	3							
			3.2 – 4.7		OH	ORGANIC CLAY: high plasticity, grey.	MC > PL	S		PUNGENT ODOUR.
		N < 1 2/700mm	4							
			4.7			END OF BOREHOLE AT 4·7m				
			5							
			6							
			7							

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Borehole No.
302

BOREHOLE LOG

Client: CRONULLA SHARKS

Project: SHARK PARK REDEVELOPMENT

Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No.	15009JTP	Method:	SPIRAL AUGER	R.L. Surface:	1·7m.
Date:	16 - 7 - 91		G.C.H. RIG.	Datum:	A.H.D.

Groundwater record	Samples	Field Tests	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
						ASPHALTIC CONCRETE over base.				PAVEMENT.
▼						FILL: Clayey Sand with gravel, rubble and abundant timber fragments, dark grey.				POORLY COMPACTED.
	DS	N = 6 2, 3, 3	1							
						becoming more silty sand.				
			2							
		N<1 1/700mm			OH.	ORGANIC CLAY: high plasticity, with shell fragments.	MC>PL	S		
			3							
		SUNK UNDER HAMMER WEIGHT.	4							
			5			END OF BOREHOLE AT 4·8m				
			6							
			7							

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BOREHOLE LOG

Borehole No. 303

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE WOOLOOWARE.

Job No. 15009JTP | Method: SPIRAL AUGER G.C.H. RIG. | R.L. Surface: 1·7m.
Date: 16 - 7 - 91 | | Datum: A.H.D

Groundwater record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
▼ (approx. 1.5m)		2, 9, 4, 2, 3, 1, 1, 2, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1	0–2.6			FILL: Sandy Clay/ Clayey Sand medium plasticity, red brown and dark grey, some gravel and cobbles, trace of timber pieces.				POORLY COMPACTED.
			2.6–3.8		OL	ORGANIC SILTY CLAY: low to medium plasticity, dark grey, abundant reed inclusions.	MC > PL	S.		
			3.8			END OF BOREHOLE AT 3·8m.				

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Borehole No. 401
1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Method: HAND AUGER
R.L. Surface: N/A
Date: 25-1-96
Datum:
Logged/Checked by: D.J./

Groundwater Record	Samples (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION	DS	REFER TO SCALA SHEET	0		–	TOPSOIL: Silty sand, fine grained, brown, with some fine roots.	M			GRASS COVER
						FILL: Clayey silty sand, fine grained, grey, with some clay nodules and fine to medium gravel.				APPEARS POORLY TO MODERATELY COMPACTED
			1			FILL: Sand, fine to medium grained, yellow brown, with some clay bands.				
						END OF BOREHOLE AT 1.3m				HAND AUGER REFUSAL
			2							
			3							
			4							
			5							
			6							
			7							

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Borehole No. 402 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP | **Method:** HAND AUGER | **R.L. Surface:** N/A
Date: 25-1-96 | **Datum:** –
Logged/Checked by: D.J./ [illegible]

Groundwater Record	SAMPLES (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLETION		REFER TO SCALA SHEET	0		–	TOPSOIL: Silty sand, fine to medium grained, brown, with some fine roots.	M			GRASS COVER
						FILL: Clayey silty sand, fine grained, grey, with some root bands and fine to medium gravel.				APPEARS MODERATELY COMPACTED
			1							
						as above, but with some coarse slag gravel.				
			2							
						FILL: Gravelly sandy clay, low to medium plasticity, brown, fine to coarse sandstone gravel.	MC>PL			
						END OF BOREHOLE AT 2.6m				HAND AUGER REFUSAL
			3							
			4							
			5							
			6							
			7							

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Borehole No.
403
1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 25-1-96
Method: SPIRAL AUGER GCH RIG
Logged/Checked by: D.J./
R.L. Surface: N/A
Datum: –

Groundwater Record	Field Tests	Depth (m)	Unified Classification	Description	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
		0	–	TOPSOIL: Silty sand, fine to medium grained, brown, with some fine roots.	M			GRASS COVER
	N_c = 2, 3, 3, 3, 6, 3, 3, 4, 7, 12R			FILL: Clayey silty sand, fine grained, grey, with some fine to coarse gravel.				APPEARS POORLY COMPACTED
AFTER ≈ 5 HRS.	N_c = 1, 2, 3, 20, 6, 3, 3, 6, 4, 4, 4, 5			FILL: Gravelly sandy clay, low to medium plasticity, brown, fine to coarse gravel, with some cobbles.	MC>PL			
			OL-OH	ORGANIC CLAY: medium to high plasticity, dark grey, with numerous fine roots.	MC>PL	St		–
				as above, but pale yellow brown, with some fine roots.				
		6		END OF BOREHOLE AT 6.0m				

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BOREHOLE LOG

Borehole No. 404 1/1

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Method:** SPIRAL AUGER GCH RIG **R.L. Surface:** N/A
Date: 25-1-96 **Datum:** –
Logged/Checked by: D.J./

Groundwater Record	Samples (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0		–	TOPSOIL: Silty sand, fine to medium grained, brown, with some fine roots.	M			GRASS COVER
	DS	N_c = 5, 8, 9, 14, 9, 5, 3, 2, 4, 9	1 – 2			FILL: Clayey silty sand, fine grained, grey, with some fine to coarse gravel and cobbles.	W (from ~2m)			APPEARS POORLY TO MODERATELY COMPACTED
▼ AFTER 2.5 HRS	DS	N_c = 2, 1, 5, 5, 3, 2, 1, 1, 1	3							
	DS		4		OL-OH	ORGANIC CLAY: medium to high plasticity, dark grey, with some fine roots.	MC>PL	F	–	–
			5, 6, 7			END OF BOREHOLE AT 4.5m				

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Borehole No. 405 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP **Method:** SPIRAL AUGER GCH RIG **R.L. Surface:** N/A
Date: 25-1-96 **Datum:** –
Logged/Checked by: D.J./ [signature]

Groundwater Record	Samples (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0			TOPSOIL: Silty sand, fine to medium grained, brown, with some fine roots.				GRASS COVER
	DS	N_c = 3, 6, 8, 9, 9, 11, 11, 9, 7, 6	1, 2		–	FILL: Clayey silty sand, fine grained, grey, fine to coarse gravel, with some cobbles.	M			APPEARS MODERATELY COMPACTED
AFTER 1.75 HRS	DS	N_c = 2, 3, 1 ↓, 4, 5, 5, 6, 4, 6, 8	3				W			APPEARS POORLY COMPACTED
	DS		4		OL-OH	ORGANIC CLAY: medium to high plasticity, yellow brown with numerous fine to medium roots.	MC>PL	St	–	–
			5, 6, 7			END OF BOREHOLE AT 4.5m				

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Borehole No. 406 1/1

BOREHOLE LOG

Client: CRONULLA SHARKS
Project: SHARK PARK REDEVELOPMENT
Location: CAPTAIN COOK DRIVE, WOOLOOWARE

Job No. 15009JTP
Date: 25-1-96
Method: SPIRAL AUGER GCH RIG
R.L. Surface: N/A
Datum: –
Logged/Checked by: D.J./

Groundwater Record	Samples (U50, DB, DS, ES)	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
			0		–	TOPSOIL: Silty san,d fine to medium grained, brown, with some fine roots.	M			GRASS COVER
		N_c = 3, 3, 3, 5, 7, 5, 5, 4, 7, 7, 5				FILL: Clayey silty sand, fine grained, grey, with some fine to coarse gravel.				APPEARS POORLY TO MODERATELY COMPACTED
AFTER 1 HOUR		N_c = 1, 1, 1, 2, 1, 4, 6, 1, 2	2			FILL: Gravelly sandy clay, medium plasticity, brown, fine to coarse gravel.	MC>PL			APPEARS POORLY COMPACTED
			4		OL-OH	ORGANIC CLAY: medium to high plasticity, grey brown, with some fine roots and a trace of shells.	MC>PL	(F)	–	–
			4.5			END OF BOREHOLE AT 4.5m				

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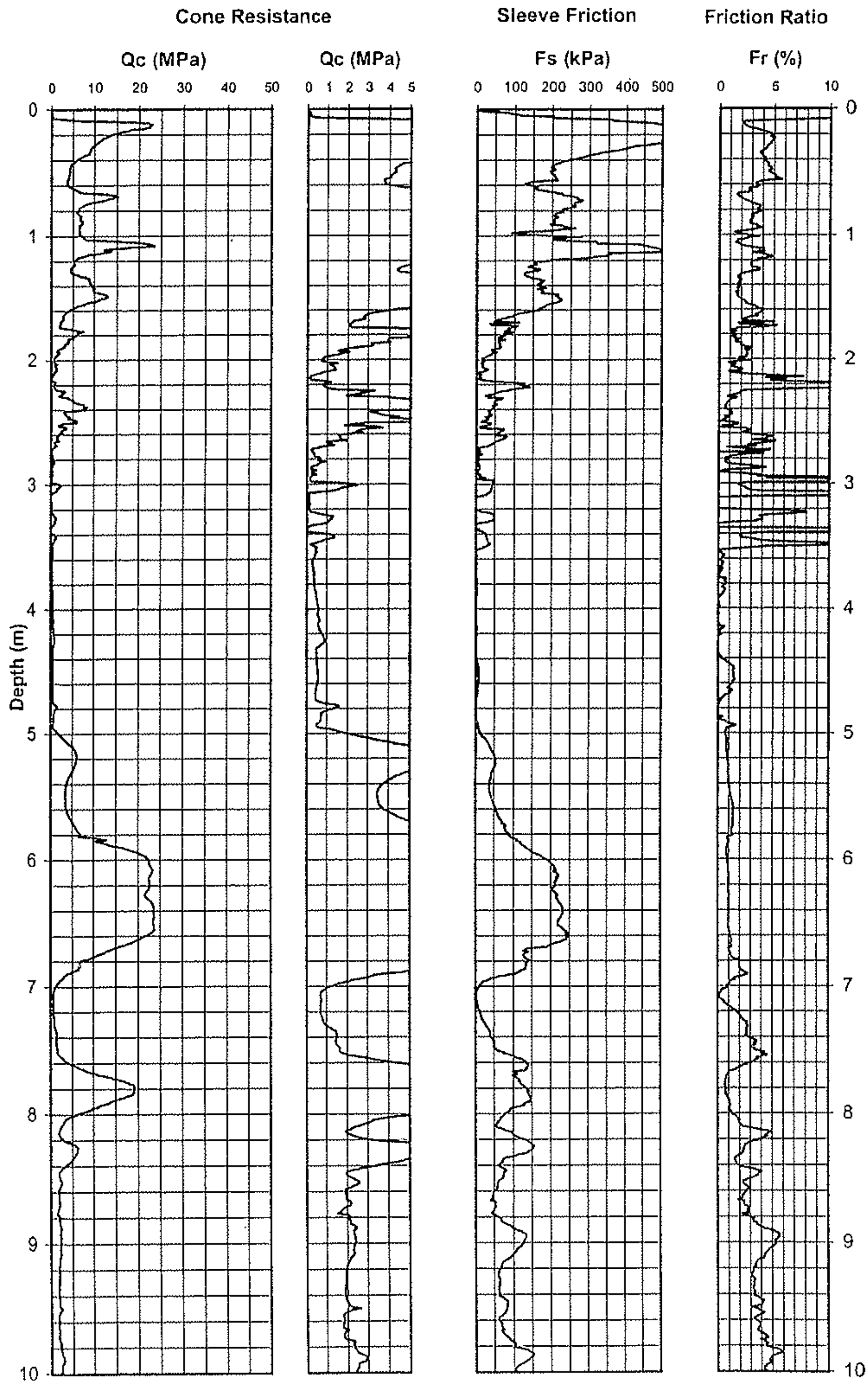
EFCP No. **806**
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt806	**RL Surface:** NA		**Data File:**	AP051158.H1
Test Date:	5/4/00	**Datum:** NA		**Operator:**	MK/AK



Interpreted Profile

Interpreted Profile
FILL: Silty clay. Appears moderately compacted. ▼
FILL: Interbedded silty clay and silty sand. Appears poorly compacted.
ORGANIC SILTY CLAY: soft, with sand.
SAND TO SILTY SAND: loose to medium dense.
as above, but dense to very dense.
CLAY: firm to stiff.
SILTY SAND: medium dense to dense.
SILTY CLAY: very stiff
SILTY SAND TO SANDY SILT medium dense/hard.
SILTY CLAY: very stiff.

Interpreted by: M.K.
Checked by: PW

Jeffery and Katauskas Pty Ltd

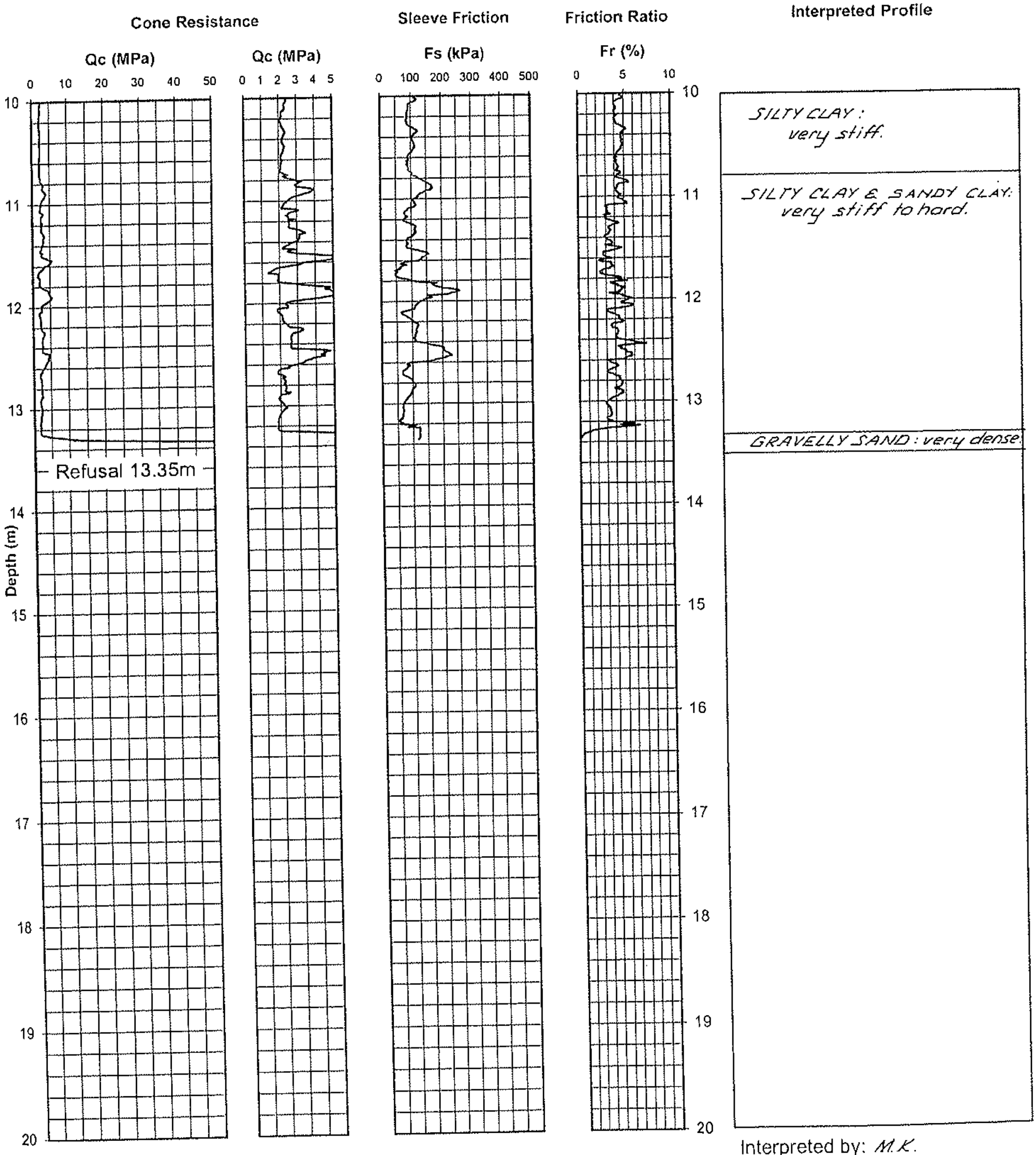
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **806**

2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt806	**RL Surface:** NA		**Data File:**	AP051158.H1
Test Date:	5/4/00	**Datum:** NA		**Operator:**	MK/AK



Interpreted by: M.K.
Checked by: PW

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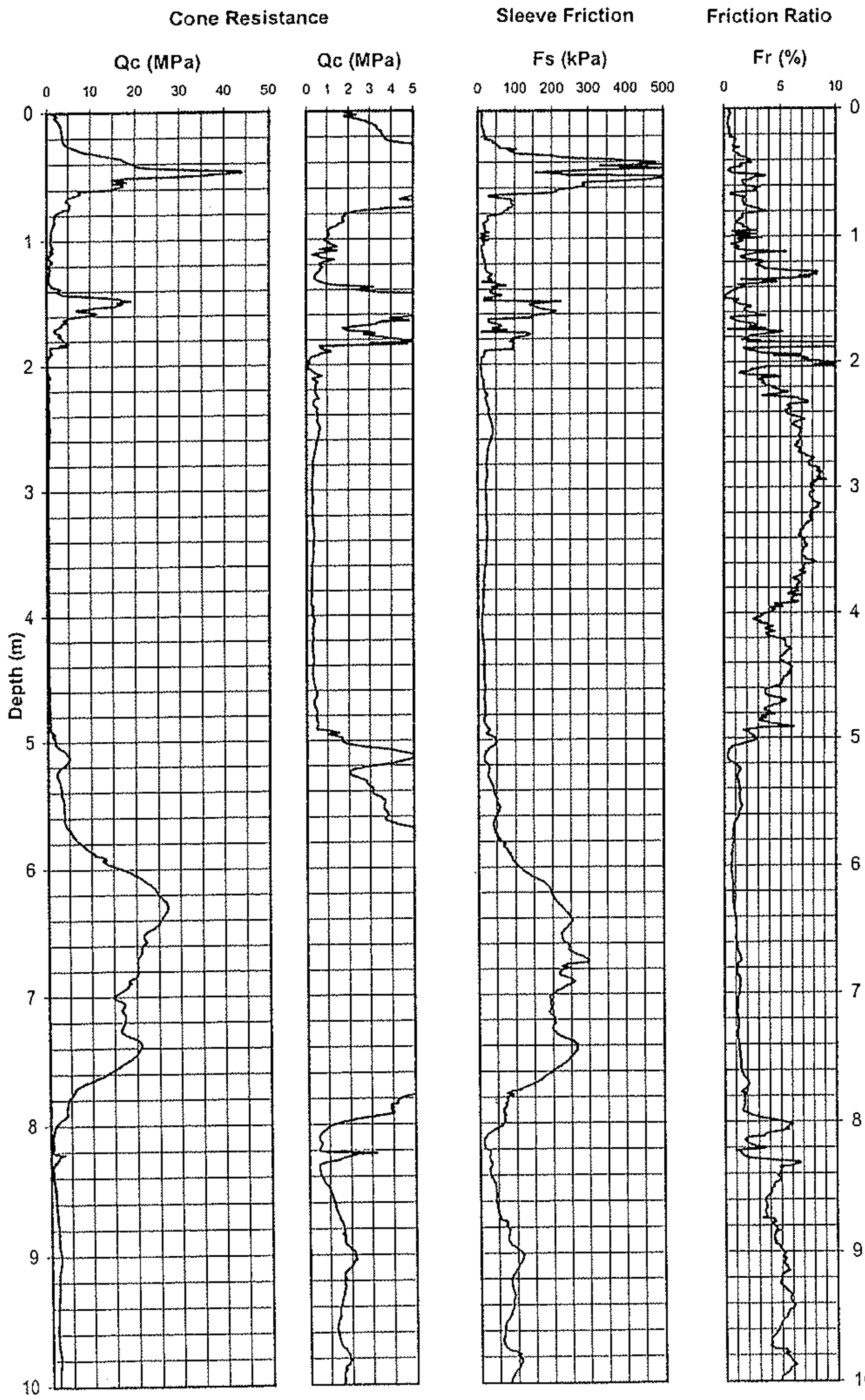
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
807
1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks
Project:	Shark Park Redevelopment
Location:	Captain Cook Drive, Woolooware, NSW.

Job Ref.:	15009JTPcpt807	**RL Surface:**	NA	**Data File:**	AP120934.H1
Test Date:	12/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted Profile

Interpreted Profile
FILL: Silty clay and silty sand. Appears poorly compacted.
ORGANIC SILTY CLAY: Soft to firm.
SAND TO SILTY SAND: loose.
as above, but loose to medium dense.
as above, but dense to very dense.
as above but dense.
ORGANIC SILTY CLAY: firm.
SILTY CLAY: stiff to very stiff.

Interpreted by: M.K.
Checked by: PW

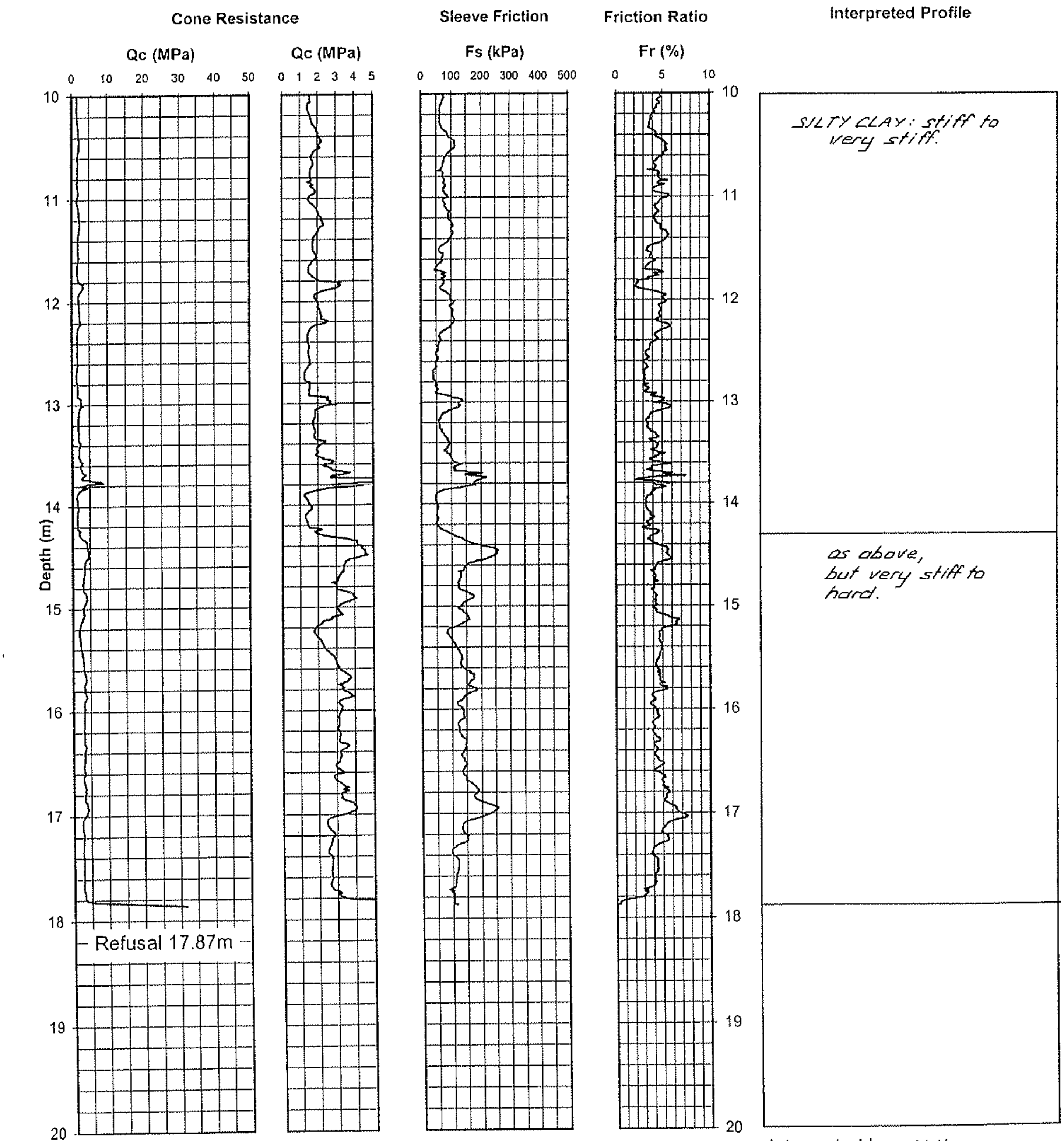
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
807
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW.				
Job Ref.:	15009JTPcpt807	**RL Surface:** NA		**Data File:**	AP120934.H1
Test Date:	12/4/00	**Datum:** NA		**Operator:**	MK/PH



Interpreted by: M.K
Checked by: PW

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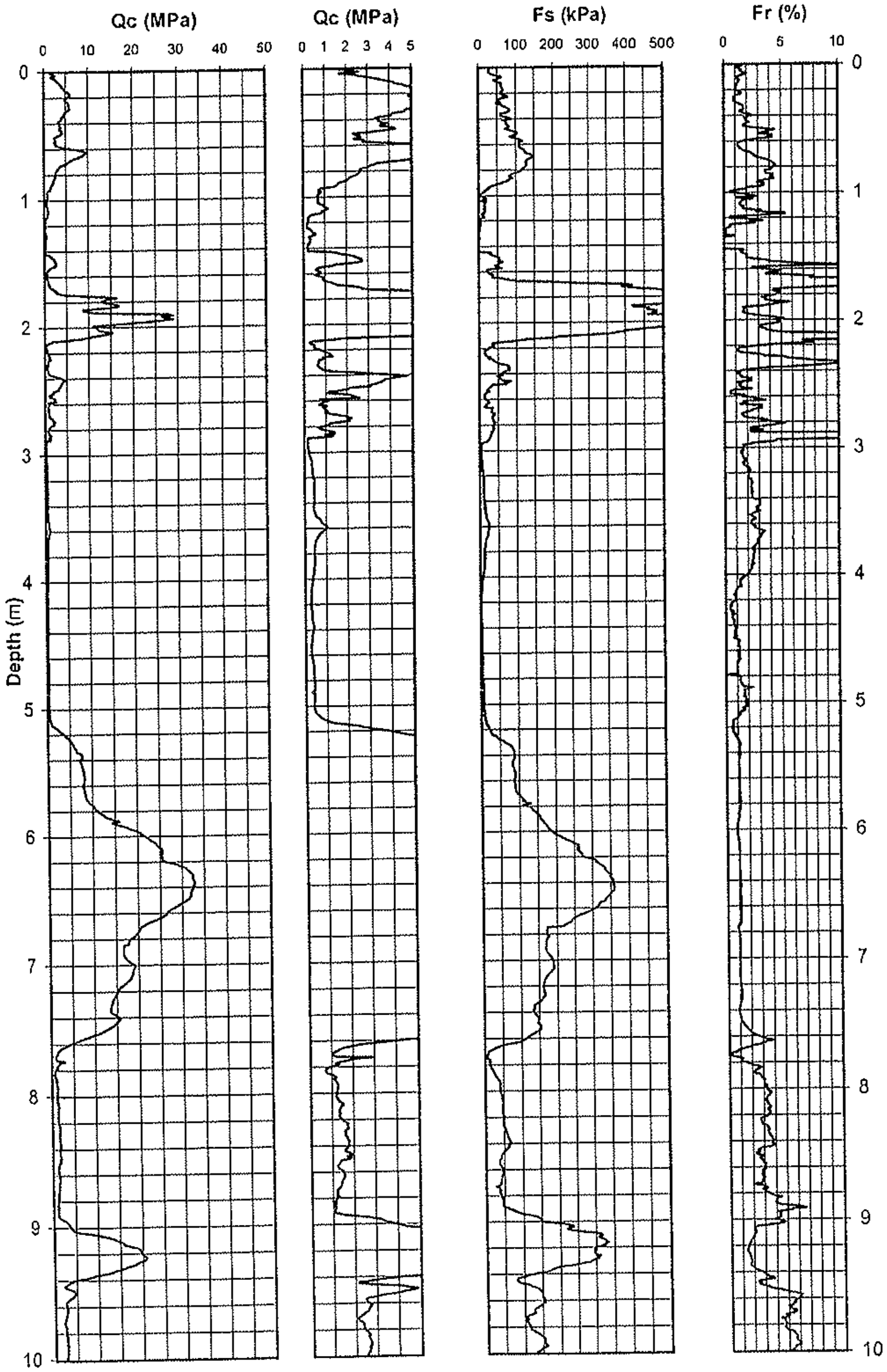
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **808** 1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt808	**RL Surface:**	NA	**Data File:**	AP061530.H1
Test Date:	6/4/00	**Datum:**	NA	**Operator:**	MK/PH



Interpreted Profile

- FILL: Silty sand. Appears poorly compacted.
- FILL: Silty clay. Appears poorly compacted.
- as above, but appears moderately compacted.
- as above, but appears poorly compacted.
- ORGANIC SILTY CLAY: very soft to soft.
- SAND AND SILTY SAND: medium dense.
- as above, but dense to very dense.
- SILTY CLAY: stiff.
- SAND TO SILTY SAND: medium dense to dense.
- CLAY: very stiff.

Interpreted by: M.K.

Checked by: PW

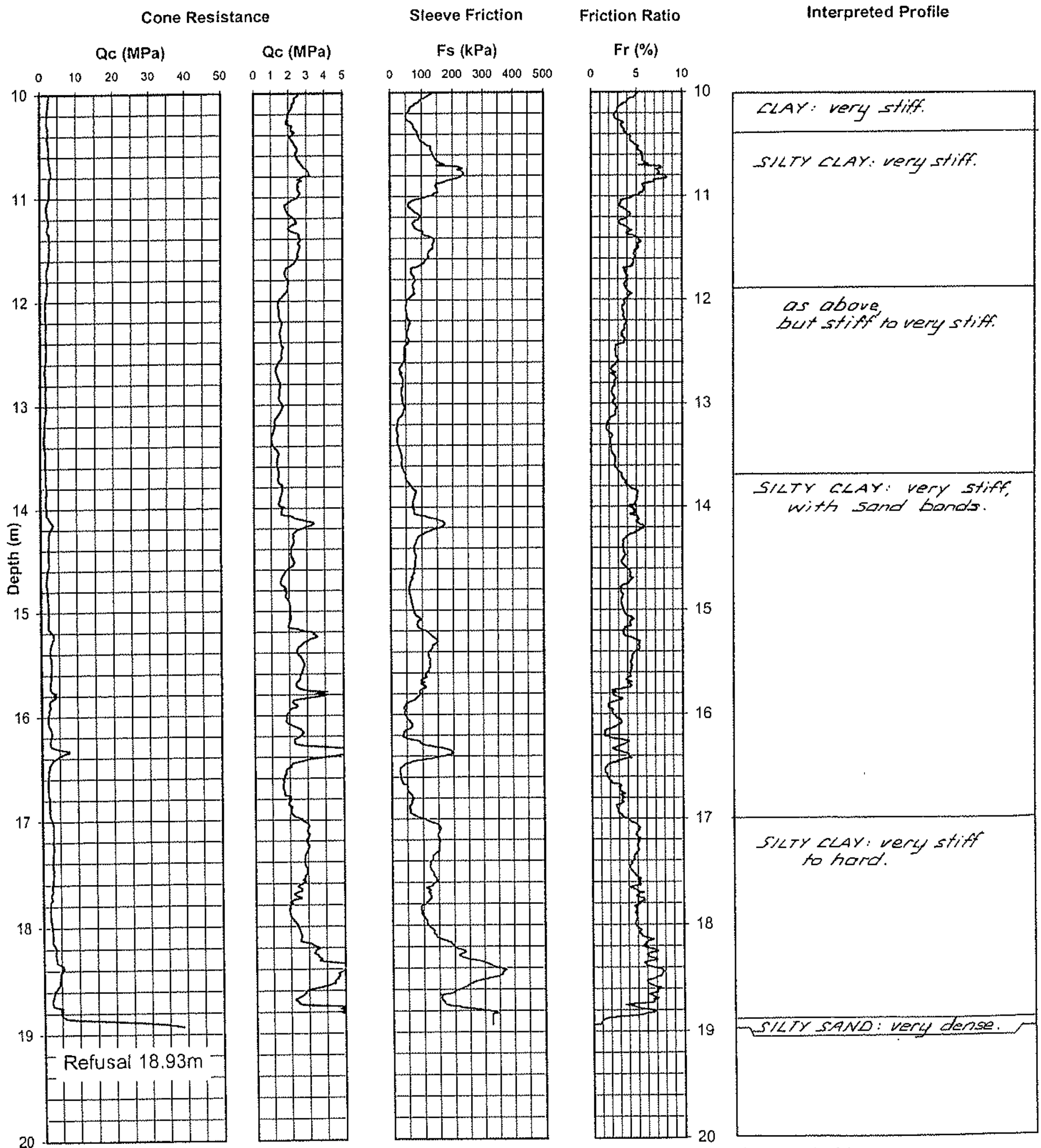
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **808** 2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt808	**RL Surface:** NA		**Data File:**	AP061530.H1
Test Date:	6/4/00	**Datum:** NA		**Operator:**	MK/PH



Interpreted by: M.K.

Checked by: PW

Jeffery and Katauskas Pty Ltd

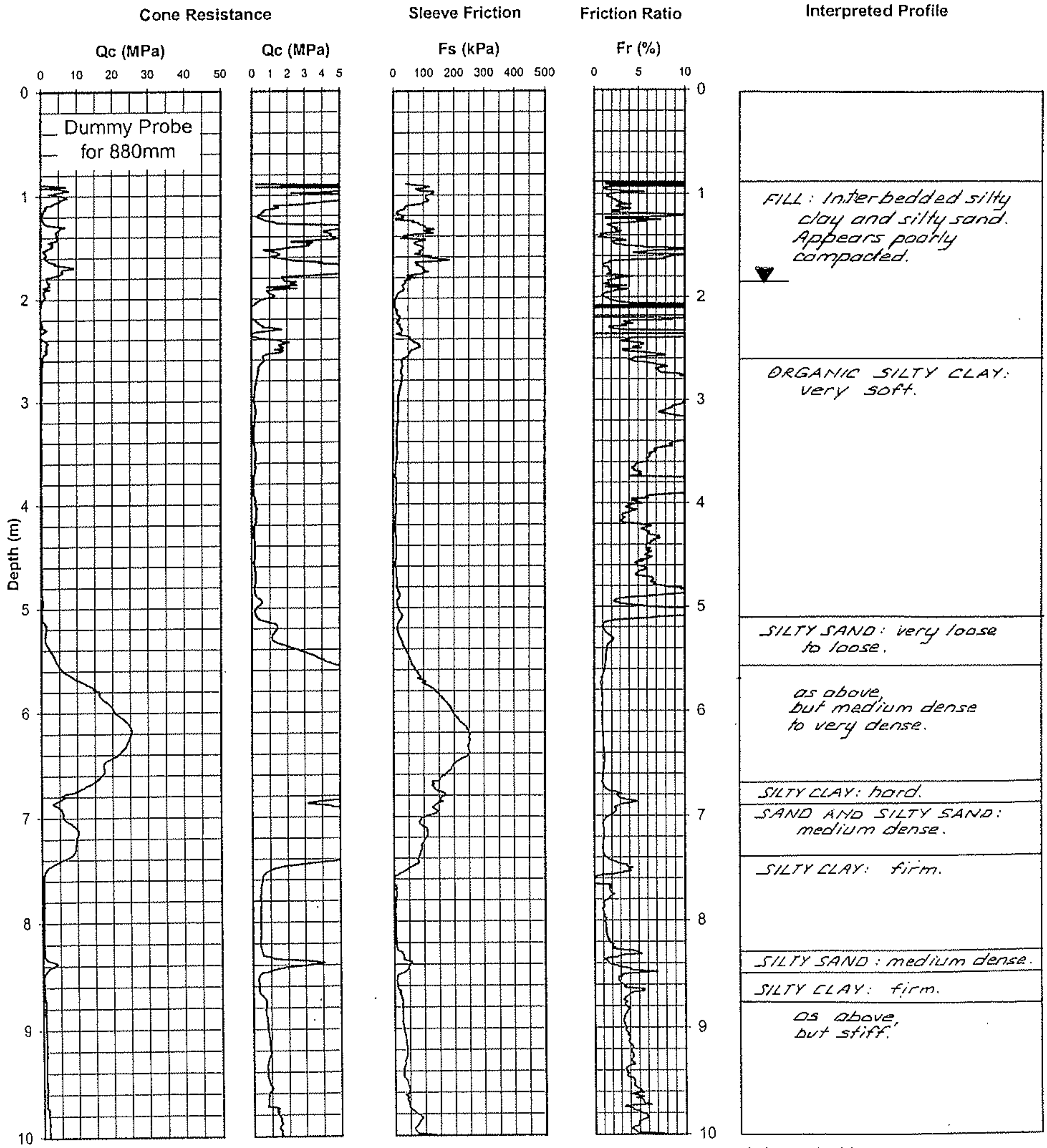
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No. **809**

1/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt809	**RL Surface:**	NA	**Data File:**	AP051052.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



Interpreted by: M.K.
Checked by: PW

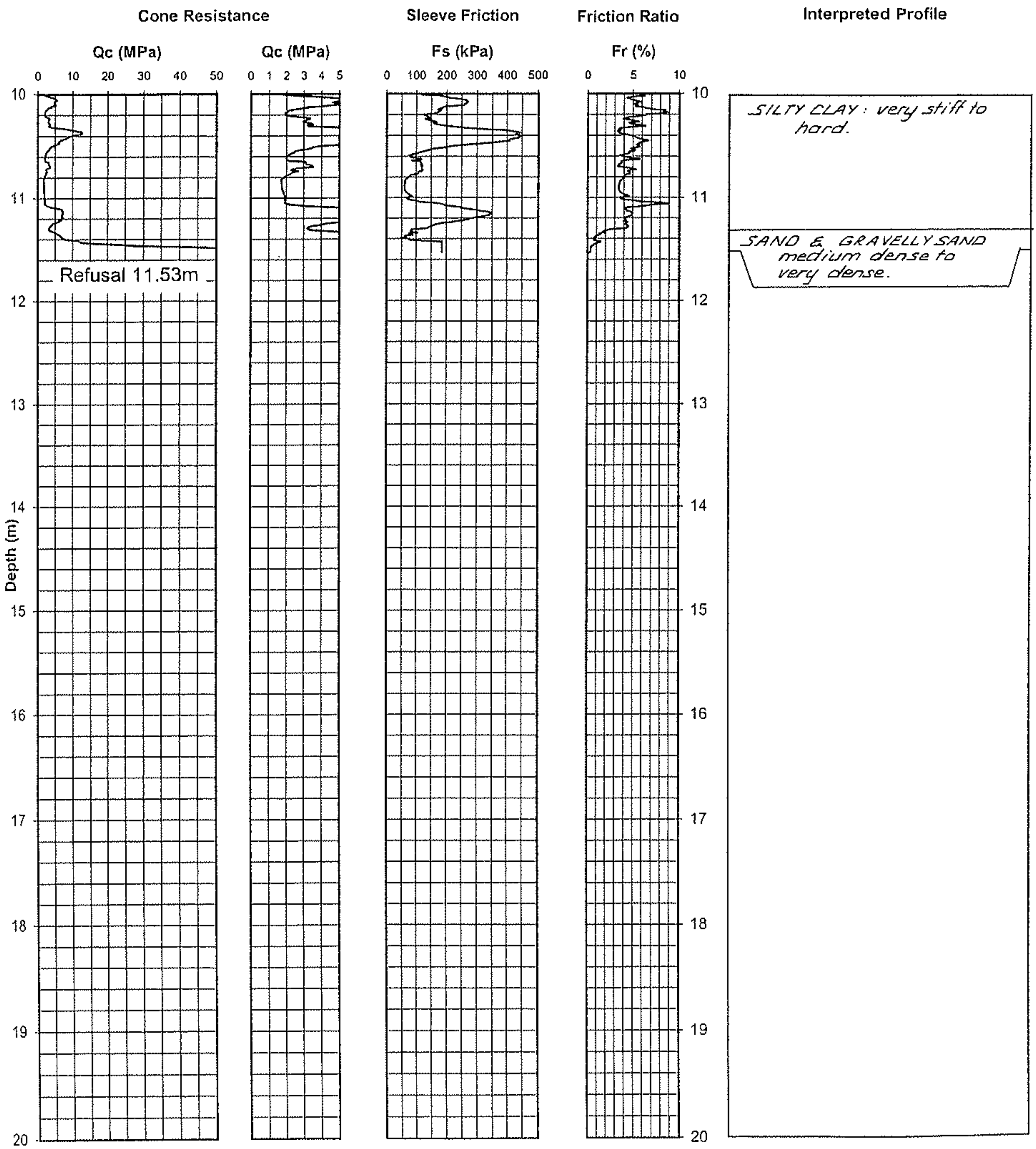
Jeffery and Katauskas Pty Ltd

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

EFCP No.
809
2/2

ELECTRICAL FRICTION CONE PENETROMETER TEST RESULTS

Client:	Cronulla Sharks				
Project:	Shark Park Redevelopment				
Location:	Captain Cook Drive, Woolooware, NSW				
Job Ref.:	15009JTPcpt809	**RL Surface:**	NA	**Data File:**	AP051052.H1
Test Date:	5/4/00	**Datum:**	NA	**Operator:**	MK/AK



Interpreted by: M.K.
Checked by: PW