APPENDIX B
Notes Relating to this Report
Results of Field Work

Douglas Partners
Geotechnics · Environment · Groundwater

NOTES RELATING TO THIS REPORT

Introduction

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

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

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

Relative Density	SPT "N" Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

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

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

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil 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 are given in the report.

Drilling Methods.

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

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

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

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

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow

sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

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

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

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

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

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

The test results are reported in the following form.

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

  as 4, 6, 7
  N = 13

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

  as 15, 30/40 mm.

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

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- 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 in percent.

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

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

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

q_c (MPa) = (0.4 to 0.6) N (blows per 300 mm)

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

q_c = (12 to 18) c_u

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

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

soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

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

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is 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.

Bore Logs

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

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

Ground Water

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

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

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

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 condition, 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 depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

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

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 than 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.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

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DESCRIPTION AND CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh Stained	Fs	Rock substance unaffected by weathering, but showing limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index ($I_{S(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by Australian Standard 4133.4.1 - 1993.

Term	Symbol	Field Guide*	Point Load Index $I_{S(50)}$ MPa	Approx Unconfined Compressive Strength q_u ** MPa
Extremely low	EL	Easily remoulded by hand to a material with soil properties	<0.03	< 0.6
Very low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3 cm thick can be broken by finger pressure.	0.03-0.1	0.6-2
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 40 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1-0.3	2-6
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3-1.0	6-20
High	H	Can be slightly scratched with a knife. A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow, rock rings under hammer.	1 - 3	20-60
Very high	VH	Cannot be scratched with a knife. Hand specimen breaks with pick after more than one blow, rock rings under hammer.	3 - 10	60-200
Extremely high	EH	Specimen requires many blows with geological pick to break through intact material, rock rings under hammer.	>10	> 200

Note that these terms refer to strength of rock material and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

* The field guide assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

** The approximate unconfined compressive strength (q_u) shown in the table is based on an assumed ratio to the point load index of 20:1. This ratio may vary widely.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plane perpendicular to the core axis. Note that where possible, recordings of the actual defect spacing or range of spacings is preferred to the general terms given below.

Term	Description
Fragmented	The core consists mainly of fragments with dimensions less than 20 mm.
Highly Fractured	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured	Core lengths are mainly 40 mm - 200 mm with occasional shorter and longer sections.
Slightly Fractured	Core lengths are generally 200 mm - 1000 mm with occasional shorter and longer sections.
Unbroken	The core does not contain any fracture.

ROCK QUALITY DESIGNATION (RQD)

This is defined as the ratio of sound (i.e. low strength or better) core in lengths of greater than 100 mm to the total length of the core, expressed in percent. If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh, irregular breaks rather than joint surfaces) the fresh broken pieces are fitted together and counted as one piece.

SEDIMENTARY ROCK TYPES

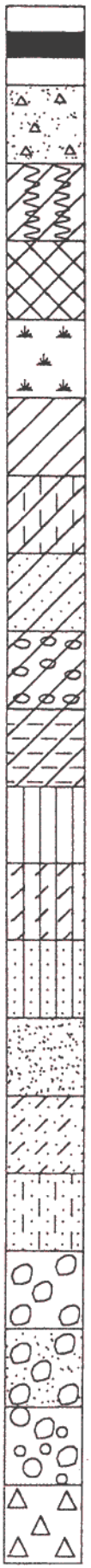
This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel-sized (greater than 2 mm) fragments
Sandstone:	More than 50% of the rock consists of sand-sized (0.06 to 2 mm) grains
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay-sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, eg. clayey sandstone, sandy shale.

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

GRAVEL

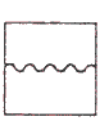
SANDY GRAVEL

COBBLES/BOULDERS

TALUS

SEAMS

SEAM >10mm



SEAM <10mm

SEDIMENTARY ROCK

BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

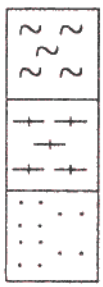
LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

METAMORPHIC ROCK

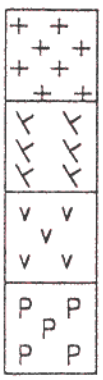


SLATE, PHYLLITE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

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DOUGLAS PARTNERS PTY LTD
COCHCLEAR GLOBAL HEADQUATERS
MACQUARIE UNIVERSITY – SOUTH PRECINCT
BORE 1 PROJECT 45298 DEC 2007
MAQUARIE UNI 45298 BH 1 BOX 1 START 2.60m
3
4
5
CORE LOSS 0.40m
6
0.10m 0.15m
2.60 – 7.00M


DOUGLAS PARTNERS PTY LTD
COCHCLEAR GLOBAL HEADQUATERS
MACQUARIE UNIVERSITY – SOUTH PRECINCT
BORE 1 PROJECT 45298 DEC 2007
7
8
9
CORE LOSS
10
11
7.00 – 12.00M

BOREHOLE LOG

CLIENT: Lachlan Project Development Pty Ltd
PROJECT: Cochlear Global Headquarters
LOCATION: Macquarie University South Precinct

SURFACE LEVEL: 67.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 45298
DATE: 11 Dec 07
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
67	0.2	TOPSOIL - grey brown silty clay topsoil, with some gravel							A			
	0.5	FILLING - orange brown clay filling, with a trace of silt and fine ironstone gravel							A			
66	1	SILTY CLAY - very stiff, orange brown silty clay with ironstone bands, damp							A			
	1.3	SANDSTONE - very low to low strength, light grey brown fine to medium grained sandstone						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes or joints dipping 0°- 10°	S			7,9,13 N = 22
65	2											
	2.6	LAMINITE - medium strength, moderately to slightly weathered, fractured to slightly fractured, light grey brown laminite with approximately 20% sandstone laminations							S			26/30mm refusal
64	3							3.22m: J20°				PL(A) = 0.7MPa
								3.74m: J85°- 90°				
63	4							3.88m: J75°	C	86	64	PL(A) = 0.6MPa
								4.39m: J20°				
								4.56m: J90°				
								4.6m: J50°				
								4.65m: J70°				
								4.75m: J60°				
								4.83m: B0°, 10mm clay				
62	5							5m: CORE LOSS: 400mm				
	5.0	LAMINITE - low strength, slightly weathered, fractured to slightly fractured, grey laminite with some sandstone laminations										PL(A) = 0.2MPa
								5.68m: J75°- 85°				
61	6								C	96	77	PL(A) = 0.2MPa
		6.16-6.41m: extremely low strength bands										
	6.63							6.57m: J75°				
	6.75	LAMINITE - low to medium and medium strength, slightly weathered then fresh, fractured to slightly fractured, grey laminite with 50% sandstone laminations						6.63m: J90°				
								6.75m: CORE LOSS: 250mm				
60	7							7.24m: J70°				PL(A) = 0.3MPa
								7.46m: J60°				
								7.6-7.78m: J30°- 60°, healed				
59	8							7.9m: J30°, healed				PL(A) = 0.7MPa
								7.95m: J40°, healed				
								8.17m: J45°- 60°, curved, healed	C	87	79	
	8.56	LAMINITE - very high strength, fresh, slightly fractured, light grey to grey laminite						8.5m: 2 x J30°, 50°, healed				PL(A) = 3.1MPa
58	9											
	9.2	SANDSTONE - medium strength, slightly weathered and fresh, slightly fractured, light grey fine grained sandstone						9.38m: J45°, partially healed				PL(A) = 0.8MPa
	9.65							9.65m: CORE LOSS: 240mm				

RIG: DT 100 **DRILLER:** L Cooper **LOGGED:** S Islam **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.6m; NMLC - coring to 17.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 14.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep
		⫢	Water level

CHECKED
Initials: STE
Date: 25/1/08

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DOUGLAS PARTNERS PTY LTD
COCHCLEAR GLOBAL HEADQUATERS
MACQUARIE UNIVERSITY - SOUTH PRECINCT
BORE 1 PROJECT 45298 DEC 2007
12
13
14
15
16
12.00 - 17.00M

BOREHOLE LOG

CLIENT: Lachlan Project Development Pty Ltd
PROJECT: Cochlear Global Headquarters
LOCATION: Macquarie University South Precinct

SURFACE LEVEL: 67.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 45298
DATE: 11 Dec 07
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
57		SANDSTONE - medium strength, slightly weathered and fresh, slightly fractured, light grey fine grained sandstone *(continued)*						10.3m: J45°, clayey 10.5m: J60° 10.69m: B0°, healed, ironstained	C	100	100	PL(A) = 0.6MPa
	10.7											
56	11	SANDSTONE - high strength, fresh, slightly fractured and unbroken, light grey medium grained sandstone - medium to coarse grained, red from 10.7 to 11.0m							C	100	100	PL(A) = 1.4MPa
55	12											PL(A) = 1.3MPa
54	13							12.73m: J30°, clay smear 13.4m: J45°				PL(A) = 1.3MPa
53	14							13.75m: B10°, 2mm clayey infill 14.1m: B20°, clayey	C	93	74	
	14.25	SANDSTONE - medium strength, fresh, fractured to slightly fractured, light grey medium grained sandstone, with very low strength bands										PL(A) = 0.8MPa
52	15							14.67m: J25°, clayey infill 14.96-15.22m: fragmented				
	15.22							15.22m: CORE LOSS: 170mm				
	15.39	SANDSTONE - high strength, fresh, slightly fractured to unbroken, light grey medium grained sandstone										PL(A) = 1.4MPa
51	16							15.91m: B10°, 5mm sandy clay infill	C	100	100	PL(A) = 1.7MPa
	17	17.0							16.78m: B5°, clayey infill				
50		Bore discontinued at 17.0m										
49	18											
48	19											

RIG: DT 100 **DRILLER:** L Cooper **LOGGED:** S Islam **CASING:** HW to 2.5m

TYPE OF BORING: Solid flight auger (TC-bit) to 2.6m; NMLC - coring to 17.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Standpipe installed to 14.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: STE
Date: 25/1/08

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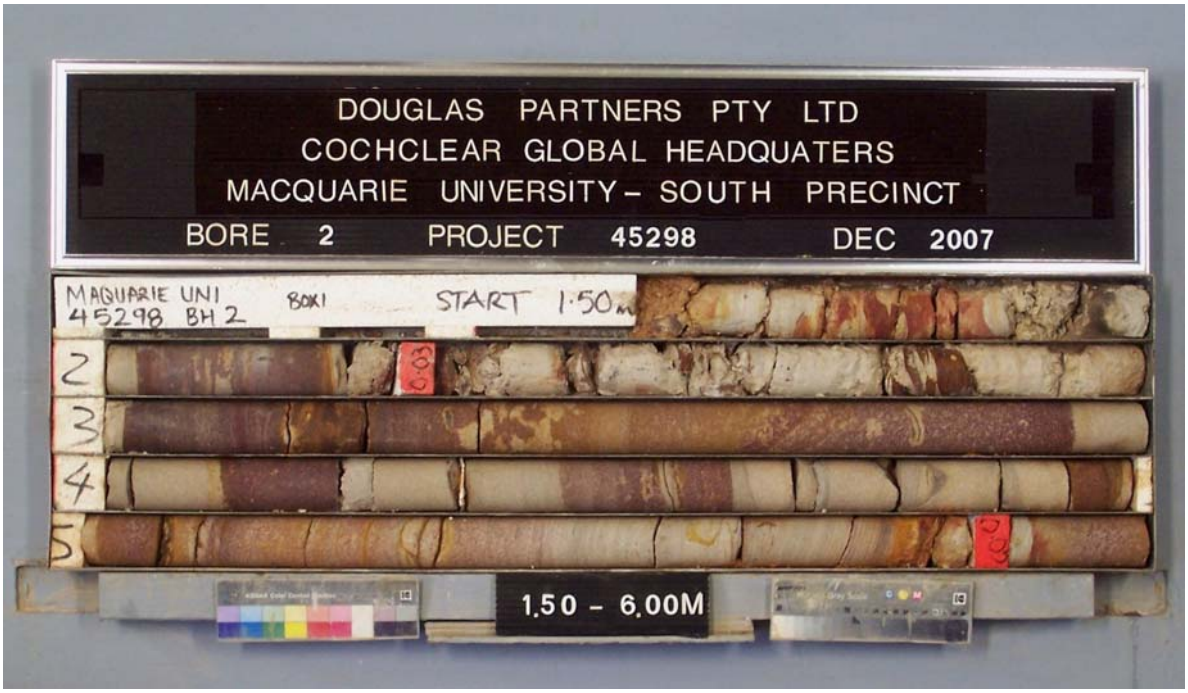
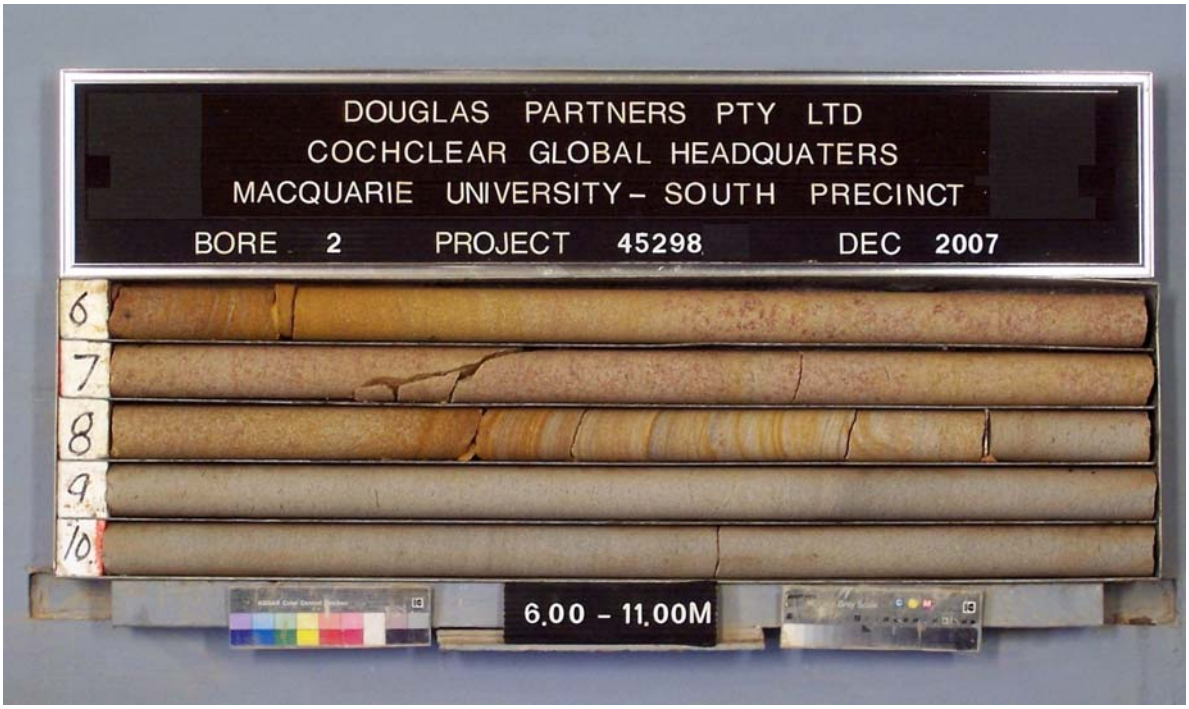

DOUGLAS PARTNERS PTY LTD
COCHCLEAR GLOBAL HEADQUATERS
MACQUARIE UNIVERSITY – SOUTH PRECINCT
BORE 2 PROJECT 45298 DEC 2007
MAQUARIE UNI
45298 BH 2
BOX1
START 1·50m
2
3
4
5
1.50 – 6.00M


DOUGLAS PARTNERS PTY LTD
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MACQUARIE UNIVERSITY – SOUTH PRECINCT
BORE 2 PROJECT 45298 DEC 2007
6
7
8
9
10
6.00 – 11.00M

BOREHOLE LOG

CLIENT:	Lachlan Project Development Pty Ltd	**SURFACE LEVEL:** 64.8 AHD	**BORE No:** 2
PROJECT:	Cochlear Global Headquarters	**EASTING:**	**PROJECT No:** 45298
LOCATION:	Macquarie University South Precinct	**NORTHING:**	**DATE:** 11 Dec 07
		DIP/AZIMUTH: 90°/--	**SHEET** 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Type	Core Rec. %	RQD %	Test Results & Comments
64	0.1	TOPSOIL - brown clayey silt. Dry							A			
		CLAY - stiff, brown clay. Dry						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes and joints dipping at 0°- 10°	A			
	0.7	SILTY CLAY - hard, orange brown silty clay							A			
1	1.25	SANDSTONE - extremely low strength, red and white sandstone							S			20,19,25/100mm refusal
	1.5	SANDSTONE - extremely low to low strength, highly fractured to fractured, light grey medium grained sandstone with clay bands and medium to high strength ironstone bands							C	96	58	PL(A) = 1.4MPa
63	2											
	2.26							2.26m: CORE LOSS: 60mm 2.33-2.95m: clay				
62	2.95	SANDSTONE - high strength, moderately to slightly weathered, slightly fractured, red brown and light grey medium grained sandstone							C	100	72	PL(A) = 1.2MPa
	3											
61	4											PL(A) = 1.4MPa
								4.22m: B5°, 30mm clayey sand 4.53m: B20°, ironstained 4.67m: B10°, 10mm clay 4.75m: J45°, 4mm clay				
60	5							5.06m: B20°, ironstone 5mm 5.09m: B20° ironstained 5.2m: B15°, ironstained 5.32m: B20°, ironstained	C	100	83	PL(A) = 1MPa
59	5.83							5.75m: B5°, 30mm clayey sand 5.83m: CORE LOSS: 30mm 6.16m: B5°, 4mm clay				PL(A) = 2.2MPa
	6											
	6.16	SANDSTONE - high strength, slightly weathered to fresh, unbroken, orange and light grey medium grained sandstone										
58	7							7.3m: J70°	C	99	96	PL(A) = 1.7MPa
57	8							8.35m: B20°, 3mm clay 8.44m: B20°, 3mm clay				PL(A) = 1.5MPa
56	9	- fresh and unbroken from 8.9m							C	100	100	PL(A) = 1.6MPa
55												

RIG: **DRILLER:** L Cooper **LOGGED:** S Islam & P Hartcliff **CASING:** HW to 1.3m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m; Rotary (water) to 1.5m; NMLC-Coring to 14.4m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: STE
Date: 25/1/08

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MACQUARIE UNIVERSITY - SOUTH PRECINCT
BORE 2 PROJECT 45298 DEC 2007
11
12
13
14
11.00 - 14.40M

BOREHOLE LOG

CLIENT: Lachlan Project Development Pty Ltd
PROJECT: Cochlear Global Headquarters
LOCATION: Macquarie University South Precinct

SURFACE LEVEL: 64.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 45298
DATE: 11 Dec 07
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
54	11	SANDSTONE - high strength, slightly weathered to fresh, unbroken, orange and light grey medium grained sandstone *(continued)*							C	100	100	PL(A) = 1.3MPa PL(A) = 1.2MPa
53	12											
52	12.1	SANDSTONE - medium to high strength, fresh stained, slightly fractured, light grey, medium grained sandstone						12.41m: J30° ironstained				PL(A) = 0.7MPa
51	13 13.0	SANDSTONE - high strength, moderately to slightly weathered, slightly fractured, orange and light grey medium grained sandstone with some medium to coarse grained bands						13m: B10°, 10mm clay 13.2m: J40°, 7mm clay 13.59m: B5°, 7mm clay	C	100	95	PL(A) = 1.1MPa PL(A) = 1.3MPa
50	14 14.4	Bore discontinued at 14.4m										
49	15											
48	16											
47	17											
46	18											
45	19											

RIG: **DRILLER:** L Cooper **LOGGED:** S Islam & P Hartcliff **CASING:** HW to 1.3m

TYPE OF BORING: Solid flight auger (TC-bit) to 1.0m; Rotary (water) to 1.5m; NMLC-Coring to 14.4m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep
		⊻	Water level

CHECKED
Initials: STE
Date: 25/1/08

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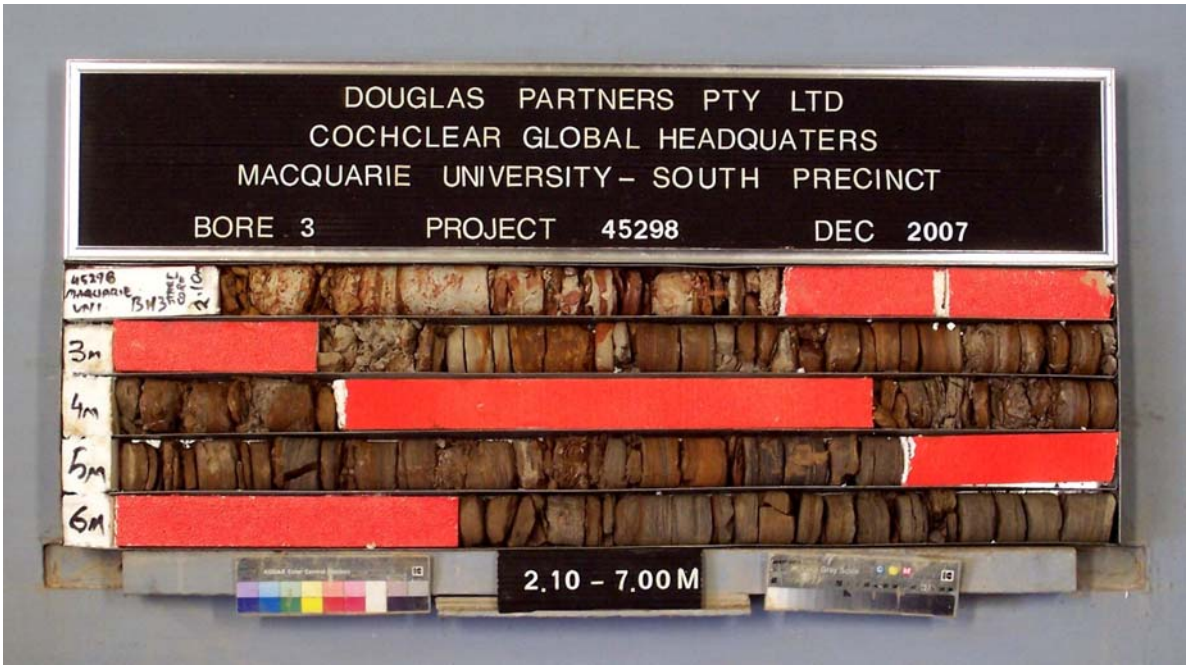
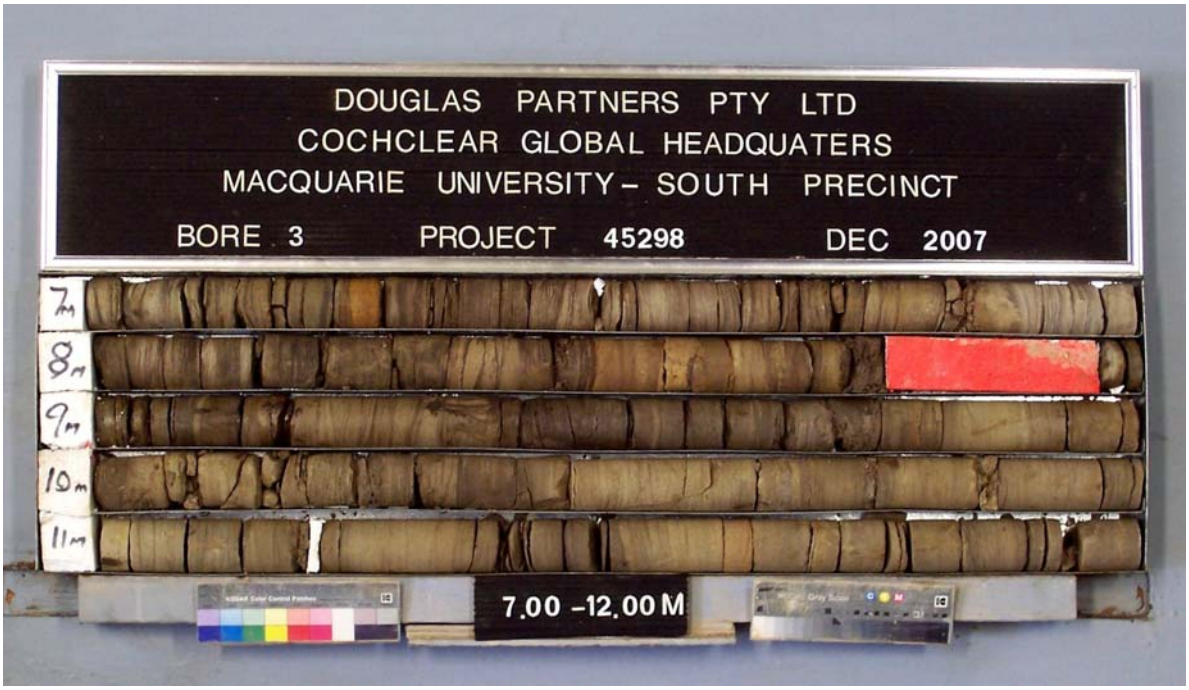

DOUGLAS PARTNERS PTY LTD
COCHCLEAR GLOBAL HEADQUATERS
MACQUARIE UNIVERSITY - SOUTH PRECINCT
BORE 3 PROJECT 45298 DEC 2007
3m
4m
5m
6m
2.10 - 7.00 M


DOUGLAS PARTNERS PTY LTD
COCHCLEAR GLOBAL HEADQUATERS
MACQUARIE UNIVERSITY - SOUTH PRECINCT
BORE 3 PROJECT 45298 DEC 2007
7m
8m
9m
10m
11m
7.00 -12.00 M

BOREHOLE LOG

CLIENT: Lachlan Project Development Pty Ltd
PROJECT: Cochlear Global Headquarters
LOCATION: Macquarie University South Precinct

SURFACE LEVEL: 64.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 45298
DATE: 18 Dec 08
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, D - Drill Break)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
64	0.3	TOPSOIL - grey silty sand topsoil										
		FILLING - red-brown and grey mottled clay filling with some ironstone gravel										
	0.8	FILLING - dark grey clay filling (possibly old topsoil)										
63	1.15	CLAY - stiff, light brown and red clay with a trace of ironstone gravel						Note: Unless otherwise stated, rock is fractured along rough planar bedding planes dipping 0°-10° and joints	S			3,4,5 N = 9
62	2.1	LAMINITE - extremely low strength, extremely weathered, fractured light grey laminite with ironstone bands							C	86	0	
	2.66							2.66m: CORE LOSS: 540mm				
61	3.3	LAMINITE - medium strength, moderately and highly weathered, fractured, reddish brown with grey laminite							C	69	0	PL(A) = 0.5MPa
	3.87											PL(A) = 1.2MPa
60	4.22	LAMINITE - medium to high strength, moderately weathered, fractured, reddish brown and grey laminite with very low strength bands						4.22m: CORE LOSS: 530mm	C	66	9	
								5.17m: J70° ironstaining spacing				
59								5.31m: B0° 2mm clay				PL(A) = 1.4MPa
	5.78							5.78m: CORE LOSS: 560mm				
58												PL(A) = 1MPa
								6.64m: J60° ironstaining				PL(A) = 0.9MPa
57	7.28	LAMINITE - high to very high strength, slightly weathered to fresh, slightly fractured, light grey and grey laminite with 35% sandstone laminations							C	81	38	PL(A) = 3.6MPa
56								8.22m: B0° 5mm clay				PL(A) = 1.3MPa PL(A) = 3.1MPa
	8.75							8.75m: CORE LOSS: 200mm				
55									C	92	84	PL(A) = 3.3MPa
	9.74	SANDSTONE - see next page										PL(A) = 2.1MPa

RIG: Edson 3000 **DRILLER:** JS **LOGGED:** JC **CASING:** HW to 1.60m

TYPE OF BORING: Solid flight auger (TC-bit) to 1m, rotary (water) to 2.1m, NMLC-coring to 14.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: Approximately 50% water loss at 10.50m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep
		⋕	Water level

CHECKED
Initials: STE
Date: 25/1/08

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