



Borehole No.
JK1C
1/3

BOREHOLE LOG

Client: CRADLE COAST WATER
Project: GEOTECHNICAL INVESTIGATION OF LANDSLIDE
Location: 9ML BIG KELCEY RESERVOIR, NEAR DEVONPORT, TASMANIA

Job No. 21508WH2 **Method:** SPIRAL AUGER HYDROPOWER SCOUT **R.L. Surface:** 111.79m
Date: 15-1-09 **Datum:** AHD
Logged/Checked by: A.J.H. *AJH*

Groundwater Record	SAMPLES				Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/Weathering	Strength/Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
	ES	USO	DB	DS									
						0			TOPSOIL: Silty sand, fine to medium grained, dark brown, with root fibres. FILL: Clayey silt, low plasticity, light brown and grey, with fine to coarse grained angular siltstone gravel.	D MC < PL			GRASS COVER
						1			FILL: Clayey silt/silty clay, low plasticity, brown and grey, with a trace of fine grained angular sub angular and angular siltstone and shale gravel.				
						2			as above, but with siltstone and shale gravel, and a trace of siltstone cobbles (to 70mm size).				
						3							
						4			FILL: Clayey silt, low plasticity, grey and brown, with fine to coarse grained angular siltstone gravel and a trace of ash.				
						5							POSSIBLE INFERRED LANDSLIDE DEBRIS BELOW 5m DEPTH
						6				MC ≈ PL			
						7		-	SILTSTONE: light grey and brown, with L-M strength seams.	XW	EL	-	INFERRED LANDSLIDE DEBRIS BELOW 6.25m DEPTH



Borehole No.
JK1C
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
































BOREHOLE LOG

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	ES	USO	DS									
ON COMPLETION OF DRILLING					8			SILTSTONE: light grey and brown, with L-M strength seams.	XW	EL		VERY LOW 'TC' BIT RESISTANCE INFERRED LANDSLIDE DEBRIS
					9			as above, but with dark grey, XW, EL shale bands.				
					10			as above, but dark grey, with a trace of fine to medium grained gravel.				
					10			END OF BOREHOLE AT 10.0m				50mm PVC STANDPIPE INSTALLED TO 10.0m DEPTH. 0m TO 7m DEPTH UNSLOTTED. 7m TO 10m DEPTH SLOTTED. REFER TO TABLE F FOR INSTALLION DETAILS
					11							
					12							
					13							
					14							

GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

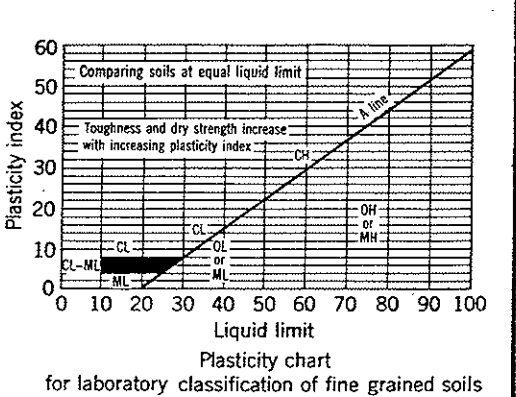
SOIL	ROCK	DEFECTS AND INCLUSIONS
 FILL	 CONGLOMERATE	 CLAY SEAM
 TOPSOIL	 SANDSTONE	 SHEARED OR CRUSHED SEAM
 CLAY (CL, CH)	 SHALE	 BRECCIATED OR SHATTERED SEAM/ZONE
 SILT (ML, MH)	 SILTSTONE, MUDSTONE, CLAYSTONE	 IRONSTONE GRAVEL
 SAND (SP, SW)	 LIMESTONE	 ORGANIC MATERIAL
 GRAVEL (GP, GW)	 PHYLLITE, SCHIST	OTHER MATERIALS
 SANDY CLAY (CL, CH)	 TUFF	 CONCRETE
 SILTY CLAY (CL, CH)	 GRANITE, GABBRO	 BITUMINOUS CONCRETE, COAL
 CLAYEY SAND (SC)	 DOLERITE, DIORITE	 COLLUVIUM
 SILTY SAND (SM)	 BASALT, ANDESITE	
 GRAVELLY CLAY (CL, CH)	 QUARTZITE	
 CLAYEY GRAVEL (GC)		
 SANDY SILT (ML)		
 PEAT AND ORGANIC SOILS		



UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 µm and basing fractions on estimated weights)		Group Symbols	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 (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	<p>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 5% GM, GC, SM, SC Borderline cases requiring use of that symbols</p> $C_U = \frac{D_{60}}{D_{10}} \text{ Greater than } 4$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ Between } 1 \text{ and } 3$ <p>Not meeting all gradation requirements for GW</p> <table border="1"> <tr> <td>Atterberg limits below "A" line, or PI less than 4</td> <td>Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols</td> </tr> </table> $C_U = \frac{D_{60}}{D_{10}} \text{ Greater than } 6$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ Between } 1 \text{ and } 3$ <p>Not meeting all gradation requirements for SW</p> <table border="1"> <tr> <td>Atterberg limits below "A" line or PI less than 5</td> <td>Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols</td> </tr> </table>	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	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
		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							
		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							
		Gravels with fines (appreciable amount of fines)	Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines					
	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					
		Sands with fines (appreciable amount of fines)	Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines					
	Fine-grained soils More than half of material is smaller than 75 µm sieve size (The 75 µm sieve size is about the smallest particle visible to naked eye)	Sands and silts Liquid limit less than 50	Nonplastic fines (for identification procedures see ML below)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures		<p>For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics</p> <p>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)</p>			
			Plastic fines (for identification procedures, see CL below)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures					
			Sils and clays Liquid limit greater than 50	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	SW			Well graded sands, gravelly sands, little or no fines		
		Predominantly one size or a range of sizes with some intermediate sizes missing		SP	Poorly graded sands, gravelly sands, little or no fines					
Nonplastic fines (for identification procedures, see ML below)		SM		Silty sands, poorly graded sand-silt mixtures						
Plastic fines (for identification procedures, see CL below)		SC	Clayey sands, poorly graded sand-clay mixtures							
Identification Procedures on Fraction Smaller than 380 µm Sieve Size										
Highly Organic Soils	Sils and clays Liquid limit greater than 50	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	<p>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</p> <p>For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions</p> <p>Example: Clayey silt, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML)</p>			
		None to slight	Quick to slow	None	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays				
		Medium to high	None to very slow	Medium	OL	Organic silts and organic silt-clays of low plasticity				
		Slight to medium	Slow	Slight	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts				
		Slight to medium	Slow to none	Slight to medium	CH	Inorganic clays of high plasticity, fat clays				
		High to very high	None	High	OH	Organic clays of medium to high plasticity				
		Medium to high	None to very slow	Slight to medium	PI	Peat and other highly organic soils				

Use grain size curve in identifying the fractions as given under field identification



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.



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.	
	ASB	Soil sample taken over depth indicated, for asbestos screening.	
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.	
	SAL	Soil sample taken over depth indicated, for salinity analysis.	
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	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.
		7	
		3R	
VNS = 25 PID = 100	Vane shear reading in kPa of Undrained Shear Strength. 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	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.	
	250		
Remarks	'V' bit	Hardened steel 'V' shaped bit.	
	'TC' bit	Tungsten carbide wing bit.	
	T 60	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.	

Jeffery and Katauskas Pty Ltd

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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	0.03	Easily remoulded by hand to a material with soil properties.
Very Low:	VL	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low:	L	0.3	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.
Medium Strength:	M	1	A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
High:	H	3	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.
Very High:	VH	10	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.
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	