



Borehole No.
JK4P
1/2

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:** 94.28m
Date: 27-1-09 **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		ML	TOPSOIL: Clayey silt, low plasticity, grey brown, with root fibres. CLAYEY SILT: low plasticity, brown, with fine to medium grained angular to sub angular siltstone gravel.	MC < PL MC < PL	(H)		GRASS COVER
						1							
						2			as above, but with silty clay bands and fine grained sub angular and angular siltstone gravel.	MC ≈ PL	(VSt - H)		
						3			as above, but grey brown, with XW fine grained sub angular siltstone gravel.				
						4			CLAYEY SILT: low plasticity, light grey mottled brown, with fine grained XW angular siltstone gravel and iron indurated shale seams.		(VSt)		
						5							
						6		CL	GRAVELLY SILTY CLAY: low to medium plasticity, light brown, fine to coarse grained angular siltstone gravel.	MC ≈ PL	VSt	260 260	
						7							

N = 9
3,4,5

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
Date: 27-1-09 **HYDROPOWER SCOUT** **R.L. Surface:** 94.28m
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										
ON COMPLETION					N = 10 2,4,6	8		CL	SILTY CLAY: medium plasticity, light red brown, with fine grained sub angular and angular shale and siltstone gravel.	MC > PL	St-VSt	180 230 330	INFERRED LANDSLIDE DEBRIS	
					N = 11 3,6,5	10		ML	SILT: low plasticity, light brown, with XW siltstone gravel and clay fines.	MC < PL	(VSt)		TOO FRIABLE FOR HP TESTING	
					N = 12 3,5,7	11			GRAVELLY SILT; low plasticity, grey mottled brown, fine to medium grained sub angular XW siltstone gravel.	MC ≈ PL	St	180 150 190		
					N = 12 4,6,6	12		CL	GRAVELLY SILTY CLAY: low plasticity, dark grey mottled orange brown, fine to coarse grained angular shale gravel. Gravel is M-H strength.					TOO GRAVELLY FOR HP TESTING
					N = 14 4,6,8	12.95			SILTY CLAY: medium plasticity, light grey mottled brown, with a trace of sub rounded quartz gravel.	MC > PL	VSt	260 280 400		
					13			END OF BOREHOLE AT 12.95m					VW PIEZOMETER INSTALLED TO 12.5m DEPTH. REFER TO TABLE E FOR INSTALLATION DETAILS	
					14									

GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

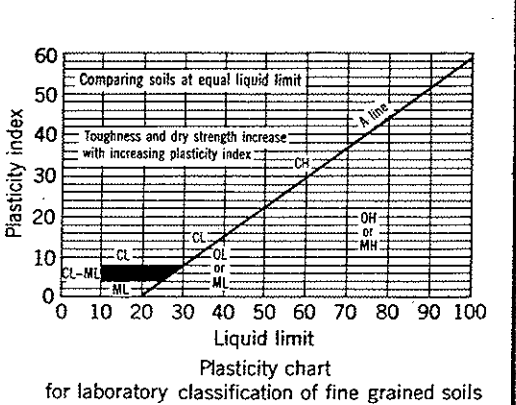
SOIL	ROCK	DEFECTS AND INCLUSIONS
FILL	CONGLOMERATE	CLAY SEAM
TOPSOIL	SANDSTONE	SHEARED OR CRUSHED SEAM
CLAY (CL, CH)	SHALE	BRECCIATED OR SHATTERED SEAM/ZONE
SILT (ML, MH)	SILTSTONE, MUDSTONE, CLAYSTONE	IRONSTONE GRAVEL
SAND (SP, SW)	LIMESTONE	ORGANIC MATERIAL
GRAVEL (GP, GW)	PHYLLITE, SCHIST	OTHER MATERIALS
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> $C_U = \frac{D_{60}}{D_{10}} \text{ Greater than 4}$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ Between 1 and 3}$ <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> <p>Atterberg limits above "A" line, with PI greater than 7</p> $C_U = \frac{D_{60}}{D_{10}} \text{ Greater than 6}$ $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}} \text{ Between 1 and 3}$ <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> <p>Atterberg limits below "A" line with PI greater than 7</p>	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					
	Nonplastic fines (for identification procedures see ML below)	Plastic fines (for identification procedures, see CL below)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures						
			GC	Clayey gravels, poorly graded gravel-sand-clay mixtures						
	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					
			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)	Plastic fines (for identification procedures, see CL below)	SM	Silty sands, poorly graded sand-silt mixtures					
				SC	Clayey sands, poorly graded sand-clay mixtures					
Identification Procedures on Fraction Smaller than 380 µm Sieve Size										
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)		Sils and clays liquid limit less than 50	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	<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	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity			
	Medium to high		None to very slow	Medium	CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
	Slight to medium		Slow	Slight	OL		Organic silts and organic silt-clays of low plasticity			
	Sils 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				
		Readily identified by colour, odour, spongy feel and frequently by fibrous texture				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) (Cohesionless 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.	
	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)	VL	Very Loose < 15	
	L	Loose 15-35	
	MD	Medium Dense 35-65	
	D	Dense 65-85	
	VD	Very Dense > 85	
	()	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

CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
 ABN 17 003 550 801



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	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	