Appendix A

Borehole Logs and Explanation Sheets



Engineering Log - Borehole

Client:

Principal: Project:

RESOURCE ESTIMATE

CHAMPIONS QUARRY

Project: Boreho		ocati	on: NEA				QUA							-ogged Checke			ALB
drill mod							ISUZU		531336	slo	ope:	-90°				, R.L	L. Surface: 29.3
hole diar				100 m	im	•		Northing	6798300	be	aring:					dat	tum: AHD
drilling	<u> </u>	form	ation			mat	1	ubstance									
method T Denetration		support water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	soil typ colour	e: plasticity o	naterial or particle chara and minor com	acteristics, ponents.		moisture condition	consistency/ density index	kF	300 b penetro- 400 meter	
TCAD	TC	M		_29			SC	TOPSOIL: brown, sand pp=80kPa	Sandy Clay, d is fine to me	medium plastic edium grained	vity, dark		М	F		\prod	TOPSOIL/COLLUVIUM
			D				СН			asticity, pale ora	 ange		-	St	×		RESIDUAL SOIL
	+	+	+	28	1	[/X[]]				as cored hole					$\left \right \right $	+	
				_20													
					2												
				_27													
					3												
				_26													
				25	4												
				_20													
					5												
				_24													
					6												
				_23													
				_22	<u>7</u>												
					-	i											
method				su	8 Ipport			notes, sam	ples. tests		cla	assificat	tion sy	mbols a	 Ind		consistency/density index
AS AD RR	thod suger screwing* M mud auger drilling* C casing roller/tricone penetration						l nil	U ₅₀ ur U ₆₃ ur D di	ndisturbed sam ndisturbed sam isturbed sample		eter soi eter bas	oil descri	iption	classifica			VS very soft S soft F firm
W CT HA		washb cable t hand a	tool auger			no resista ranging to refusal	ance o	N* SI Nc SI	PT - sample re PT with solid co	one	D	oisture dry					St stiff VSt very stiff H hard
DT B V T		V bit	bit	wa		98 water te showr		P pr Bs bu	ane shear (kPa ressuremeter ulk sample nvironmental sa		M W Wp W	p plast	st tic limit d limit	t			Fb friable VL very loose L loose MD medium dense
	blank bit V bit TC bit shown by suffix					inflow outflow			efusal	ampie		_ iiquit	amm				D dense VD very dense

dense very dense

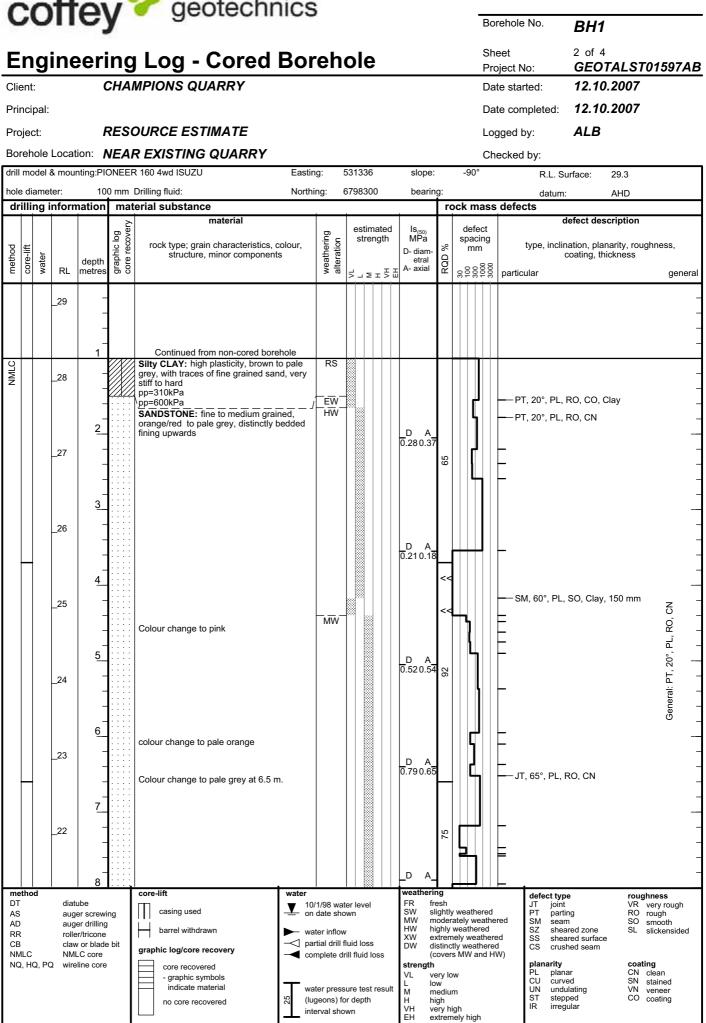
BH1 1 of 4 GEOTALST01597AB 12.10.2007 12.10.2007

Logged by:

Sheet Project No: Date started: Date completed:

Borehole No.

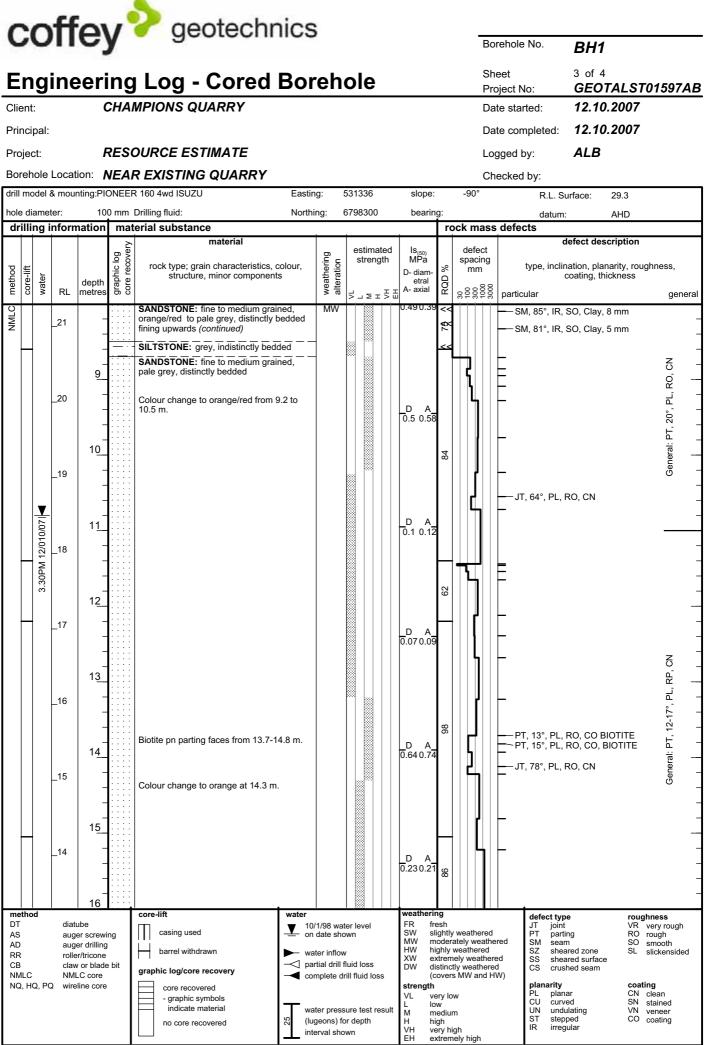
ALB



22.1.08 COFFEY.GDT CORED BOREHOLE GEOTCOFH01597AB.GPJ

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r			ff			geotechr	nics	:												
C		U		6	y	gootoon									В	orehole	e No.	BH1		
Ε	n	a	ine	eri	ina	Log - Cored	Bor	eh	ol	е						neet oject N		4 of 4	TAI STA	1597AB
Clie						MPIONS QUARRY										ate sta		12.10		TUSTAD
		pal:													Da	ate cor	npleted:	12.10		
Pro	ojec	ct:		ŀ	RESO	OURCE ESTIMATE									Lo	gged	by:	ALB		
	-		Loca	tion: /	VEAI	R EXISTING QUARRY										necked				
drill	mc	del a	& mou	nting:Pl	ONEEF	R 160 4wd ISUZU	Eastir	ng:	5313	36		slope:		-90)°		R.L. Su	urface:	29.3	
		amet		10 nation		Drilling fluid: terial substance	North	ing:	6798	300		bearin	ř.		nae	s defe	datum:		AHD	
u		ing i				material			05	stima	ted	Is ₍₅₀₎			fect			lefect des	cription	
method	core-lift	water	RL	depth metres	graphic log core recovery	rock type; grain characteristics, structure, minor componen		weathering alteration	st	treng	jth	MPa D- diam- etral	RQD %	spa m		partic	(nation, plar coating, thi	narity, rougł ickness	nness, general
NMLC			12	_		SANDSTONE: fine to medium gra		MW	- 8											
Z			_13	-			,	HW								L				-
				-								DA	9			-				-
				17_								0.020.04	86							
			_12	-									<<							- CN
				-	· · · · ·	NO CORE=0.90 m		<u> </u>								_				-, RP,
				18																General: PT, 12-17°, PL, RP, CN
			_11	-									<<							; 12-1
				-		SANDSTONE: medium to fine gra		HW-		8						_				al: PT
				19		pale grey	inou,					DA 0.140.16	5		1	-				Gener
			10	_				MW					9]	L				-
				-								D A			1	F				-
				-																-
				20								D A 2.9 2.59				-				
			9	-		BH1 terminated at 20.3 m due to li	mit of													
				-		required investigation. BH1 terminated at 20.3m														-
				2 <u>1</u>																
			_8	-																-
				-																-
				22_																
			_7	-																-
				-																_
				23																-
			_6	-																_
				-																-
				24																-
me DT		d		ube		core-lift	water 10	/1/98 wa	ter lev	vel			esh				defect typ JT joint		rough VR ve	erv rough
AS AD RR			aug	er screwi er drilling er/tricone	, T	barrel withdrawn	→ on	date sho				MW m HW hi	oder ghly	weat ately v weath	veath ered	ered		n ared zone	SL sl	ough mooth lickensided
CB			clav	v or blade		graphic log/core recovery	-⊲ pa	rtial drill mplete d	fluid lo		s	DW di	stinc	iely we tly we s MW	athere	ed		ared surface hed seam		
		Q, PC		eline core		core recovered - graphic symbols						strength VL ve	ery lo				planarity PL plana CU curve		coatin CN cl SN st	lean
						indicate material no core recovered		ater press geons) f			sult	H hi	iediui igh				UN undu ST step	ulating ped	VN ve CO ce	eneer
								erval sho	own .			VH ve	ery hi	gh iely hi	gh		IR irreg	ular		

CORED BOREHOLE GEOTCOFH01597AB.GPJ COFFEY.GDT 22.1.08



Engineering Log - Borehole

Client:

Principal: Project:

RESOURCE ESTIMATE

CHAMPIONS QUARRY

Borehole Location: NORTH OF EXISTING QUARRY

				on: NOR	TH	OF E	=XIS	TING	QUAR	₹ <u>Υ</u>			(Checke	d by	y:	
drill m	node	el and	mou	inting: F	PIONE	ER 16	0 4wd	ISUZU	Easting:	531199	slope:	-90°				R.I	L. Surface: 28.7
hole o					00 m	m			Northing	6798403	bearing	J:				dat	tum: AHD
dril	-	info	orma	ation			mat		ubstance				i				
method	5 penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	soil typ colou	pe: plasticity or	terial particle characteri nd minor compone	istics, ents.	moisture condition	consistency/ density index	kF	300 benetro- 400 meter	
TCAD		С					} }	SW	TOPSOIL:	Sand, medium of CH clay and	grained, orange/l	brown,	М	L			TOPSOIL/COLLUVIUM
TC					_28	– – – 1		SP	SAND: find	e to medium gra	ained, pale orange es of medium plas	e/brown, sticity clay		MD			RESIDUAL SOIL
									Borehole B	3H2 continued a	is cored hole				++	++	
					_27												
	_26					- - - - - - -											
	_25																
					_24	5											
					_23	6											
					22	- - 7 -											
math					_21	 8			notos com	nples, tests	i	oloosifi	cation sy	mboloo			consistency/density index
AS AD RR W CT HA DT B V T	AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix					ter 10/1/9	n no resista anging tr efusal 8 water e shown inflow	level	U ₅₀ u U ₆₃ u D d N s N s N c s V v P p Bs b E e	undisturbed sampl	overed	soil des based or system Moistur D dr M m W w Wp pl	e ry oist	classifica			VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense

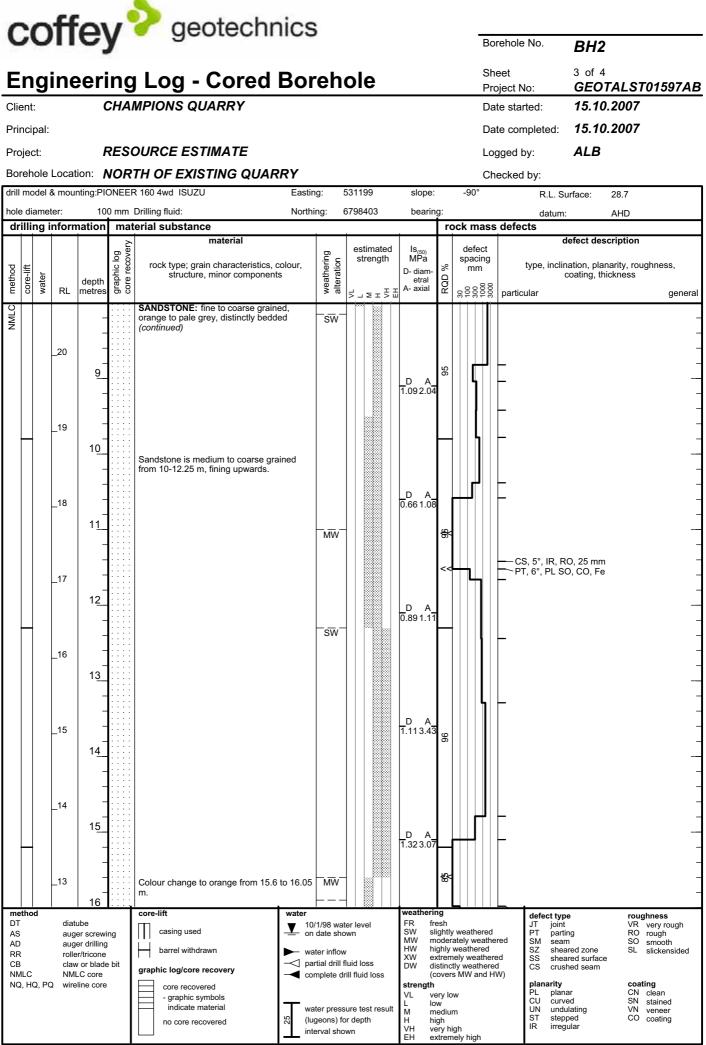
Borehole No. BH2 Sheet 1 of 4 GEOTALST01597AB Project No: 15.10.2007 Date started: 15.10.2007 Date completed: ALB Logged by:

Checked by:

BOREHOLE GEOTCOFH01597AB.GPJ COFFEY.GDT 22.1.08

Form GEO 5.3 Issue 3 Rev.2

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•				·.	y	0								Bo	orehole No.	BH2	
Ε	n	g	ine	eri	inc	J Log - Cored	Bor	eh	ole						neet roject No:	2 of 4 GFOTA	LST01597A
Cli						MPIONS QUARRY									ate started:	15.10.2	
Pri	nci	pal:												Da	ate completed:	15.10.2	007
Pro	ojeo	ct:		F	RES	OURCE ESTIMATE								Lc	ogged by:	ALB	
Во	reh	ole	Locat	ion: 🖊	VOR	TH OF EXISTING QUAR	RY							Cł	necked by:		
				·		R 160 4wd ISUZU	Eastir	ng:	531199		slope:		-9	0°	R.L. Sı	urface: 2	8.7
		amet ng i		10 nation		Drilling fluid: terial substance	North	ing:	6798403	3	bearin	Ň	ock	mas	datum: s defects	A	HD
	Γ	-			g /ery	material		5	estima		Is(50)			efect	d	lefect descri	ption
por	rlift	۲			graphic log core recovery	rock type; grain characteristics, c structure, minor components		weathering alteration	stren	ngth	MPá D- diam-	% (acing nm		ation, planar	ity, roughness, ness
method	core-lift	water	RL	depth metres	grap core			wea altei	: צרל	I N H	etral A- axial	RQD	30	3000 3000		0.	genera
				-													
				-													
			_28														
NMLC				1	· · · · ·	Continued from non-cored bore SAND: fine to coarse grained, brown/orange	noie					<<					
Z				-		SANDSTONE: fine grained, orange pale grey, distinctly bedded, remoul											
			_27	-		SP-fine grained sand, with some me plasticity clay						0			SM, 20°, PL,	SO Clay 80	mm
				2_		pp=240kPa									0, 20 , 1 2,	00, 010 <u>,</u> 00	-
				-	· · · · ·												
			_26	-													
				3								<<					_
				-	· · · · ·												
		AM 16/10/07	25	-	::::: —·	pp=160kPa						10					
		AM 1	_25	4	·	SILTSTONE: white, indistinctly lam remoulds to a low plasticity clayey s stiff						-				O, CN	
		8.50		- T	<u> </u>	SANDSTONE: fine to coarse graine		-									-
				-		pale grey, remoulds to SW, sandsto	ne										
			_24	-		SILTSTONE: pale grey, laminated pp=250kPa		HW-						ľ		O, CN	
				5_		SANDSTONE: fine to coarse graine pale orange, distinctly bedded, finin											-
				-		upwards		<u> </u>			-				4		
			_23	-		SANDSTONE: fine to coarse graine orange to pale grey, distinctly bedde		HW			-						
				6		pp=100kPa					_D A_			Ĺ			
				-		Colour change to pale grey at 6.1 m	1.	MW			0.79 1.9	62					
			_22	-													
				7_											PT, 5°, PL, R	O, CN	_
				-	· · · · ·												
			21	-													
			_21	8							0.180.17	95					
DT		d	diat		•••••	core-lift	water 10	1 /1/98 wat	er level	(]		esh			defect typ JT joint		roughness VR very rough
AS AE)		aug	er screwi er drilling	, T	barrel withdrawn	📕 on	date sho	wn		MW m	oder	ately	thered weath hered	ered PT parti	ng	RO rough SO smooth SL slickensided
RF CE NM			clav	er/tricone v or blade LC core		graphic log/core recovery	- pa	rtial drill f mplete d	luid loss	199	XW ex DW di	ktrem stinc	nely w tly we	eathere athere	red SS shea ed CS crus	ared surface hed seam	
		Q, PC		line core		core recovered - graphic symbols	- co	mpiere a		133	strength				planarity PL plana		coating CN clean
						indicate material		ater press geons) fo		result	L lo M m				ST step	ulating ped	SN stained VN veneer CO coating
						no core recovered		erval sho			VH ve	ery hi	igh 1ely h	igh	IR irreg		



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COII	Ξy	gootoon				Bo	orehole No.	BH2
Engine	erin	g Log - Cored	Boreh	nole			neet oject No:	4 of 4 GEOTALST01597A
Client:		AMPIONS QUARRY					ate started:	15.10.2007
Principal:	••••						ate completed:	15.10.2007
Project:	RES	SOURCE ESTIMATE				Lo	gged by:	ALB
Borehole Loca	tion: NOI	RTH OF EXISTING QUAR	RY			Cł	necked by:	
drill model & mou	nting:PIONE	ER 160 4wd ISUZU	Easting:	531199	slope:	-90°	R.L. S	urface: 28.7
hole diameter: drilling inforr		n Drilling fluid: aterial substance	Northing:	6798403	bearing	rock mas	datum:	: AHD
		motorial		estimated	ls ₍₅₀₎	defect		defect description
method core-lift water	depth metres	rock type; grain characteristics, c structure, minor components			MPa D- diam- etral	spacing % 000 % 000 % % % 000 % % % % 000 %		nation, planarity, roughness, coating, thickness gener
NWI 12 11 10 10 9 9 9 _		SANDSTONE: fine to coarse graine orange to pale grey, distinctly bedde (continued) Colour change to pale grey at 16.05 SILTSTONE: dark grey, laminated coaliferous SANDSTONE: fine to medium grain grey SILTSTONE: dark grey, laminated BH2 terminated due to limit of requi investigation. BH2 terminated at 20.3m	ed 5 m. SW		D A 0.690.59 0.590.66			50, Clay, 40 mm
AS aug AD aug RR rolle CB clav NMLC NM	24 tube ger screwing ger drilling er drilling er drilling er/tricone w or blade bit LC core eline core	core-lift casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered	 on date s water influct partial dri complete water pre 	ow II fluid loss drill fluid loss ssure test result for depth	MW mc HW hig XW ex DW dis (cc strength VL ve L lov M mc H hig VH ve	sh ghtly weathered derately weather hly weathered tremely weather tinctly weather overs MW and H ry low v edium	ered SM sear SZ shea SS shea SS crus W) planarity PL plan CU curv	Coating VR very rough RO rough M SO smooth ared zone SL slickensided ared surface whether seam CN clean red SN stained ulating VN veneer ped CO coating

CORED BOREHOLE GEOTCOFH01597AB.GPJ COFFEY.GDT 22.1.08



Engineering Log - Borehole

Client:

Principal: Project:

RESOURCE ESTIMATE

CHAMPIONS QUARRY

Borehole Location: EASTERN EXTENT OF PROPOSED QUARRY

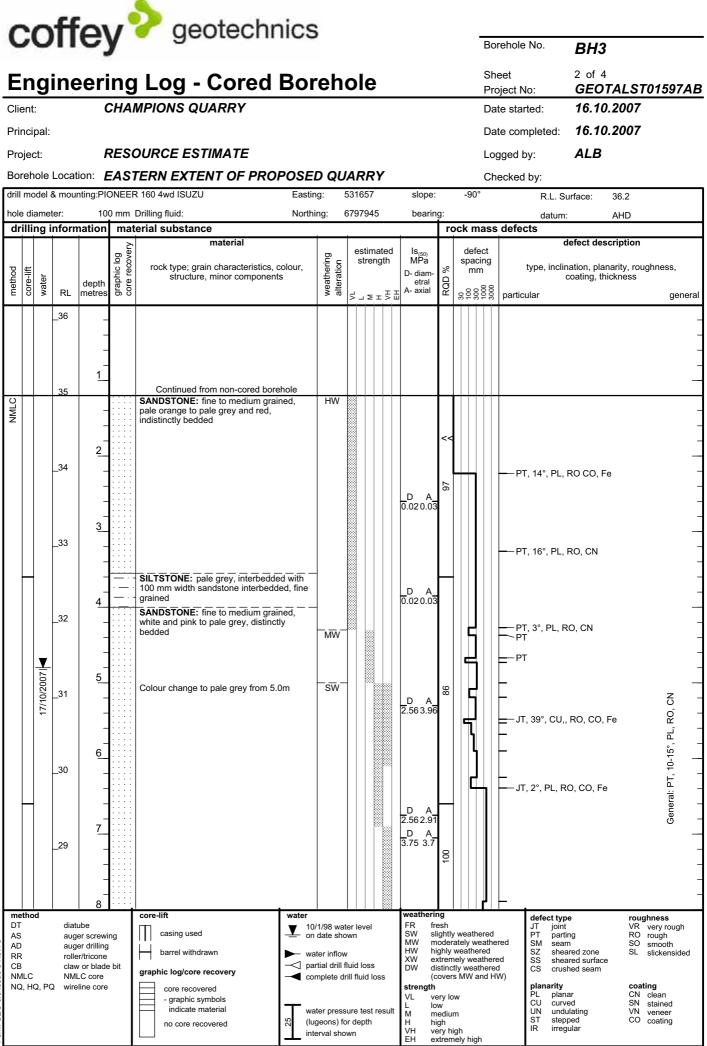
	-
Sheet	1 of 4
Project No:	GEOTALST01597AB
Date started:	16.10.2007
Date completed:	16.10.2007
Logged by:	ALB

BH3

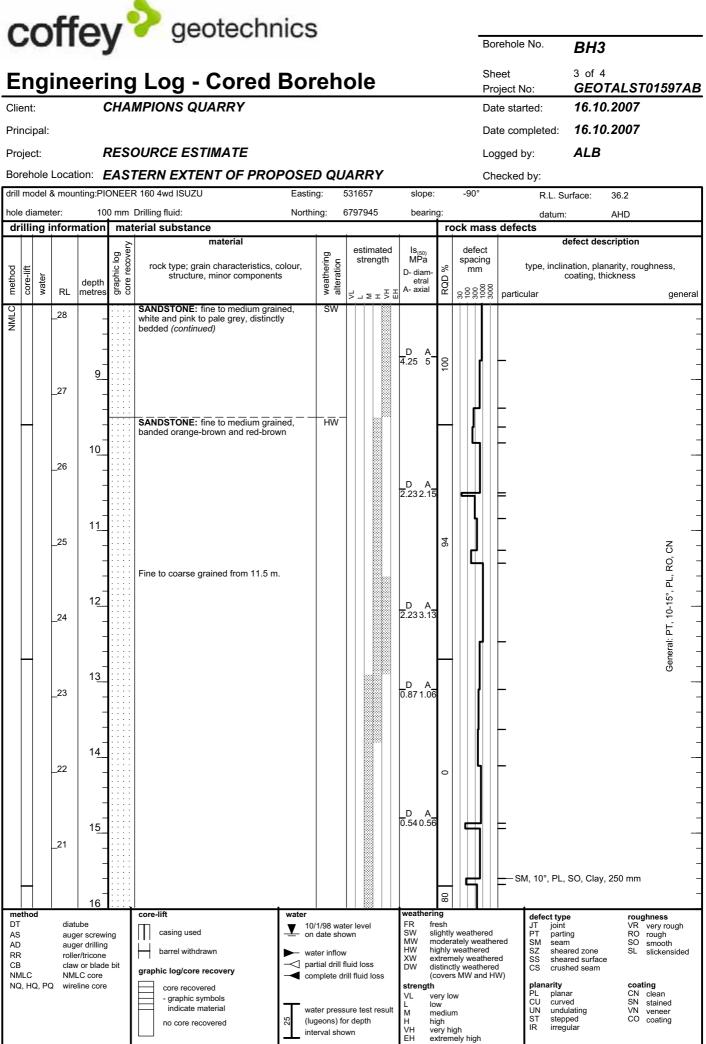
Checked by:

Borehole No.

dı	rill r	nodel	and	mou	nting: F	PIONE	ER 16	0 4wd	ISUZU	Easting:	531657	slope:	-90°				R.L	Surface: 36.2
h	ole	diame	eter:			100 m	m			Northing	6797945	bearing	:				dat	um: AHD
Ľ	dril	ling	info	orma	ition			mate	erial s	ubstance								
mathod		5 penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	soil type: colour, s	materia plasticity or part secondary and n	icle characteri	stics, ents.	moisture condition	consistency/ density index	kF	300 benetro- 400 meter	structure and additional observations
	3		СМ			_36	_	$ \{ \}$	SC	dark brown, c	layey Sand, fine lay is medium pl	to coarse grai asticity, traces	ned, s of	М	L			RESIDUAL TOPSOIL
ľ	-						-	\$ \$	SP	rootlets and c SAND: fine to traces of very	organics o medium graine v low strength sa	d, orange/brov	 wn,		D			EXTREMELY WEATHERED
						05			SP		o medium graine		e/brown,		VD			-
F						35	-	<u></u> .		with trace of r	medium plasticity 3 continued as co	/ clay	/					
						_34	2											
						_33												
						_32	 4 											
						_31												-
						_30	 6											-
						_29												-
rm GEO 5.3 Issue 3 Rev.2 	V T IA IT	hown t	au ro wa ca ha di bl bl V T(T(oy su	iger d ller/tri ashbo ble to and au atube ank b bit C bit	re ol ıger	M C pe 1 W wa Wa	ter 10/1/9	on no resista ranging to refusal 8 water e showr inflow	level	U ₆₃ und D distr N star N* SPT Nc SPT V van P pres Bs bulk	isturbed sample 50 isturbed sample 60 urbed sample dard penetration tu r - sample recover r with solid cone e shear (KPa) ssuremeter sample ironmental sample	Bmm diameter est (SPT) ed	W we Wp pla	cription n unified e y poist	classifica			consistency/density indexVSvery softSsoftFfirmStstiffVStvery stiffHhardFbfriableVLvery looseLlooseMDmedium denseDdenseVDvery dense



1 GEO 5.5 Issue 3 Rev.



GEO 5.5 Issue 3 Rev.

1	-		ff			geotecl	hnics										
•	•	U		6	y	geotee						В	orehole	No.	BH3		
E	'n	a	ine	eri	inc	y Log - Core	d Bor	eh	ole				heet		4 of 4	ALST01	
	ent					MPIONS QUARRY							roject N ate star		16.10.2		JAD
		pal:												npleted:	16.10.2		
Pro				F	RES	OURCE ESTIMATE							ogged b		ALB		
	-		Locat	ion: E	EAS	TERN EXTENT OF P	ROPOSE	D QU	ARRY				hecked				
dril	mc	del	& mou	nting:Pl	ONEE	R 160 4wd ISUZU	Eastin	ig: ł	531657	slope:	:	-90°		R.L. Su	Irface: 3	6.2	
		ame				Drilling fluid:	Northi	ng: (6797945	bearin	ř.			datum:	A	HD	
a		ng i	ntorn	nation		terial substance material			a attime to d		ro	ck mas	s dered		efect descri	ption	
method	core-lift	water		depth	graphic log core recovery	rock type; grain characteris structure, minor compo		weathering alteration	estimated strength	Is ₍₅₀₎ MPa D- diam- etral	RQD %	defect spacing mm		c	ation, planar coating, thick		SS,
	ö	3	RL	metres	చ్ ర		narained		д тагұд		۳		_		SO Clay 25		general
NMLC			19 18 17 16 15			SANDSTONE: fine to medium banded orange-brown and rec (continued) Colour change to banded whit at 18.2 m.	I-brown	HW		D A 0.740.75 0.150.84 0.150.84 0.150.84 0.150.84 0.150.84 0.150.84	77 40 40			, 65°, UN, 5 , 62°, UN, 5 , 60°, UN, F	SO, Clay, 25 SO, CO, Cla SO, CO, Cla RO, CO, Fe RO, CO, Fe	y y	General: PT, 10-15°, PL, RO, CN
			_14	 22 		BH3 terminated at 21.65 due t client. BH3 terminated at 21.65m	to direction of			D A 1.891.97	7						
			13	23 23_ - - - 24													
DT AS AE RF CE NM	s) R S MLC	d Q, P(aug rolle clav NMI		e bit	core-lift casing used barrel withdrawn graphic log/core recovery core recovered - graphic symbols indicate material no core recovered	ישמי שישמי ער ער ער ער שישמי שימי שי		wn luid loss rill fluid loss ure test result or depth	SW sl MW m HW h XW e DW d (c strength VL v L lc M m H h VH v	esh lightly nodera ighly v xtrem istinct covers ery lov w nediun igh ery hig	n	nered ered red	SS shea	ng red zone red surface ned seam ar ad lating ped	roughnes VR very RO rougi SO smoc SL slicke coating CN clean SN stain VN vene CO coatin	rough 1 hth ensided ed er



Engineering Log - Borehole

Client:

BOREHOLE GEOTCOFH01597AB.GPJ COFFEY.GDT 22.1.08

Principal: Project:

RESOURCE ESTIMATE

CHAMPIONS QUARRY

Borehole Locatio SOUTH OF EXISTING OUAPPY

Bor	reho	ole	Lo	catio	on: SOL	JTH	OF E	EXIS	TING	QUARR	?Y				Checke		:		
drill	moo	del a	and	mou	inting:	PIONE	EER 16	0 4wd	ISUZU	Easting:	531440	slope:	-90°				R.L.	Surface:	50.2
	e dia					100 m	m			Northing	6797931	bearing	g:				datu	m:	AHD
dr	_	-	nfc	orma	ation		-	mate	erial s	ubstance				i		.			
method	1 2		support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	soil typ colour	mate be: plasticity or p r, secondary and	erial earticle character d minor compone	istics, ents.	moisture condition	consistency/ density index	100 pocket 200 pocket	a		structure and onal observations
ICAD			СМ			_50	-		SP	TOPSOIL: S brown, with and rootlets	traces of high p	barse grained, da blasticity clay, org	ark ganics	М	L			TOPSOIL/F	RESIDUAL SOIL
							-		SP	SAND: fine	to coarse grain	ied, orange/brow			D			EXTREME SANDSTO	LY WEATHERED NE
						_49	<u>1</u> –			Borehole BH	H4 continued as	s cored hole							
							- - 2												
						_48	-												
						_47	<u>3</u> 												
						_46	4 												
						_45	5 - -												
						_44	6												
						_43	7												
							8									$\left \left \right \right $			
AS AD RR V CT HA DT 3 V	shov		au ro va ca ha di bl bl V T(y su	iger o ller/tr ashbo ible to and a atube ank b bit C bit	ool uger	M C pe 1 W wa wa	pport mud casing netratio 2 3 4 1 1 1 tter 10/1/9	on no resista ranging to refusal 8 water 8 water e showr inflow	level	U _{e3} un D dis N sta N* SF Nc SF V va P prr Bs bu E en	ples, tests ndisturbed sample ndisturbed sample isturbed sample tandard penetratio PT - sample recov PT with solid cone ane shear (kPa) ressuremeter ulk sample nvironmental samp fusal	e 63mm diameter n test (SPT) vered	W w Wp pl	cription n unified e y oist	classifica			consister VS F St VSt H Fb VL L MD D VD	ncy/density index very soft soft firm stiff very stiff hard friable very loose loose medium dense dense very dense

Borehole No.

Project No:

Date started:

Logged by:

Date completed:

Sheet

BH4

1 of 7

ALB

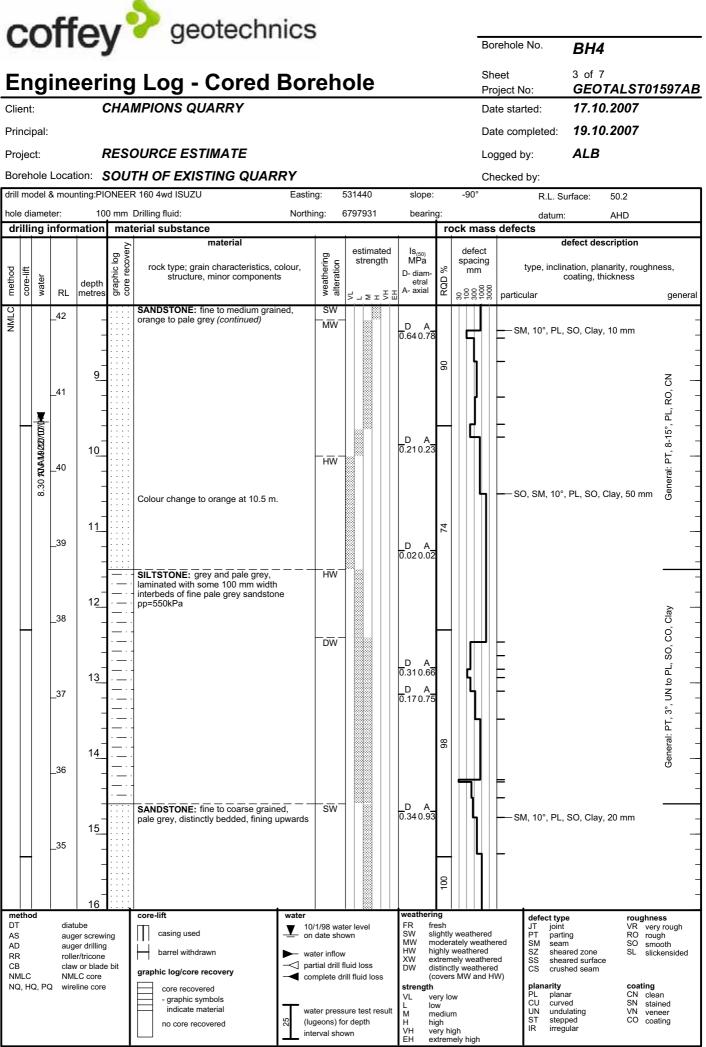
17.10.2007

19.10.2007

GEOTALST01597AB

C		n	ff			geotechr	nics	3					_			
•				·.	y	5							В	orehole No.	BH4	
E	n	g	ine	eri	ing	J Log - Cored	Bor	reh	ole					heet roject No:	2 of 7 GEOTAI	_ST01597AB
Cli	ent	::		(СНА	MPIONS QUARRY							D	ate started:	17.10.20	07
Pri	nci	pal:											D	ate completed:	19.10.20	07
Pro	ojeo	ct:		F	RES	OURCE ESTIMATE							L	ogged by:	ALB	
						TH OF EXISTING QUAR	RY						С	hecked by:		
				0		R 160 4wd ISUZU	Eastir	5	531440		slope:		-90°		Surface: 50.	
		iame ng i		nation		Drilling fluid: terial substance	North	ing:	6797931		bearin	ĭ –	ock mas	datun s defects	n: AH	D
					g Very	material		0	estima		Is ₍₅₀₎ MPa		defect		defect descrip	tion
poq	-lift	2			graphic log core recovery	rock type; grain characteristics, o structure, minor component		weathering alteration	stren	gth	D- diam-	% C	spacing mm	type, incl	ination, planarity coating, thickne	r, roughness, ess
method	core-lift	water	RL	depth metres	grap core			wea altei	נצרל	⊔ H H	etral A- axial	RQD	30 300 1000	particular	0,	general
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				-												-
о V	\vdash		_49	1		Continued from non-cored bore SANDSTONE: fine to medium grai		XW								
NMLC			_43	-		orange to pale grey		HW								-
															, SO Clay, 30 m	- m
				2											, , ,	-
			_48	-		Becoming pale grey from 2.0m		MW			DA	52			SO, Clay, 90 mr	
				-		pp=400kPa					D A 0.150.13	Ĵ			ee, eaj, ee	
													ļ		, SO, Clay, 15 m	ım —
			_47	3												
				_												-
	┢	V		-										-		_
		07		4							D A 0.590.74					
		1 18/10/	_46	-		Fine to coarse grained from 4.1 m.							ļ		SO, Clay, 40 mi	n –
		30 AM		-												-
		80		5				-sw		8			ł	-		General: PT, 8-15°, PL, RO, CN
			_45	_							D A	97		_		- L, R(
											2.9 2.52					-15°, F
				_										-		- РТ, 8 -
			_44	6												heral:
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				-										_		-
				7_							D A 1.892.75		٦L	F		-
			_43									90	1			-
				-								0,	ΙL	-		-
																-
me DT	etho	l od	 dist	ube		core-lift	water	1	or lovel	3	weatherin FR fre	ng esh		defect ty JT joir		roughness
AS AD			aug	ube er screwi er drilling		Casing used	📥 on	/1/98 wat date sho	wn		SW sli MW m	ightly oder	weathere ately weat	d PT par nered SM sea	ting am	VR very rough RO rough SO smooth
RF CB	2		rolle	er/tricone v or blade		barrel withdrawn	-	ater inflow artial drill f			XW ex DW di	xtrem stinc	weathered lely weathe tly weathe	ered SS she ed CS cru	eared zone eared surface shed seam	SL slickensided
	1LC 2, H	Q, PC		LC core eline core		graphic log/core recovery core recovered	- - co	mplete d	ill fluid los	SS	(c strength	over	s MW and	HW) planarity	,	coating
						- graphic symbols indicate material	T wa	ater press	ure test r	esult	L lo	ery lo w iediui		UN und	ved dulating	CN clean SN stained VN veneer
						no core recovered		igeons) fo terval sho			H hi VH ve	igh ery hi			pped gular	CO coating

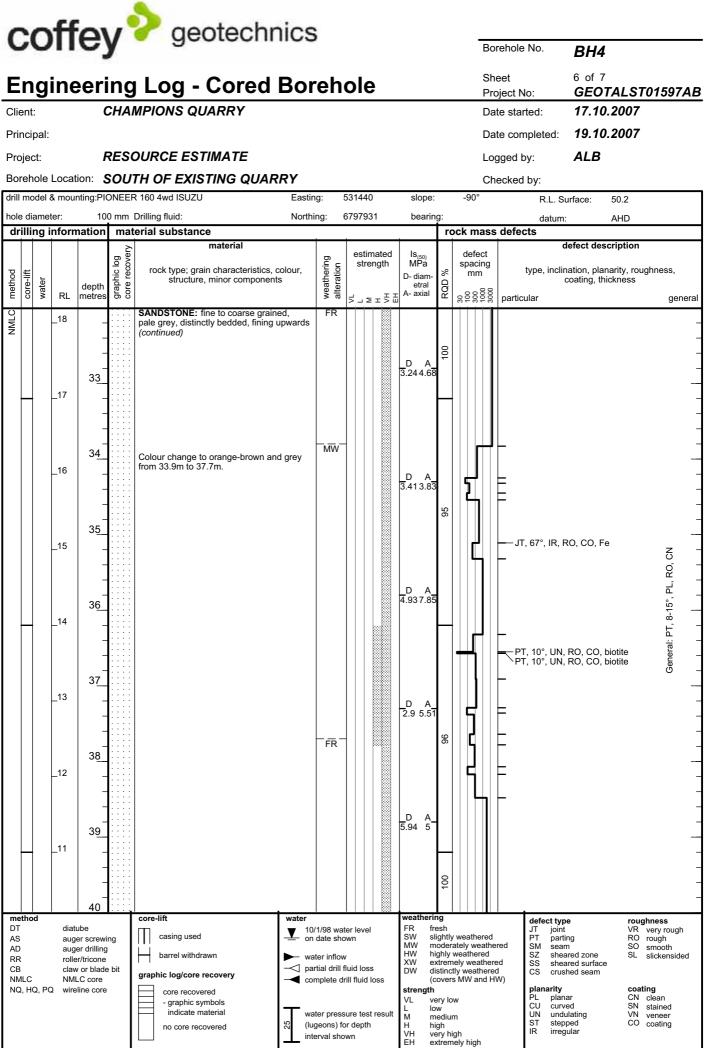
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1 GEO 5.5 Issue 3 Rev.

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•			-	Υ.	y	U						Bo	rehole No.	BH4	
Ε	in	g	ine	eri	ing	J Log - Core	d Bor	eh	ole				eet oject No:	4 of 7 GEOT	ALST01597AB
	ient					MPIONS QUARRY							ite started:	17.10.2	
Pr	inci	pal:										Da	ite completed:	19.10.2	2007
Pr	oje	ct:		I	RES	OURCE ESTIMATE						Lo	gged by:	ALB	
						TH OF EXISTING QU	IARRY					Ch	ecked by:		
		odel a		•		R 160 4wd ISUZU	Eastir Northi	0	531440 6797931	slope:		-90°			50.2
				nation		Drilling fluid: terial substance	North			bearin	Ĕ	ck mass	datun defects	n: <i>F</i>	AHD
					og overy	material		bu	estimated strength	ls ₍₅₀₎ MPa		defect spacing		defect descr	iption
method	core-lift	water		depth	graphic log core recovery	rock type; grain characteris structure, minor comp		weathering alteration	ouongui	D- diam- etral	RQD %	ʻmm ັ		ination, plana coating, thicl	rity, roughness, kness
	8	8N N	RL	metres	in S	SANDSTONE: fine to coarse	grained	af ≪ W2	Z⊐zı¥	A- axial	Ř	300000000000000000000000000000000000000	particular		general
NMLC			_34	-		pale grey, distinctly bedded, fi (continued)		300		D A 0.9 0.99			-		-
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				17_											-
			_33								100	┎╝		ndy clay 3mm	, –
				-											-
				18						D A 3.244.36					-
			_32	_											-
				-											-
				-											-
			31	19											_
				-						D A 3.754.66					ý -
				-							100				5°, PL, RO, CN
			30	20											
			_30	-									-		&
				-									——————————————————————————————————————	RO, Sand an	d Clay La
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			_29	-											-
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				22						D A 3.91 5.54					-
			_28	-						D A					-
										3.91 2.75	100				-
				23											-
			_27	-											-
				-											_
				24						D A					-
m D	etho T	d	ı diat	Ube	<u> </u>	core-lift	water	 /1/98 wat	er level	weatherin FR fre	ng esh		l defect ty JT joir		roughness VR very rough
AS AI	S D		aug aug	jer screw jer drilling	,	│	– on	date sho	own	SW sli MW m	ightly odera	weathered ately weathered weathered	PT par ered SM sea	ting	RO rough SO smooth SL slickensided
RI CI NI			clav	er/tricone v or blade LC core		graphic log/core recovery	-⊲ pa	ater inflow rtial drill f	luid loss	XW ex DW di	drem stinct	ely weather ly weathere MW and H	ed SS she d CS cru	ared surface shed seam	Slickensided
		Q, PC		LC core eline core		core recovered - graphic symbols		mpiere di	ill fluid loss	strength	ery lov		PL pla	nar	coating CN clean
						indicate material		ater press geons) fo	ure test result or depth	L lo M m			UN und ST ste	ved dulating pped	SN stained VN veneer CO coating
L								erval sho	•	VH ve	ery hig	gh ely high		gular	5

(2	n	ff	e	v	geotechr	nics	5				_				
													orehole No	Ы		
E	n	g	ine	eeri	ing	Log - Cored	Bor	eh	ole				neet roject No:	5 of GE	7 OTALST01	597AB
Cli						MPIONS QUARRY						Da	ate started		10.2007	
Pri	nci	pal:										Da	ate comple	eted: 19. 3	10.2007	
Pro	ojeo	ct:		ŀ	RES	OURCE ESTIMATE						Lo	ogged by:	ALE	3	
						TH OF EXISTING QUAR							necked by:	:		
		odel ame		0		R 160 4wd ISUZU Drilling fluid:	Eastir Northi	0	531440 6797931	slope bearir		-90°		R.L. Surface:	50.2	
				nation		terial substance	North	ing.		beam	ĭ	ck mas	s defects	datum:	AHD	
					og overy	material		۔ ور	estimated strength	Is ₍₅₀₎ MPa		defect spacing		defect d	lescription	
method	core-lift	water		depth	graphic log core recovery	rock type; grain characteristics, structure, minor component		weathering alteration	Strongth	D- diam- etral	RQD %	ʻmm ັ			lanarity, roughne thickness	SS,
	ō	wa	RL	metres	gra coi				, z i ≩ I			3000 300	particular			general
NMLC	\vdash		_26	-		SANDSTONE: fine to coarse grain pale grey, distinctly bedded, fining (continued)		SW			100					-
				-												_
				25												-
			_25	_						D A						_
				-						3.244.6						_
				26							98		—— SM, 7°	°, IR, RO, Clay	vey Sand, 40 mm	-
			_24	- 20												
				-												-
				-				FR		D A	-		-			-
			23	27						2.9 3.4	°					
			_20	-									-			C CN
				-												5°, PL, RO, CN I I I I
				28_												<u> </u>
			_22	-		Fine to medium grained from 28.05	m.			D A	9					General: PT, 8.
				-							100					eneral:
				29												- ق
			_21	-												-
				-												_
				30						D A 3.413.8	7					-
			_20	-												_
																-
				-												-
			_19	31							100					
				-						D A 3.244.9	1					_
				-												_
	etho	d		32	<u> :::</u> 	core-lift	water			weather	-		 def	fect type	roughnes	s
D1 AS AE	6			er screwi		casing used		/1/98 wat date sho		SW s	resh lightly nodera	weathered	JT PT	joint parting	VR very RO rough SO smoo	rough า
RF CE	२		rolle	er drilling er/tricone v or blade		barrel withdrawn	-	ater inflow rtial drill f		HW h XW e	ighly xtrem	weathered ely weathe ly weathere	red SZ	sheared zon sheared surf	e SL slicke ace	ensided
N	ИLС	Q, PC	NM	LC core line core		graphic log/core recovery core recovered			rill fluid loss	(strength	covers I	MW and H	HW) pla	inarity	coating	
						- graphic symbols indicate material			ure test result	L le	ery lo ow nediur		PL CU UN	curved undulating	CN clean SN stain VN vene	ed er
						no core recovered		geons) fo erval sho		H h VH v	igh ery hi		ST IR	stepped irregular	CO coati	ng



GEO 5.5 Issue 3 Rev.

r			ff			geote	chnics	5											
C		U		6	y	90010	0111100						E	orehole	e No.	BH4			
Ε	n	g	ine	eri	ing	Log - Co	red Bor	eh	ol	е				heet roject N	No:	7 of 7 GEO1	TALSTO	1597/	<i>۹В</i>
Clie						MPIONS QUARR								ate sta		17.10			_
Pri	nci	pal:											0	ate cor	npleted:	19.10	.2007		
Pro	ojec	ct:		F	RESO	OURCE ESTIMAT	Έ						L	ogged	by:	ALB			
Bo	reh	ole	Locat	tion: S	SOU	TH OF EXISTING	QUARRY						C	hecked	l by:				
drill	mc	del	& mou	nting:Pl	ONEEF	R 160 4wd ISUZU	Eastir	ng:	53144	10	slope:		-90°		R.L. Sı	urface:	50.2		
		ame na i		10 nation		Drilling fluid: erial substance	North	ing:	67979	931	bearir	ĭ –	ock mas	s defe	datum:		AHD		_
u.						materia	al		est	imated	Is ₍₅₀₎		defect	- I		lefect des	cription		
method	core-lift	water	RL	depth metres	graphic log core recovery	rock type; grain charac structure, minor c		weathering alteration	sti	rength ≥ ± →	MPa D- diam- etral	RQD %	spacing mm	3	(ation, plan coating, thi	iarity, roughi ckness	ness, gene	eral
NMLC			_10			SANDSTONE: fine to compale grey, distinctly bedde		FR		21>1			0 - 0 -					gond	101
NN			_	-		(continued)	eu, ining upwarus				D A 3.915.27	7						S	
				-									ļ					General: PT, 8-15°, PL, RO, CN	-
				41	· · · · ·													5°, PL	_
			_9	-								100		L				Г, 8-1	-
				-														ral: P	_
				42	· · · · ·						D A 4.596.19	9	L C					Gene	-
			_8		· · · · ·														_
				_		BH4 terminated at 42.3 d required investigation.													_
				-		BH4 terminated at 42.3m													_
			7	4 <u>3</u>															
			Γ	_															
				-															-
				44_															_
			_6	-															-
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				45															-
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			4	46															_
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				-															-
				47															_
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				48	L.		•								•				-
me DT		d		ube		core-lift		/1/98 wat		el		esh	weather	d	defect typ JT joint		roughn VR vei	ry rough	
AS AD RR			aug	jer screwi jer drilling er/tricone	Ĩ	barrel withdrawn		date sho			MW m HW h	noder ighly	weathere ately weat weathered	hered I		n ired zone	SO sm SL slid	ugh Iooth ckenside	t I
СВ			clav	w or blade		graphic log/core recovery	pa	rtial drill f mplete d	fluid lo		DW d	istinc	ely weath tly weathe s MW and	red		red surface hed seam			
NG), H0	Q, P(eline core		core recovered - graphic symbols					strength VL v	ery lo			planarity PL plana CU curve		coating CN cle SN sta		
						indicate material		ater press igeons) fo			M m H h	ow nediur igh	m		UN undu ST step	ılating ped	VN vei CO co	neer	
								erval sho			VH v	ery hi	gh iely high		IR irreg	ular			

CORED BOREHOLE GEOTCOFH01597AB.GPJ COFFEY.GDT 22.1.08

coffey	geotechnics
,	

Engineering Log - Borehole

Client:

Principal: Project:

RESOURCE ESTIMATE

CHAMPIONS QUARRY

Borehole Location: WESTERN EXTENT OF PROPOSED QUARRY

	Sheet Project No:	1 of 7 GEOTALST01597AB
	Date started:	22.10.2007
	Date completed:	22.10.2007
	Logged by:	ALB
QUARRY	Checked by:	

Borehole No.

BH5

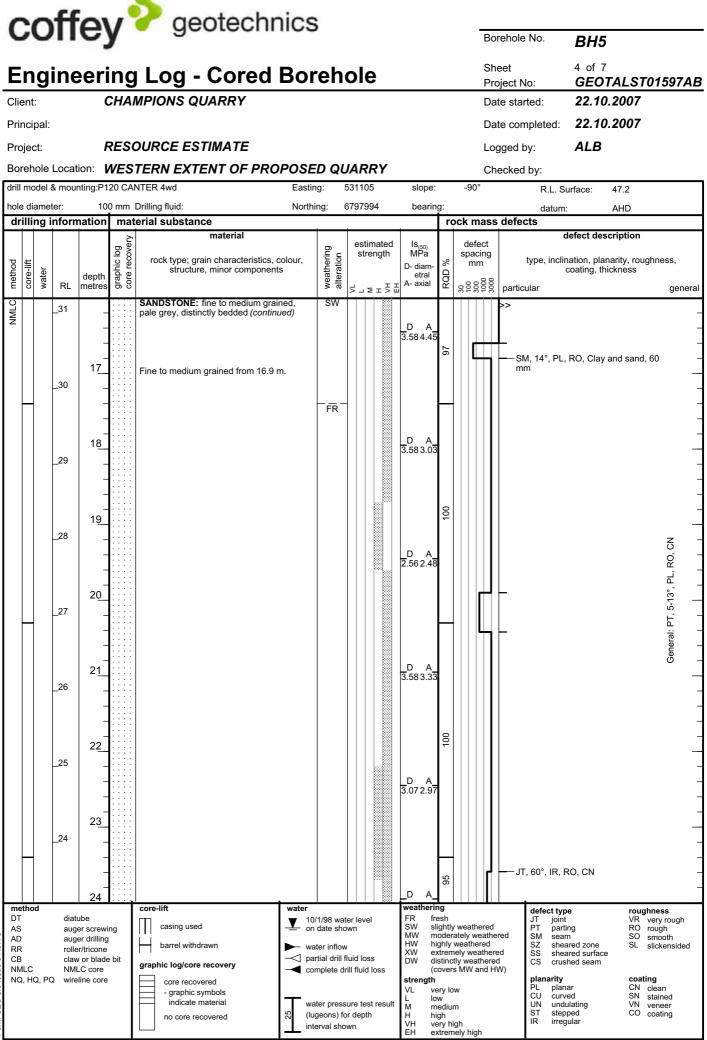
drill	m	odel	and	d me	oun	ting: F	P120	CANTE	R 4wd		Easting:	531105	slope:	-90°			-	R.L.	. Surface: 47.2
hole	e di	ame	eter:				100 m	m			Northing	6797994	bearing	j :				datu	um: AHD
dr	-	-	inf	orn	nat	tion			mate	erial s	ubstance								
method		benetration benetration	support	water		notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	soil type colour	mater e: plasticity or pa , secondary and		istics, ents.	moisture condition	consistency/ density index	100 A pocket	a	structure and additional observations
TCAD							_47	-		SP	orange/brow	to medium grain vn, traces of fine n plasticity clay	ed, red/brown to coarse graine	o ed gravel	М	L			RESDIUAL SOIL
			с		_	SPT 10,25 N*=R	_46	<u>1</u> _		SC	Clayey SAN	otlets to 0.9 m. ND: fine to mediu vn, clay is mediu	 ım grained, m plasticity			D			EXTREMELY WEATHERED
							_45	2			Borehole BH	H5 continued as o	cored hole						
							_44	3											
							_43												
							_42	5											
							_41	6											
							_40	7											
met AS AD RR W CT HA DT B V T *bit e.g.	sho	d own t	a ro c h d b V T sy su	uge oller able and iatu lank bit C b	er dri /trice bore too l aug be k bit it	e bl ger	M C pe 1 H Wa Wa	ter 10/1/9	on no resista ranging to refusal 8 water e showr inflow	level	U ₆₃ un D dis N str N* SF Nc SF V va P pr Bs bu E en	ples, tests disturbed sample 6 sturbed sample 6 sturbed sample andard penetration PT - sample recove PT with solid cone ane shear (kPa) essuremeter ulk sample vironmental sampl fusal	63mm diameter test (SPT) – ered	W we Wp pla	cription n unified of e y poist	classifica			consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense

0	-	n	ff			geote	chnics	3										
			-	<u> </u>	y	0								Bor	ehole No.	BH5	5	
E	n	g	ine	eri	ng	J Log - Cor	ed Boi	reh	ole					She Proj	et ect No:	2 of 7 GEO		1597AB
Cli						MPIONS QUARRY									e started:		0.2007	
Pri	nci	pal:												Date	e complete	ed: 22.10	0.2007	
Pro	ojeo	ct:		F	RES	OURCE ESTIMATI	E							Log	ged by:	ALB		
Во	reh	ole	Locat	tion:	VES	TERN EXTENT OI	= PROPOSE	D QL	JARR	Y				Che	cked by:			
						NTER 4wd	Easti	Ũ	531105		slope:		-90°)	R.	L. Surface:	47.2	
		ame ng i		10 nation		Drilling fluid: terial substance	North	ing:	6797994		bearin	ĭ	ock m	ass	da defects	atum:	AHD	
					g /ery	materia		0	estima		Is(50)		defe			defect de	scription	
method	core-lift	water	RL	depth metres	graphic log core recovery	rock type; grain charact structure, minor co		weathering alteration	strenç		MPá D- diam- etral A- axial	RQD %	spac mn	n		inclination, pla coating, tl		
-		_	47	metres	0, 0			2.0	zıΣı	: 5 ā		-	858	₽ 8 ₽ 8	particular			general
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				1														_
U			_46	-		Continued from non-co SANDSTONE: fine to meet		XW					┓┥┥┥┥					
NMLC				_	· · · · ·	orange/brown, remoulds to plasticity clayey sand, indi	o medium				DA 0.020.02							_
				2	· · · · · · · · · ·							0						-
			_45	-	· · · · · · · · · ·													-
				_	· · · · ·	SANDSTONE: fine to med	dium grained,	HW-										-
				3	· · · · · · · · · ·	orange and pale grey, dist	inctly bedded				_D A_	60						-
			_44	_							0.090.07	,	╙┶┧		=			
				-	· · · · ·								Ц		=			_
				_	· · · · ·													_
			_43	4	· · · · ·										━ JT, 39°,	IR, RO, CO, C	Clay	
				_	· · · · ·						D A	45	┟╎		-			_
		⊻		-	· · · · ·						0.010.01		H		=			- CN
		10/07	42	5_									.					, RO,
		M 23/		-	· · · · ·										_			3°, PL
		3 0 F		-	· · · · ·							84						Т, 5-1 -
		AM 23/10/07		6	· · · · ·						DA 0.090.15	5				, PL, SO, Clay		General: PT, 5-13°, PL, RO, CN
		M 23/*	_41	_									.]		–— SM, 10°,	, PL, SO, Clay	r, 50 mm	Gen
		8 AI		_	· · · · ·								4	-	-			-
				7_	· · · · ·								Ľ		-			
			_40	_	· · · · ·							100						_
				-	· · · · · · · · · ·						D A 0.140.13	3		1	-			-
				8	· · · · ·													-
DT		d		ube		core-lift)/1/98 wat		1 1		esh			JT	joint		ery rough
AS AD RF			aug	er screwi er drilling		barrel withdrawn	- or	i date sho ater inflow	wn		MW m HW h	noder ighly	weather ately we weather	eathere red	SZ	parting seam sheared zone	RO ro SO si SL si	ough mooth lickensided
CE			clav	er/tricone v or blade LC core	e bit	graphic log/core recovery	→ pa	rtial drill f		s	XW e DW d	xtrem	iely wea tly weat s MW a	athered hered	I SS CS	sheared surfac crushed seam		
		Q, PC		eline core		core recovered - graphic symbols				-	strength VL v	ery lo			PL CU	a rity planar curved		lean
						indicate material		ater press Igeons) fo	ure test re or depth	esult	M m H h	ow nediur igh			UN ST	undulating stepped	VN v	tained eneer oating
								erval sho	•		VH v	ery hi	gh Iely high	ı	IR	irregular		

CORED BOREHOLE GEOTCOFH01597AB.GPJ COFFEY.GDT 22.1.08

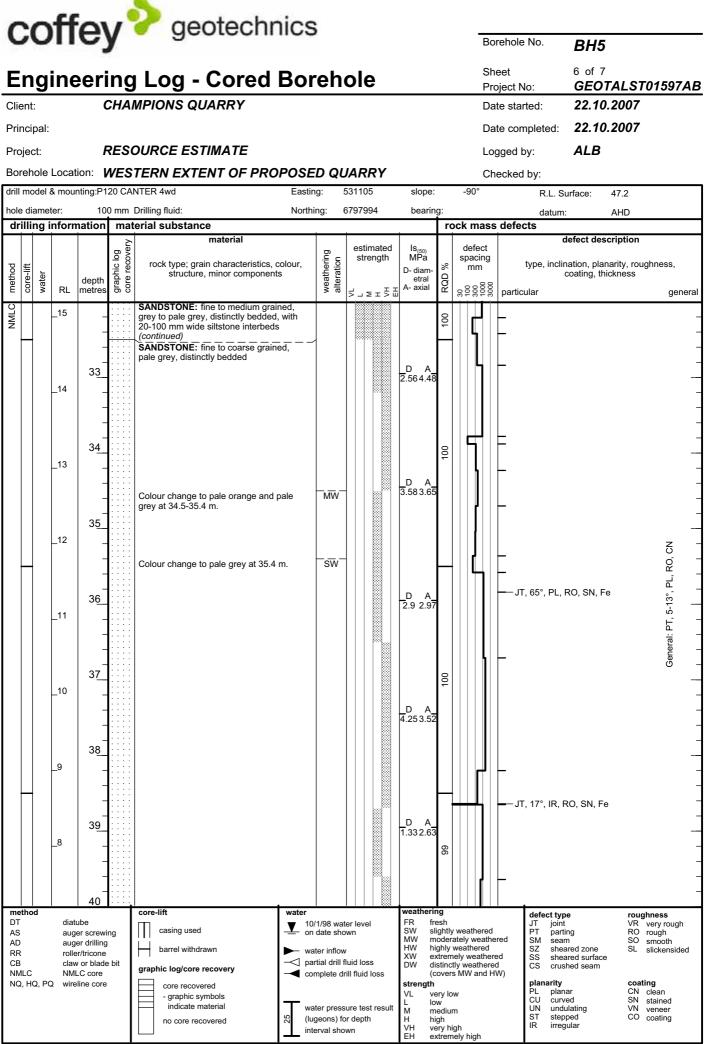
Section With Section	(ff			aeotechi	nics	;				_			
Engineering Log - Corect Borenole Prior Mon GEOTALSTOTSTABE Clent: CHAMPIONS QUARY Date stated: 22.10.2007 Priopat: RESOURCE ESTIMATE Loggod by: ALB Borehole Location: WESTERN EXTENT OF PROPOSED QUARY Checked by: Checked by: Immode Anomany P20 Contrel And State	•				Ч.	y	5						В	orehole No.	BH5	
	E	n	g	ine	eeri	ing	J Log - Cored	Bor	eh	ole						ST01597AB
	Cli	ent	:		(CHA	MPIONS QUARRY						D	ate started:	22.10.200	7
Barbala Location: WESTERNEXTEND OPROPOSED QUARK Description: util maint A munifier 2020. NUTR Awit Example Status off IL Sunce: 47.2 and mainted A munifier 2020. NUTR Awit Example Off IL Sunce: 47.2 and mainted To moliting information material substance Tork away Off IL Sunce: 47.2 and mainted Information material substance Tork away Off detect detects advance Awd and mainted Information material substance model type: grain characteristic, color. Image detects grain gr	Pr	inci	pal:										D	ate completed:	22.10.200	7
dott model & mounting P102 CANTER 4wd Easting: 531105 stope: 90' FLL Suttice: 47.2 hold dameer: 100 milling fuld: Nothing: F17294 beering: data: A4D diffiling information material Material <td< td=""><td>Pr</td><td>oje</td><td>ct:</td><td></td><td>ŀ</td><td>RES</td><td>OURCE ESTIMATE</td><td></td><td></td><td></td><td></td><td></td><td>L</td><td>ogged by:</td><td>ALB</td><td></td></td<>	Pr	oje	ct:		ŀ	RES	OURCE ESTIMATE						L	ogged by:	ALB	
Index dameter 100 mm Delling fluid Northing 107111 deating datum And drilling information material substance material substance for A type: (rain and matchenities, colour, substance) get substance of advects defect description get substance g	Bo	reh	ole	Locat	tion:	NES	TERN EXTENT OF PRO	OPOSE	D QL	JARRY			С	hecked by:		
drilling information rack mass defects addition of the constraints o	I 1				•				5				-90°	R.L. S	urface: 47.2	
1 30 10								North	ing:	6797994	bearin	ř.	ck mas		: AHD	
9										estimated	Is(50)				defect descriptio	n
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38 -37 -37 -58M, 5', PL, SO, Clay, 5 mm 37 -58M, 5', PL, SO, Clay, 5 mm 37 -58M, 5', PL, SO, Clay, 5 mm 38 -58M, 5', PL, SO, Clay, 5 mm 11 -58M, 5', UN, SO, Coal, 4 mm 36 -58M, 5', UN, SO, Coal, 4 mm 12 -58M, 5', UN, SO, Coal, 4 mm 36 -58M, 5', UN, SO, Coal, 4 mm 12 -50 mm pythe vein at 12.15 m. 13 -50 mm pythe vein at 12.15 m. 13 -50 mm pythe vein at 12.15 m. 14 -50M, 10', PL, SO, Clay, 80 mm 14 -50M, 10', PL, SO, Clay, 80 mm 14 -50 mm pythe vein at 12.15 m. 150 mm wide sillstone bed at 12.7 m. 16 -50M, 10', PL, SO, Clay, 80 mm 2.9 2.9 2.91 14 37 15 16 17 18 19 19 10 10 10 11 12 13 14 15 16 17 18 18 19 19 10 10 10					9	· · · · ·					_D A_				RO, Coal, 3 mm	-
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no core recovered $\[match{N}\]$ (lugeons) for depth H high $\[match{S}\]$ stepped CO coating		.,			2 30.0		- graphic symbols		iter nress	ure test result	VL v	ery lo w		PL plan CU curv	iar C red S	N clean N stained
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GEO 5.5 Issue 3 Rev.

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Ri Ci	З		rolle	er/tricone v or blade		barrel withdrawn graphic log/core recovery	- par		fluid loss	XW ex DW di	xtren istinc	ely weather	ered red	SS shea	red zone red surface ied seam	SL slickensided
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Engineering Log - Borehole

Client:

Principal: Project:

RESOURCE ESTIMATE

CHAMPIONS QUARRY

Borehole Location: SOUTHERN EXTENT OF PROPOSED QUARRY

	drill	mo	del	and	mou	inting:	JACR	O 6WD			Easting:	531450	slope:	-90°				R.	.L. Surface: 29.2	
	hole	e dia	ame	ter:			100 m	m			Northing	6797729	bearing	g:				da	atum: AHD	
	dr	-	<u> </u>	info	orma	ation			mate	erial s	ubstance									
	method		c penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	soil type colour,	e: plasticity or r	erial particle character d minor compone	istics, ents.	moisture condition	consistency/ density index	k	300 B penetro-		
	TCAD		ĪŤ	СМ			_29		3113	SP			nedium grained. g anics and rootlet		М	L			TOPSOIL, COLLUVIAL	
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1 of 4 GEOTALST01597AB Project No: 22.10.2007 Date started: 22.10.2007 Date completed: ALB Logged by:

BH6

Checked by:

Borehole No.

Sheet

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RR CB			rolle	er/tricone w or blade		barrel withdrawn	-	vater inflow partial drill f		ss	XW ex	xtrem	weather nely weat tly weat	there	d SZ she	eared zone eared surface ished seam	SL slickensided	
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						- graphic symbols indicate material		vater press	sure ter	st result	L lo	ery lo w nediur			CU cur	inar rved dulating	CN clean SN stained VN veneer	
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N	Q, H	Q, P(Q wire	eline core		core recovered - graphic symbols indicate material no core recovered	ul) 52	ater press geons) fo erval sho		ult L lo M m H h VH v	ery lo ow nediur igh ery hi	m	planarity PL plan CU curv UN undu ST step IR irreg	ed ulating ped	coating CN clean SN stained VN veneer CO coating

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Pri	nci	pal:										Da	ate comple	eted: 22.	10.2007
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				inting:JA			Eastir	0	531450	slope:		-90°		R.L. Surface:	
		iamet ng i		10 nation		Drilling fluid: terial substance	North	ing:	6797729	bearin	ř.	ock mass	s defects	datum:	AHD
					e /er	material		5	estimated	Is ₍₅₀₎ MPa		defect		defect	description
po	Ë	5			graphic log core recovery	rock type; grain characterist structure, minor compo	ics, colour, ments	weathering alteration	strength	D- diam-	% (spacing mm	typ		planarity, roughness, g, thickness
method	core-lift	water	RL	depth metres	grap core			wea	- - - - - - - - - - - - - - - - - - -	etral A- axial	RQD	30 300 3000 3000	particula		gener
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				_		and 19.8 m.	, at 10.0 m					E	=		Gen
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NC	ς, Η	Q, PC	Q wire	eline core		core recovered - graphic symbols				Strength VL ve L lo	ery lo	w	pl PL CU		coating CN clean SN stained
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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 µm to 2.36 mm
	medium	200 µm to 600 µm
	fine	75 µm to 200 µm

MOISTURE CONDITION

- Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
- **Moist** Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
- Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH S _U (kPa)	FIELD GUIDE			
Very Soft	<12	A finger can be pushed well into the soil with little effort.			
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.			
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.			
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.			
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.			
Hard	>200	The surface of the soil can be marked only with the thumbnail.			
Friable	_	Crumbles or powders when scraped by thumbnail.			

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)			
Very loose	Less than 15			
Loose	15 - 35			
Medium Dense	35 - 65			
Dense	65 - 85			
Very Dense	Greater than 85			

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:		
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%		
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%		

SOIL STRUCTURE

	ZONING	CEMENTING					
Layers	Continuous across exposure or sample.	Weakly cemented	Easily broken up by hand in air or water.				
Lenses	Discontinuous layers of lenticular shape.	Moderately cemented	Effort is required to break up the soil by hand in air or water.				
Pockets	Irregular inclusions of different material.						

GEOLOGICAI WEATHERED Extremely weathered material	- ORIGIN IN PLACE SOILS Structure and fabric of parent rock visible.
Residual soil	Structure and fabric of parent rock not visible.
TRANSPORTE	
Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity).
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.
Marine soil	Deposited in ocean basins, bays, beaches and estuaries.

coffey **>**

Soil Description Explanation Sheet (2 of 2)

								-								
(Exclue	ding				ON PROCEDURE and basing fractions		USC	PRIMARY NAME								
si mm is		arse 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL								
		ELS If of co than 2	CLE GRANE (Lit	Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL								
SOILS than 60	eye)	GRAVELS More than half of coarse ction is larger than 2.0 m	/ELS FINES ciable unt nes)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL								
COARSE GRAIINED SOILS 0% of materials less than 6 larger than 0.075 mm	e naked	GRAVELS More than half of coarse fraction is larger than 2.0 mm	GRAVELS WITH FINES (Appreciable amount of fines)		c fines (for identificat L below)	tion procedures	GC	CLAYEY GRAVEL								
ARSE GF of mater ger than	ble to th	arse 2.0 mm	S) ss) ss)	Wide amou	range in grain sizes a ints of all intermediat	and substantial e sizes missing	SW	SAND								
cO/ In 50% lan	icle visi	DS If of coa	CLEAN SANDS (Little or no fines)	Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND								
COARSE GRAIINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm lest particle visible to the naked eye)	(A 0.075 mm particle is about the smallest particle visible to the naked eye)	SANDS More than half of coarse fraction is smaller than 2.0 mm	SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND								
	the sma	Mor€ fraction	SA WITH (Appre am of f		c fines (for identificat L below).	tion procedures	SC	CLAYEY SAND								
	ont		IDENTIFICAT	ION PI	ROCEDURES ON FR	ACTIONS <0.2 mm.										
nan Tan	s ab	()	DRY STREN	GTH	DILATANCY	TOUGHNESS										
JILS less th 775 mr	rticle i	CLAYS limit tin 50	None to Low	,	Quick to slow	None	ML	SILT								
FINE GRAINED SOILS in 50% of material less is smaller than 0.075 i	nm pa	TS & (_iquid ess tha	SILTS & CLAYS Liquid limit less than 50	TS & (_iquid ess the	LTS & Liquid ess the	LTS & Liquid ess the	LTS & Liquid ess the	LTS & Liquid ess the	LTS & Liquid ess the	LTS & Liquid ess tha	Medium to H	ligh	None	Medium	CL	CLAY
GRAIN 6 of m aller th	.075 r	IIS IIS	Low to medi	um	Slow to very slow	Low	OL	ORGANIC SILT								
FINE (an 50% is sm	(A 0	LAYS mit an 50	Low to medi	um	Slow to very slow	Low to medium	MH	SILT								
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm		SILTS & CLAYS Liquid limit greater than 50	High None		None	High	СН	CLAY								
Wc 8	Medium to High None Low to			Low to medium	OH	ORGANIC CLAY										
HIGHLY SOILS	/ OF	RGANIC	Readily ident frequently by		y colour, odour, spon s texture.	gy feel and	Pt	PEAT								
• Low pl	lastic	city – Liqu	uid Limit WL les	s than	35%. • Modium plast	icity – W _L between 35%	6 and 50%.									

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM	TERM	DEFINITION	DIAGRAM	
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.		SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	MINTER COMM	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.		TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter		
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.		TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.		
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.		INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.		



Rock Description Explanation Sheet (1 of 2)

The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993. DEFINITIONS: Rock substance, defect and mass are defined as follows: Rock Substance In engineering terms roch substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic. Defect Discontinuity or break in the continuity of a substance or substances. Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or Mass more substances with one or more defects. SUBSTANCE DESCRIPTIVE TERMS: **ROCK SUBSTANCE STRENGTH TERMS ROCK NAME** Simple rock names are used rather than precise Abbrev- Point Load Field Guide Term Index, I_S50 (MPa) geological classification. iation PARTICLE SIZE Grain size terms for sandstone are: Coarse grained Mainly 0.6mm to 2mm Mainly 0.2mm to 0.6mm Very Low VL Less than 0.1 Material crumbles under firm Medium grained blows with sharp end of pick; Mainly 0.06mm (just visible) to 0.2mm Fine grained can be peeled with a knife: pieces up to 30mm thick can FABRIC Terms for layering of penetrative fabric (eg. bedding, be broken by finger pressure. cleavage etc.) are: Massive No layering or penetrative fabric. 0.1 to 0.3 Easily scored with a knife: Low L Indistinct Lavering or fabric just visible. Little effect on properties. indentations 1mm to 3mm show with firm bows of a Layering or fabric is easily visible. Rock breaks more Distinct pick point; has a dull sound easily parallel to layering of fabric. under hammer. Pieces of core 150mm long by 50mm CLASSIFICATION OF WEATHERING PRODUCTS diameter may be broken by Term Abbreviation Definition hand. Sharp edges of core may be friable and break RS Soil derived from the weathering of rock; the during handling. Residual Soil mass structure and substance fabric are no longer evident; there is a large change in 0.3 to 1.0 volume but the soil has not been significantly Medium Μ Readily scored with a knife; a piece of core 150mm long by transported. , 50mm diameter can be broken by hand with difficulty. xw Extremely Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or Weathered can be remoulded in water. Original rock fabric Material Hiah н 1 to 3 A piece of core 150mm long still visible. by 50mm can not be broken by hand but can be broken нw Rock strength is changed by weathering. The Highly by a pick with a single firm whole of the rock substance is discoloured, Weathered blow; rock rings under usually by iron staining or bleaching to the Rock extent that the colour of the original rock is not hammer. recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by Very High VH 3 to 10 Hand specimen breaks after leaching or may be decreased due to the more than one blow of a deposition of minerals in pores pick: rock rings under Moderately MW The whole of the rock substance is discoloured, hammer. usually by iron staining or bleaching , to the Weathered extent that the colour of the fresh rock is no Rock Extremely EH More than 10 Specimen requires many longer recognisable. blows with geological pick to High Rock substance affected by weathering to the break; rock rings under Slightly SW extent that partial staining or partial hammer Weathered discolouration of the rock substance (usually by Rock limonite) has taken place. The colour and texture of the fresh rock is recognisable: strength properties are essentially those of the Notes on Rock Substance Strength: fresh rock substance. 1. In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may Fresh Rock FR Rock substance unaffected by weathering. break readily parallel to the planar anisotropy. The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein Notes on Weathering: 1. AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of makes it clear that materials in that strength range are soils in substance weathering conditions between XW and SW. For projects where it is engineering terms. not practical to delineate between HW and MW or it is judged that there is no 3. The unconfined compressive strength for isotropic rocks (and advantage in making such a distinction. DW may be used with the definition anisotropic rocks which fall across the planar anisotropy) is typically given in AS1726. 10 to 25 times the point load index (Is50). The ratio may vary for 2. Where physical and chemical changes were caused by hot gasses and liquids different rock types. Lower strength rocks often have lower ratios associated with igneous rocks, the term "altered" may be substituted for than higher strength rocks. "weathering" to give the abbreviations XA, HA, MA, SA and DA.



Rock Description Explanation Sheet (2 of 2)

ROCK MA		Diagram	Map Symbol	Graphic Log (Note 1)	DEFECT SHAPE Planar	TERMS The defect does not vary in orientation
Term	Definition					orientation
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering		20 Beddi	. 13	Curved	The defect has a gradual change in orientation
	(eg bedding) or a planar anisotropy in the rock substance (eg, cleavage).		20 Cleava	1	Undulating	The defect has a wavy surfac
	May be open or closed.			(Note 2)	Stepped	The defect has one or mor well defined steps
loint	A surface or crack across which the rock has little or no tensile strength.	1			Irregular	The defect has many sharp changes of orientation
	but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance.		×60	(Note 2)		sment of defect shape is partly by the scale of the observatior
	May be open or closed.			(1002)	ROUGHNESS Slickensided	TERMS Grooved or striated surface usually polished
Sheared Zone Note 3)	Zone of rock substance with roughly parallel near planar, curved or				Polished	Shiny smooth surface
	undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of	A	35	11200	Smooth	Smooth to touch. Few or n surface irregularities
	the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			[*]	Rough	Many small surface irregularitie (amplitude generally less thar 1mm). Feels like fine to coars sand paper.
Sheared Surface Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.		40 47	<u> 10,000</u>	Very Rough	Many large surface irregularities (amplitude generally more than 1mm) Feels like, or coarser than ver coarse sand paper.
Crushed Seam	Seam with roughly parallel almost planar boundaries, composed of				COATING TER Clean	MS No visible coating
Note 3)	disoriented, usually angular fragments of the host rock substance which may be more	10) 10)	50	Ar	Stained	No visible coating but surfaces are discoloured
	weathered than the host rock. The seam has soil properties.		1	121	Veneer	A visible coating of soil or mineral, too thin to measure may be patchy
nfilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infiled seams less than 1mm thick may be described as veneer or coating on joint surface.		AL.	55	Coating	A visible coating up to 1mr thick. Thicker soil material i usually described using appropriate defect terms (er infilled seam). Thicker roci strength material is usually described as a vein.
Extremely	Seam of soil substance, often with		32		BLOCK SHAPE Blocky	E TERMS Approximately equidimensional
Weathered Seam	gradational boundaries. Formad by weathering of the rock substance in place.	\$575 SQ 5855	Infin	1	Tabular	Thickness much less than length or width
		Seam		[4] [4]	Columnar	Height much greate than cross section

1. Usually borehole logs show the true dip of defects and face sketches and sections the apparent dip.

2. Partings and joints are not usually shown on the graphic log unless considered significant.

3. Sheared zones, sheared surfaces and crushed seams are faults in geological terms.