APPENDIX 'A'

SITE PHOTOS









Plate 1 - Slightly elevated flat terrain at location of proposed hospital (Area 1).

Plate 2 - Looking southwards at slightly elevated flat terrain also at location of proposed hospital (Area 1).



Plate 3 - Mild sloping terrain downslope of proposed car parking area to the north east. Detention basin is proposed in this terrain in the distance.



Plate 5 - Mild sloping terrain downslope to the west of the proposed hospital.



Plate 6 - Mild sloping terrain in the far western portion of the site at the location of the proposed south western car parking area (Area 4)

APPENDIX 'B'

BOREHOLE LOGS







GEOTECHNIC

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH1

Page: 1 of 4

Job Number: GE18/144

Easting: 555510.00 Drilling Rig: Hydrapower Scout Client: Wood & Grieve Engineers Northing: 6873397.00 Driller: Redlands Drilling

Project: Geotechnical Invest - Tweed Valley Hospital RL: Logged By: L. Bexley 23.20

	Tot	al Depth:					9: 01/08/2018	Locati	on: C	udgen	Road, I	Kingscliff		
	Drilli	ng Info	rmation				Material Description					Tes	st San	nples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
Washbore 100mm Auger with T.C Bit	-	23.0	0.4 -	Residual Slopewash	V A	CH CH BAS	Silty CLAY: Stiff, high plasticity, red brown, moist. Silty CLAY: As above but very stiff and cobbles. Silty CLAY: Very stiff, medium plasticity, red brown with some orange brown mottling, moist. BASALT: Very low strength, extremely weathered,	xw	M	St VSt VSt VLS		0.1	– U50 – PP	- PP: 400kPa - 150-200kPa - 8,17,25, N=42
Nasl			1.4 -	Bedrock	VΛ	BAS	orange brown mottled dark grey. BASALT: As above but medium strength and distinctly	DW	-	MS		J		H
			3.0				1.60m: COMMENCE NMLC CORING							
Со	mm	ents:						Ι.	uthori					

										Authorised by: Date:
Water	Wea	thering	Con	sistency	Den	sity	Rock	Strength	Tests	s & Results
	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
── Water outflow	SW	Slightly		_			VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
•		weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	D D	ry M Moist	w v	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

GEOTECHNIC

Easting:

Northing:

RL:

555510.00

6873397 00

23.20

FR

Fresh

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH1

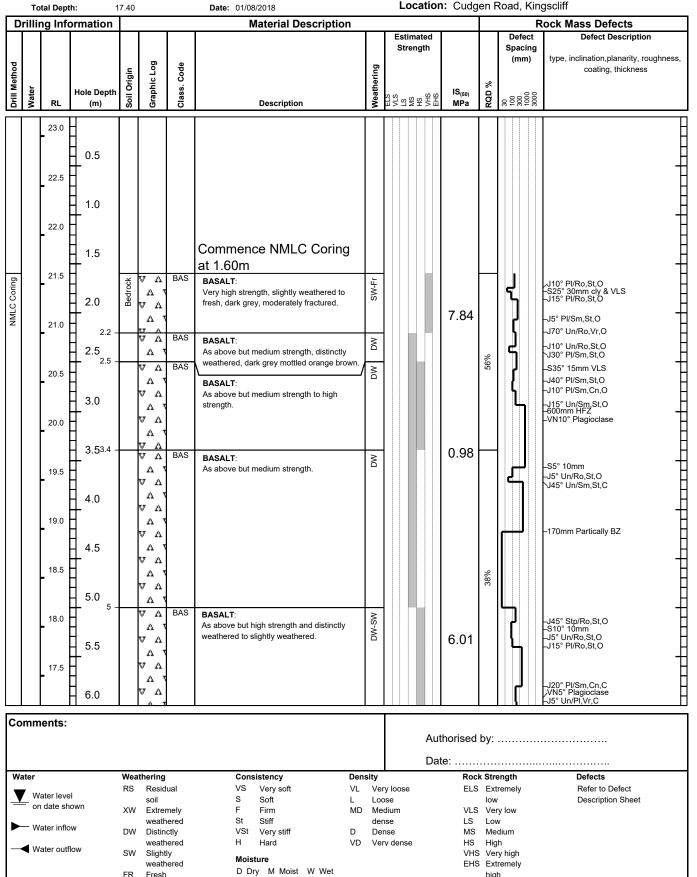
Page: 2 of 4

Job Number: GE18/144

Client: Wood & Grieve Engineers

high

Project: Geotechnical Invest - Tweed Valley Hospital



GEOTECHNIC

Easting:

Northing:

on date shown

- Water inflow

Water outflow

XW

SW

FR

Extremely

Distinctly

Slightly

Fresh

weathered

weathered

weathered

F

St Stiff

Н

VSt

Moisture

Firm

Hard

Very stiff

D Dry M Moist W Wet

MD

Medium

dense

Dense

Very dense

555510.00

6873397.00

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH1

Page: 3 of 4

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

Location: Cudgen Road, Kingscliff

VLS Very low

Low

VHS Very high

EHS Extremely

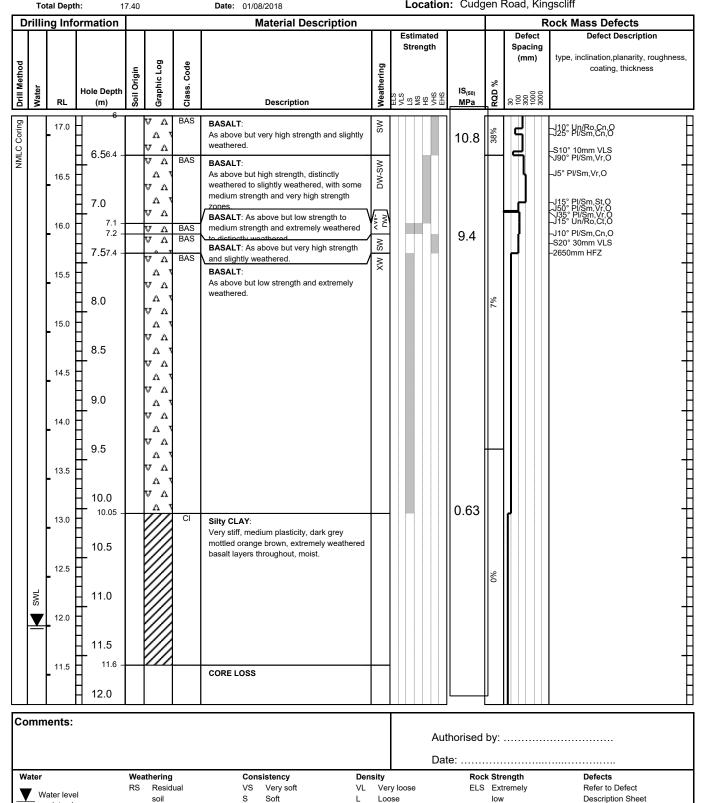
high

Medium

LS

MS

HS High



GEOTECHNIC

Easting:

Northing:

Total Depth:

RL:

555510.00

6873397.00

23.20

17.40

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Date: 01/08/2018

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH1

Page: 4 of 4

Job Number: GE18/144

Client: Wood & Grieve Engineers

EHS Extremely

high

Project: Geotechnical Invest - Tweed Valley Hospital

Location: Cudgen Road, Kingscliff

D	rilli	ng Info	ormation				Material Description								Rock Mass Defects
F	<u> </u>	J								Estimated				efect	Defect Description
Drill Method				rigin	Graphic Log	Class. Code		Weathering		Strength		%		acing mm)	type, inclination,planarity, roughness, coating, thickness
Orill M	Water	RL	Hole Depth (m)	Soil Origin	Graph	Class.	Description	Neath	ELS	VLS LS MS HS VMS EHS	IS ₍₅₀₎ MPa	RQD %	30	300	
	_			٠,			CORFLOSS	_	f		•	ر ت		11	<u> </u>
NMLC Coring		11.0	12.1 -			CI	Silty CLAY: Very stiff, medium plasticity, dark grey mottled orange brown, extremely weathered basalt layers throughout, moist.					%0			
		10.0	13.0									%			-
		9.5	13.5 - - - - - - - - - - - - - - - - - - -		<u>"</u> А	BAS	BASALT:	wx	_			%0			_
		9.0	14.2 –		V V	BAS	Very low strength, extremely weathered, dark grey. BASALT:								J5° Pl/Ro,Cn,O J5° Pl/Sm,Cn,Q
		8.5	14.5		V V		As above but very high strength and slightly weathered, hardly any fractures.	SW			8.03		2		J5° PI/Ro,Cn,O J5° PI/Sm,Cn,O J3° PI/Sm,Cn,O J40° Un/Ro,Cn,O J5° PI/Ro,Cn,O J5° PI/Sm,Cn,O
		8.0	15.0		V V										-J15° Pl/Sm,Cn,O
		7.5 -	15.5		7 A 7 A 7 A							%56			–J5° Pl/Ro,Cn,O
		7.0	16.5		7 A 7 A 7 A						10	36			-J5° Pl/Ro,Cn,O
		6.5 -	17.0		νν νν νν										
		6.0			Λ V Λ V						8.63				
		5.5	17:54 - - 18.0				17.40m: BOREHOLE TERMINATED								-
Co	mm	ents:													<u> </u>
												-			
<u></u>	Water Weathering Consistency D ✓ Water level on date shown RS Residual Soil Soft L VS Very soft V ✓ Water inflow Extremely F Firm Meathered St Stiff ✓ Water inflow DW Distinctly VSt Very stiff Meathered H Hard V ✓ Water outflow SW Slightly Weathered Moisture									loose e um e e dense	VLS LS MS HS VHS	k Stree Extraction Ver Low Med High	y lov v dium h y hig	ly , h	Defects Refer to Defect Description Sheet

D Dry M Moist W Wet

weathered

Fresh

FR





PROJECT: GEOTECHNICAL INVESTIGATION - TWEED VALLEY HOSPITAL **CLIENT: WOOD AND GRIEVE ENGINEERS PTY LTD LOCATION: CUDGEN ROAD, KINGSCLIFF**

JOB NUMBER: GE18/144

BOREHOLE NUMBER: BH1

BOREHOLE DEPTH: 1.6m TO 17.4m



GEOTECHNIC

Morrison Geotechnic Pty Ltd

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MORRISON Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole Borehole No.: BH2

Page: 1 of 3

Job Number: GE18/144

Easting: Drilling Rig: Hydrapower Scout 555532.40 Client: Wood & Grieve Engineers Northing: 6873454.10 Driller: Redlands Drilling

Project: Geotechnical Invest - Tweed Valley Hospital RL: 24.10 Logged By: L. Bexley

		al Depth:	3.1					.ocati	on: C	udgen	Road, I	Kingscliff		
	Drilli	ng Info	rmation				Material Description					Tes	st San	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
		24.0		Slopewash		СН	Silty CLAY: Stiff, high plasticity, red brown, with some fine to coarse		М	St		0.15	– U50	- PP: 300kPa
100mm Auger with T.C Bit		23.0	1.0	Residual Slope	,	СН	sized gravel, moist. Sitty CLAY: As above but very stiff and with some cobbles.		М	VSt		1-7	– SPT	
100mm Aug		22.0	2.0			СН	Silty CLAY: Very stiff, high plasticity, red brown, moist.		M	VSt		J		
bore		- 22.0	 - -			CI	Sitry CLAY: As above but medium plasticity, red brown mottled orange brown and grey.		М	VSt		2.5	- SPT	- 6,11,18, N=29
Washbore		21.0	3.0	Bedrock	V Λ Λ	BAS	BASALT: Very low strength, extremely weathered, orange brown mottled dark grey.	xw		VLS		J		
			4.0				3.10m: COMMENCE NMLC CORING							
Co	mme	ents:												
Wa		ter level	Weathering RS Resid			stency Very soft		s & Res	ults	50mm dia				

											7.144.101.1004.037.11111111111111111111111111111111111
											Date:
W	ater	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
١.	-	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
	Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
	on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
I.			weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
▮►	— Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
	4114		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
_	— Water outflow	SW	Slightly					VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
			weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
		FR	Fresh	D D	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

GEOTECHNIC

Easting:

Northing:

RL:

555532.40

6873454.10

24.10

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH2

Page: 2 of 3

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

	То	tal Dept		9.80		_	Date: 01/08/2018		Location	n: Cudg	jen l	Road, Kin	ngscliff
	rilli	ng Inf	ormation				Material Description						Rock Mass Defects
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description	Weathering	Estimated Strength SH SW SI	IS ₍₅₀₎ MPa	RQD %	Defect Spacing (mm)	Defect Description type, inclination,planarity, roughness, coating, thickness
NMLC Coring		23.5 23.0 22.5 22.0 21.5 21.0 20.5 20.0 19.5	0.5 1.0 1.5 2.0 2.5 3.0 4.0 4.5 5.0	Bedrock	A A A A A A A A A A A A A A A A A A A	BAS	Commence NMLC Coring at 3.10m BASALT: Very high strength, slightly weathered to fresh, dark grey, slightly fractured.	SW-Fr		9.14	81%		-S5° 60mm cly & VLS -S15° 70mm cly & VLS -S15° 70mm cly & VLS -J5° Pl/Ro, Vn, O -J20° Stp/Ro, St, O -J5° Pl/Sm, Cn, C -J5° Pl/Sm, Cn, O -J5° Un/Ro, Vr, O -J5° Un/Ro, Vr, O -J5° Pl/Sm, Cn, O -S15° 40mm VLS -J40° Pl/Sm, Ct, O -J5° Pl/Sm, Ct, O
C	omm	nents:									•		
N	Water level so on date shown XW Ex we Water inflow DW Dis Water outflow SW Sli we				Resid soil Extrer weath Distin- weath	mely nered ctly nered ly nered	Consistency Den VS Very soft VL S Soft L F Firm MD St Stiff VSt VSt Very stiff D H Hard VD Moisture D Dry M Moist W Wet	Loc Med den Der	dium se	VLS LS MS HS VHS	low Ve Low Me Hig Ve	ry low N dium Ih ry high tremely	Defects Refer to Defect Description Sheet

GEOTECHNIC

Easting:

Northing:

RL:

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Job Number: GE18/144

Client: Wood & Grieve Engineers

Engineering Log - Cored Borehole Borehole No.: BH2

Page: 3 of 3

Drilling Rig: Hydrapower Scout 555532.40 Driller: Redlands Drilling 6873454.10 Project: Geotechnical Invest - Tweed Valley Hospital 24.10 Logged By: L. Bexley Date: 01/08/2018 9.80

	Tot	al Dept		4.10 9.80			gged By: L. Bexley Date: 01/08/2018		Location	: Cudg	en F	Road, Kin	gscliff
D			ormation				Material Description						ock Mass Defects
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description	Weathering	Estimated Strength STRENGTH STAN	IS ₍₅₀₎ MPa	RQD %	Defect Spacing (mm)	Defect Description type, inclination,planarity, roughness, coating, thickness
NMLC Coring		17.5 17.0 16.5 16.0 15.5 15.0 14.5 13.0	6.5 6.7 - 7.06.9 - 7.5 - 7.5 - 7.65 - 8.07.9 - 8.5 8.7 - 9.0 9 - 9.5 35 - 10.0 10.5	Bedrock		BAS BAS BAS BAS BAS BAS BAS	BASALT: Very high strength, slightly weathered to fresh, dark grey, slightly fractured. BASALT: As above but medium strength, distinctly weathered highly fractured BASALT: As above but very high strength and slightly weathered to fresh. BASALT: As above but medium strength, distinctly weathered, orange brown, highly fractured. BASALT: As above but very high strength and slightly weathered. BASALT: As above but medium strength, distinctly weathered, orange brown and grey. BASALT: As above but very high strength and slightly weathered to fresh. BASALT: As above but low strength to medium strength and extremely weathered to distinctly weathered BASALT: As above but very high strength and slightly weathered to fresh. BASALT: As above but very high strength and slightly weathered to fresh. BASALT: As above but very high strength and slightly weathered to fresh. BASALT: As above but low strength to medium strength and extremely weathered to distinctly weathered. 9.80m: BOREHOLE TERMINATED	XW-DW SW-Fr XW-DW SW-Fr DW SW SW Fr DW SW-Fr DW SW-Fr		7.45 10.9	32% 35% 64%		-S15° 15mm VLS -J30° PI/Sm, Vr, Q -S20° 40mm VLS -J30° PI/Sm, Cn, Q -S25° 15mm -J20° PI/Sm, St, Q -S0mm HFZ -90mm HFZ -90mm HFZ -J45° PI/Sm, St, Q -190mm HFZ -70mm BZ -J15° PI/Sm, Cn, Q -J30° PI/Sm, Cn, Q -J5° PI/Sm, Cn, Q -J5° PI/Ro, Vr, Q -S5° 35mm VLS -270mm HFZ -200mm CZ
Wa	ater Wa	ents: ater leve date sh ater inflo	el own ow	Wea RS XW DW SW	weath	mely nered ctly nered ly	Consistency Den VS Very soft VL S Soft L F Firm MD St Stiff VSt VSt Very stiff D H Hard VD Moisture D D D D Moist W Wet W Wet	Ver Loc Me der Der	y loose ose dium	e: Roc ELS VLS LS MS HS VHS	k Str Ext low Ver Lov Me Hig	ength rremely ry low w dium h ry high rremely	Defects Refer to Defect Description Sheet





PROJECT: GEOTECHNICAL INVESTIGATION - TWEED VALLEY HOSPITAL **CLIENT: WOOD AND GRIEVE ENGINEERS PTY LTD**

LOCATION: CUDGEN ROAD, KINGSCLIFF JOB NUMBER: GE18/144 BOREHOLE NUMBER: BH2 BOREHOLE DEPTH: 3.1m TO 9.8m



GEOTECHNIC

Morrison Geotechnic Pty Ltd

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Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH3

Page: 1 of 2

Job Number: GE18/144

Easting: 555581.40 Drilling Rig: Hydrapower Scout Client: Wood & Grieve Engineers Northing: 6873502.40 Driller: Redlands Drilling

Project: Geotechnical Invest - Tweed Valley Hospital RL: Logged By: L. Bexley 25.30 Total Depth: 7.95

Date: 31/07/2018 Location: Cudgen Road, Kingscliff

		al Depth:	7.9 rmation	95		Da	te: 31/07/2018		Locat	ion: C	uagen	Road, I	Kingscliff	et Co-	anles
)riiii	ng into	rmation		T	1	Materiai	Description	1	1	ı		16:	st San	npies I
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Local	Classification Code		Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
				٠ پ		СН	Silty CLAY:		1	М	St			1	
		25.0	0.2 -	ewas	Ш	CH	Stiff, high plasticity, red sized gravel, moist.	brown, with some fine to coarse	<u> </u>	М	St		0.2 –	- PP	– 150kPa
				Slopewash	AIIII	III Cn	Silty CLAY:		4	IVI	SI				[
			0.6 –		<u>'Ш</u>		As above but with some	e cobbles.							
Bit] 0.0 -	dual		СН	Silty CLAY: As above but very stiff.			М	VSt				
T.C			1.0	Residual	Ш										
100mm Auger with T.C Bit			T		Ш								1 —		†
er v		24.0			Ш								}	– SPT	_ 4,8,7, N=15: PP=300-350kPa
Aug			4.5		Ш								₁₅		
י שנ			1.5 –		1111	СН	Silty CLAY:	brown trace of grey mottling,		М	St		1.5		
00n					Ш			thered basalt gravel, moist.							l <u> </u>
7			2.0		Ш									- D	
			Π		Ш										Τ
		23.0			Ш										
					Ш								2.5 —		
			\dashv		Ш										3,3,7, N=10:
			4		Ш								\ \ \	– SPT	PP=150-200kPa
			3.0 2.9 -		1111	СН	Silty CLAY:			М	VSt		J		l <u> </u>
					Ш		As above but very stiff.								
		22.0			Ш										
					Ш										
ler			3.6 –	支	₩.	Λ BAS	BASALT:		XW	+	VLS				
Rol			H_{AA}	Bedrock	Δ		Very low strength, extre mottled dark grey.	emely weathered, orange brown							
Washbore with Rock Roller			4.0		VΛ	Λ							4 —		l ∔
h R		21.0				Λ							ļ	– SPT	18,19,30/130mm,
wit					Δ	. 1									N*=54
ore			4.5 –		v	Λ BAS	BASALT: As above bu	t low strength.	xw	1	LS				
ıshk			4.7 –			Λ BAS		t medium strength, distinctly	DW	<u> </u>	MS				Ī
Wa			5.0 4.9 -		۸	1	weathered, dark grey n		<u></u>						
			+		VΛ	A BAS	BASALT: As above but low stren	gth and extremely weathered.] xw		LS				†
		20.0	\exists			Λ		,							
			4		Δ										
					VΛ	Λ							5.5 -}	- SPT	– 30/100mm, N*=90
						Λ									
			6.0		Δ	. 1									[
Ca	mm	ents:								•					
		511 1 5.							1	Authori	sed hv	:			
Wa	_		Weatherin RS Resi	g idual	Cons VS	sistency Very so	Density VL Very loose	Rock Strength Tes ELS Extremely U5	sts & Re		50mm dia	am tube			
lacksquare		ter level date showr	soil		S	Soft	L Loose	low D	Dist	urbed sa	mple.				
			^VV	emely thered	F St	Firm Stiff	MD Medium dense	VLS Very low SP LS Low					number of b Illing 762mr		Irive 50mm sampler
	– Wa	ter inflow DW Distinctly VSt Very stiff D Dense MS Medium PP							Hand	d penetro	meter es	stimate of ι			sive strength, kPa.
-	Wa	ter outflow	weat SW Sligh	thered ntly	н .	Hard	VD Very dense	HS High S VHS Very high DC			alue kPa ne test, 9		mer, fall 508	Bmm, dri	ving 20mm, 30 deg
				thered	Mois D Di		ist W Wet	EHS Extremely	tape	r cone fit	ted to roo	ds of small	er section.		
			rr ries	11		,	-	high	LION	1 MO 128	∍-। ੲ ੲ੭ Ⅳ	เซนเบนร์ ปโ	resung soll	o i∪i ⊏no	gineering Purposes

RL:

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH3

Page: 2 of 2

Job Number: GE18/144

Easting: 555581.40 Drilling Rig: Hydrapower Scout Northing: 6873502.40 Driller: Redlands Drilling

Logged By: L. Bexley 25.30 7.95 Date: 31/07/2018

Client: Wood & Grieve Engineers Project: Geotechnical Invest - Tweed Valley Hospital

	To	tal Depth:	25.3 7.9				e: 31/07/2018	Locati	on: C	udgen	Road, I	Kingscliff		
	Drilli	ing Info	rmation		1	T	Material Description		T	T		Tes	st San	nples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
Washbore with Rock Roller		19.0	6		V V V	BAS	BASALT: As above but low strength to medium strength and extremely weathered to distinctly weathered.	XW- DW		LS- MS				
H. R.			7.0		VΛ	BAS	BASALT: As above but medium strength and distinctly weathered.	DW		MS		7		Π
re wit		18.0	□ '		ν 'n	BAS	BASALT: As above but low strength and extremely weathered.	xw		LS		7-}	– SPT	– 30/140mm, N*=64
Washbo		- 15.5	7.3 –		V A	BAS	BASALT: As above but medium strength and distinctly weathered	DW		MS				
			7.8 – 8.0 _{7.05}		V A	BAS	BASALT: As above but high strength and slightly weathered.	sw	ļ	HS				H
		17.0	-				7.95m: BOREHOLE TERMINATED							
		16.0	9.0											
		15.0	10.0											- - - -
		_ 14.0	11.0											
		onto	12.0											<u> </u>

Comments:										Authorised by:Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
—	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
Water outflow	SW	Slightly					VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
		weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	D Di	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

RL:

26.70

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Logged By: L. Bexley

Engineering Log - Borehole

Project: Geotechnical Invest - Tweed Valley Hospital

Borehole No.: BH4

Page: 1 of 3

Job Number: GE18/144

Easting: 555582.40 Drilling Rig: Hydrapower Scout Client: Wood & Grieve Engineers
Northing: 6873458.60 Driller: Redlands Drilling

Total Depth: 0.90 Date: 31/07/2018 Location: Cudgen Road, Kingscliff

		tal Depth:	0.9 rmation	Ī		Date	Material Description	oouti	J 0	aagon	r touu, r	Ingsciiπ	st San	nles
	T	ling iinio	Illation			0	Material Description					16.	Jan	ipies
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
with T.C Bit				Slope sidual wash		СН	Silty CLAY: Stiff, high plasticity, red brown, with some fine to coarse sized gravel, moist.		М	St		0.1 - 0.2 -	∇PP U50	150kPa PP: 290kPa
100mm Auger with T.C Bit		26.0	0.5 -	Bedrock Residual wash		CH BAS	Silty CLAY: As above but very stiff and with some cobbles. BASALT: Medium strength, distinctly weathered, dark grey stained orange brown.	DW	М	VSt		0.5 - 0.6 -	=BP	_ 300kPa
			1.0 0.0				0.90m: COMMENCE NMLC CORING							#
		25.0	2.0											
		24.0	3.0											
		23.0	4.0											
		22.0	5.0											
C	hmm	21.0 ents:	6.0											

										Authorised by:
										Date:
Water	Wea	thering	Con	sistency	Den	sity	Rock	Strength	Tests	& Results
Water level on date shown	RS	Residual soil	VS S	Very soft Soft	VL L	Loose		Extremely	U50 D	Undisturbed 50mm diam tube. Disturbed sample.
	XW	Extremely weathered	F St	Firm Stiff	MD	Medium dense	VLS LS	Very low Low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly weathered	VSt H	Very stiff Hard	D VD	Dense Very dense	MS HS	Medium High	PP S	Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa
— Water outflow	SW	Slightly weathered	Mois				VHS EHS	Very high Extremely	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg taper cone fitted to rods of smaller section.
	FR	Fresh	D D	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

GEOTECHNIC

Easting:

Northing:

RL:

555582.40

6873458.60

26.70

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

Engineering Log - Cored Borehole Borehole No.: BH4

Page: 2 of 3

_	Tot	tal Dept		0.10			Date: 31/07/2018		Location	: Cudg	en I	Road, Kin	gscliff
Di	rillir	ng Info	ormation				Material Description						lock Mass Defects
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description	Weathering	Estimated Strength STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH STRENGTH	IS ₍₅₀₎ MPa	RQD %	Defect Spacing (mm)	Defect Description type, inclination,planarity, roughness, coating, thickness
NMLC Coring		26.5 26.0 25.5 25.0 24.5 24.0 23.5 22.0 21.5	0.5 1.0 1.5 2.01.9 - 2.5 3.0 3.5 4.0 4.5 5.0 5.5	Bedrock	V V V V V V V V V V V V V V V V V V V	BAS	Commence NMLC Coring at 0.90m BASALT: Very high strength, slightly weathered, dark grey stained orange brown, moderately to highly fractured. BASALT: As above but medium strength and distinctly weathered. BASALT: As above but very high strength and slightly weathered.	MS MG MS		8.22	65% 23% 17%	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	J10° JIn/Ro Vr.O 10mm cly
Wa	water Water on	ater leve date sh ater inflo	own	RS XW DW	Resid soil Extree weath Distin weath Slight weath Fresh	mely nered ctly nered ly	Consistency Den VS Very soft VL S Soft L F Firm MD St Stiff VSt VSt Very stiff D H Hard VD Moisture D Dry M Moist W Wet	Loc Me der Der	Dat y loose sse dium sse	e: Roc ELS VLS LS MS HS VHS	k Str Ext low Ver Low Me Hig	ength rremely ry low w dium h ry high rremely	Defects Refer to Defect Description Sheet

GEOTECHNIC

Easting:

Northing:

Total Depth:

RL:

555582.40

6873458.60

26.70

10.10

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Date: 31/07/2018

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH4

Page: 3 of 3

Job Number: GE18/144

Client: Wood & Grieve Engineers

EHS Extremely

high

Project: Geotechnical Invest - Tweed Valley Hospital

Location: Cudgen Road, Kingscliff

r	rilli.	na Inf	ormation				Material Description								Rock Mass Defects
۳	11111	iig iiiī	ormation I		1	1	Material Description	T	T =	stimat	ed			Defect	Defect Description
										Streng				Spacing	·
g				_	60	g		و و						(mm)	type, inclination,planarity, roughness, coating, thickness
Drill Method	١.			Soil Origin	Graphic Log	. Code		Weathering					%		
Ę	Water	RL	Hole Depth (m)	oi C	rap	Class.	Description	/eat	S	2 S S	웃	IS ₍₅₀₎ MPa	RQD	300 300 300 300 300 300	
ഥ	5	KL	(111)	S			Description	5	- ۳	721	>ш	IVIFA	œ	0 - 0 - 0	
ring		20.5	H		VΛ.	BAS	BASALT:	SW						₽,	N10° PI/Ro,Cn,O ≺40mm BZ N30° PI/Sm,St,O
ပို			П		V V		As above but very high strength and slightly weathered.						%59		
NMLC Coring			6.5		Λ							11.8	9		_J5° Un/Ro,Cn,O -S5° with 15mm VLS
_		20.0	F		VΛ										
		-	Ħ		Λ									الحا	-S15° 25mm VLS -S20° 50mm VLS
			7.0		Λ V							40.0		J	J5° Pl/Ro,Cn,O J10° Pl/Sm,Vr,O VLS & cly
		19.5	H		VΛ							12.0		ጀ 📗	-S15° 25mm VLS -S20° 50mm VLS J5° PJRO, Cn.O J10° PJ/Sm,Vr,O VLS & cly J5° PJSm,Vr,O with VLS & cly J5° PJSm,Vr,O VJ5° PJ/Sm,Vr,O
		ļ	Ħ		Λ									"	S15° with VLS
			7.5		VΛ										-J5° PI/Ro,Cn,O
		19.0	H		A V								73%	쓰	–50mm BZ
		•	Ħ		Λ										
			8.0		VΥ							14 7			-S10° 30mm
		18.5	H		Λ 7							11.7			
		Γ	A .		V V										S15° 20mm J20° PI/Sm,Cn,O J35° PI/Sm,Cn,O -S25° 25mm VLS
			8.5		VΥ							14.0		ולו	J35° PI/Sm,Cn,O -S25° 25mm VLS
		18.0	Н		ΛΙ							14.0		ካ	–J15° PI/Sm,Cn,O
		Ī	A		V A									2	-J10° PI/Sm,Cn,O -S10° 50mm VLS
			9.0		A V										
		17.5	H		Λ										L 15° PI/Sm Cn O
			A		VΛ								72%	171	J5° Pl/Sm,Cn,O J10° Pl/Sm,Vr,O 10mm VLS
			9.5		A V										-S5° 30mm VLS
		17.0	Н		Λ										–J5° PI/Sm,St,O
			H		VΥ							10.2			
			10.0		V V									[–S15° 20mm VLS –J15° Un/Ro,St,O √J70° Un/Ro,St,O
_		16.5	10.1		v n		10.10m: BOREHOLE		H						070 On/10,0t,0
			H 40.5				TERMINATED								
			10.5												
		16.0	Ħ												
			11.0												
			H												_
		15.5	Н												
			11.5												
			F ''.3												_
		15.0 -	Ħ												
			12.0												
느	<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>		<u> </u>	Ш	Ш					
Co	mn	nents:													
1									1		Aut	horised	by:		
									1		Dat	te:			
w	ater			Wea	athering	<u> </u>	Consistency Der	nsity	1					ength	Defects
l _	_	ater leve	el	RS	Resid		VS Very soft VL	Ve	ry lo	ose			Ext	remely	Refer to Defect
-	,	n date sh		xw	soil Extre	mely	S Soft L F Firm MD		ose ediun	1		VLS	low Ver	y low	Description Sheet
	— w	ater infl	ow		weath	nered	St Stiff	der	nse			LS	Lov	v	
Ĺ				DW	Distin weath		VSt Very stiff D H Hard VD		nse ry de	ense		MS HS	Me Hig	dium h	
I^{-}	W	ater out	flow	SW		ly	Moisture					VHS	Ver	y high remely	

D Dry M Moist W Wet

weathered

Fresh

FR





PROJECT: GEOTECHNICAL INVESTIGATION - TWEED VALLEY HOSPITAL **CLIENT: WOOD AND GRIEVE ENGINEERS PTY LTD**

LOCATION: CUDGEN ROAD, KINGSCLIFF

JOB NUMBER: GE18/144
BOREHOLE NUMBER: BH4
BOREHOLE DEPTH: 3.1m TO 10.1m



GEOTECHNIC

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH5

Page: 1 of 3

Job Number: GE18/144

Easting: 555622.80 Drilling Rig: Hydrapower Scout Northing:

6873483.70 Driller: Redlands Drilling RL: Logged By: L. Bexley 26.80

Date: 30/07/2018

Client: Wood & Grieve Engineers Project: Geotechnical Invest - Tweed Valley Hospital

	To	tal Depth:	26.8				g: 30/07/2018	Locati	on: C	udgen	Road, ł	Kingscliff		
	Drill	ing Info	rmation				Material Description					Tes	st San	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
Was 100mm Auger with T.C Bit		00.0	0.7 –	Residual Slopewash		СН	Silty CLAY: Stiff, high plasticity, red brown, with some fine to coarse sized gravel, moist. Silty CLAY: Very stiff, high plasticity, red brown, some		М	St				-
00mr		_ 26.0	1.0 0.9 -	Re		CH	cobbles, moist.		М	VSt				H
38			1.0 3.3	Bedrock	V//	CI	Silty CLAY: As above but hard and medium plasticity.	<u> </u>	М	Н		1 —		15,24/150mm,
Š			1.2	Bed	V A	BAS	BASALT: Low strength, extremely weathered, orange brown mottled dark grey.	XW		LS			– SPT	N*=48
		25.0	2.0				1.30m: COMMENCE NMLC CORING							- - - - - - - - - - - - - - - - - - -
		22.0	5.0											- - - - - - -
Co	mm	ents:	Ш						<u> </u>				I	

Comments.										Authorised by: Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
4111		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
── Water outflow	SW	Slightly					VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
		weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	D Di	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

GEOTECHNIC

Easting:

Northing:

Total Depth:

555622.80

6873483.70

26.80

6.95

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

FR Fresh D Dry M Moist W Wet

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Date: 30/07/2018

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH5

Page: 2 of 3

Job Number: GE18/144

Client: Wood & Grieve Engineers

high

Project: Geotechnical Invest - Tweed Valley Hospital

Dri	illing	Info	rmation				Material Description					R	Rock Mass Defects
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description	Weathering	Estimated Strength STRENGTH STANDARD	IS ₍₅₀₎ MPa	RQD %	Defect Spacing (mm)	Defect Description type, inclination,planarity, roughness, coating, thickness
NMLC Coring	2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2: 2	6.5 6.0 5.5 5.0 4.5 4.0 3.5 2.5	0.5 1.0 1.5 1.7 - 2.0.95 - 2.5 - 3.0 3.5.41 - 3.57 - 4.0 4.5 5.0.95 - 5.25 - 5.25 - 5.25 -	Bedrock	A V V V V V V V V V V V V V V V V V V V	BAS BAS BAS BAS	Commence NMLC Coring at 1.30m BASALT: Very high strength, slightly weathered, dark grey with some orange brown staining. BASALT: As above but medium strength, distinctly weathered, highly fractured. BASALT: As above but very high strength and slightly weathered. BASALT: As above but medium strength and distinctly weathered BASALT: As above but very high strength and slightly weathered. BASALT: As above but very low strength and extremely weathered. BASALT: As above but very low strength and extremely weathered. BASALT: As above but very high strength and slightly weathered. BASALT: As above but very high strength and distinctly weathered. BASALT: As above but medium strength and distinctly weathered. BASALT: As above but wery high strength and slightly weathered.	MS MG MS MG MS MG MX MS		8.11 12.5	10% 45% 35% 11% 46%		-J15° PI/Sm,Cn,O J40° PI/Sm,St,O -40mm CZ with cly & VLS -460° PI/Sm,Vr,C '130mm BZ -J40° PI/Sm,Vr,O -J45° PI/Sm,Vr,O -J45° PI/Sm,Vr,O -J40mm HFZ -250mm BZ -J10° PI/Ro,Vr,O with VLS & cly '200mm HFZ -J45° Stp/Ro,Vr,O -J5° PI/Sm,Cn,O -J5° PI/Sm,Cn,O -J5° PI/Sm,Cn,O -J5° PI/Sm,Cn,O -J60mm BZ -J5° PI/Ro,Vr,O -160mm CZ with VLS -100mm BZ -40mm CZ with VLS -100mm BZ -40mm CZ with VLS -100mm BZ -20mm HFZ -310° 20mm -J5° Stp/Ro,Cn,O -310° 20mm -J5° PI/Sm,Cn,O -J10° PI/Sm,Vr,O -J10° PI/Sm,Vr,O -J10° PI/Sm,Vr,O -J10° PI/Sm,Vr,O -J10° PI/Sm,Vr,O -J10° PI/Sm,Cn,O
	nmen	nts:		14/-	A 3		Out like the second of the sec			e:			
<u>▼</u>	Water level on date shown Water inflow Water outflow			RS XW DW	Residence Soil Extremed Weath Distinence Weath Slight Weath Weath Slight Weath Weath Slight Weat	mely nered actly nered	Consistency Den VS Very soft VL S Soft L F Firm MD St Stiff VSt Very stiff D H Hard VD Moisture D D D D D D D W W Wet	Ver Loc Med der Der	dium se	VLS LS MS HS VHS	Ext low Ve Low Me Hig Ve	ry low v dium	Defects Refer to Defect Description Sheet

GEOTECHNIC

Easting:

Northing:

RL:

555622.80

6873483.70

26.80

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH5

Page: 3 of 3

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

	To	al Dept		6.95			Date: 30/07/2018			Lo	cati	on	: Cudg	en l	Road, Kings	scliff
D	rillir	ng Inf	ormation				Material Description									ck Mass Defects
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description	Weathering	ELS	Stre	ngth	ı	IS ₍₅₀₎ MPa	RQD %	Defect Spacing (mm) 1	Defect Description type, inclination,planarity, roughness, coating, thickness
NMLC Coring		20.5	6.5		V V V	BAS	BASALT: As above but very high strength and slightly weathered.	MS					9.46	%59		40° PI/Sm,Cn,C 10° PI/Sm,Cn,C 10° PI/Sm,Cn,O 10° PI/Sm,Cn,O 5° PI/Ro,St,O
		18.5 18.0 17.5 17.0 16.5	7.5 8.0 8.5 9.0 9.5 10.0 11.5 11.0				6.95m: BOREHOLE TERMINATED									
Co	omm	ents:												-		
<u></u>	— on — w	ater leve date sh ater inflo	own	Wea RS XW DW SW FR	weath Distin weath	mely nered ctly nered ly	Consistency De VS Very soft VL S Soft L F Firm MI St Stiff VSt VSt Very stiff D H Hard VE Moisture D Dry M Moist W Wet	Loc D Me der De	ery l ose ediu ense ense	um ∋			VLS LS MS HS VHS	Ext low Ve Low Me Hig Ve	ry low w dium gh ry high tremely	Defects Refer to Defect Description Sheet





PROJECT: GEOTECHNICAL INVESTIGATION - TWEED VALLEY HOSPITAL **CLIENT: WOOD AND GRIEVE ENGINEERS PTY LTD**

LOCATION: CUDGEN ROAD, KINGSCLIFF

JOB NUMBER: GE18/144
BOREHOLE NUMBER: BH5
BOREHOLE DEPTH: 1.3m TO 6.9m



GEOTECHNIC

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH6

Page: 1 of 4

Job Number: GE18/144

 Easting:
 555579.90
 Drilling Rig:
 Hydrapower Scout

 Northing:
 6873410.10
 Driller:
 Redlands Drilling

 RL:
 27.00
 Logged By:
 L. Bexley

 Total Depth:
 8.00
 Date:
 30/07/2018

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

Г		al Depth:	8.0 rmation	l			Date	Material Description	·oouti	0 111. O	aagon	rtouu, r	ingsciiπ Tes	st San	nnles
Ε,	<u> </u>				П		Φ	material bescription					160	Jan	.p.55
Drill Method	Water	RL 27.0	Hole Depth (m)	Soil Origin		Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
				ash			CH	Silty CLAY:		М	St				
			0.2 –	Slopewash	Ш	Ш	СН	Stiff, high plasticity, red brown, moist. Silty CLAY:		М	St				H
				<u></u>	$\parallel\parallel$			As above but with some cobbles.					0.5 –	– PP	– 150kPa
äŧ															H
100mm Auger with T.C		26.0	1.0		$\parallel \parallel$								1_		
with			Τ '-	Residual	$\parallel \parallel$		СН	Silty CLAY: Stiff, high plasticity, red brown, some fine to coarse		М	St		']	OPT	2,2,2, N=4:
uger				Res	Ш			sized gravel, moist.						– SPT	PP=150-200kPa
n A					Ш								,		
00m			1.8 –		Щ	Щ									
_		25.0	2.0				CI	Silty CLAY: As above but hard, medium plasticity, red brown mottled		М	Н				Ш.
								grey and some extremely weathered basalt lenses.							Ц
															Ц
													2.5		Ц
			2.7 –	SC X	v	Λ	BAS	BASALT: Very low strength, extremely weathered, orange brown	XW		VLS		}	– SPT	– 7,21,15, N=36
		24.0	3.0	Bedrock	v	Λ		mottled dark grey.					J		4
					1	7									Н
					V A	Λ									H
ē					Ψ,	Δ									H
Roll			4.0		v V	Λ,									Н
Washbore with Rock Roller		23.0	4.0		v V	7 A							4 –		23,30/120mm,
ith R					Ž								}	– SPT	
le w					V A	Λ									H
shbo					v	Λ									H
Was		22.0	5.0		v	Λ									H
		_ 22.0	+ ""			7									
			H		V A										H
					V A								5.5 —		l H
					v									- SPT	– 22,22,26, N=48
		21.0	6.0		v V	Λ									
Со	mme	ents:	-												

										Authorised by: Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
Water outflow	SW	Slightly					VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
		weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	D Di	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH6

Page: 2 of 4

Job Number: GE18/144

Easting: 555579.90 Drilling Rig: Hydrapower Scout

Northing: 6873410.10 Driller: Redlands Drilling Logged By: L. Bexley RL:

27.00 8.00 Date: 30/07/2018 Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

	То	tal Depth:	27.0 8.0		,		e: 30/07/2018	_ocati	on: C	udgen	Road, Ł	Kingscliff		
	Drill	ing Info	rmation		1		Material Description					Tes	st San	ples
Drill Method	Water	RL 21.0	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
ller			6.5 –	Bedrock	V V V V	BAS	BASALT: Very low strength, extremely weathered, orange brownmottled dark grey	XW		VLS				
Washbore with Rock Roller		20.0	7.0		A V A V A V	BAS	BASALT: As above but low strength and dark grey mottled orange .brown	XW		LS		⁷ →	– SPT	– 30/75mm, N*=120
Washbore			8.0		A V A V A V	BAS	BASALT: "As above but medium strength and distinctly weathered"	DW		MS				
		19.0	0.0		Λ		8.00m: COMMENCE NMLC							
		18.0	9.0				CORING							- - - - - -
		17.0	10.0											- - - -
		16.0	11.0											
[CC	mm	15.0 ents:	12.0											

Comments:										Authorised by: Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
► Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
4147		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
── Water outflow	SW	Slightly		_			VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
		weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	D Di	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

GEOTECHNIC

Easting:

Northing:

Total Depth:

555579.90

6873410.10

14.50

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Date: 30/07/2018

Logged By: L. Bexley

Driller: Redlands Drilling

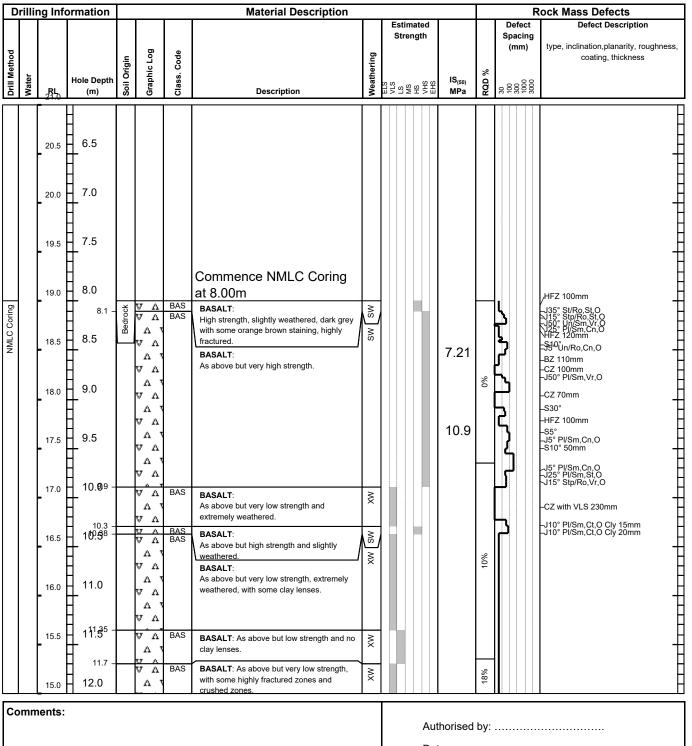
Engineering Log - Cored Borehole Borehole No.: BH6

Page: 3 of 4

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital



Comments:							41	h	
						A	utnorisea	by:	
						D	ate:		
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Defects
—	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	Refer to Defect
Water level		soil	S	Soft	L	Loose		low	Description Sheet
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	
		weathered	St	Stiff		dense	LS	Low	
Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	
4		weathered	Н	Hard	VD	Very dense	HS	High	
── Water outflow	SW	Slightly					VHS	Very high	
		weathered	Mois				EHS	Extremely	
	FR	Fresh	D Dr	y M Moist W We	et			high	

GEOTECHNIC

Easting:

Northing:

RL:

555579.90

6873410.10

27.00

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH6

Page: 4 of 4

Job Number: GE18/144

Client: Wood & Grieve Engineers

high

Project: Geotechnical Invest - Tweed Valley Hospital

	To	tal Dep	th:		.50			Date: 30/07/2018		Location	n: Cudg	en I	Road, Kin	gscliff
	rilli	ng Inf	ormatio	n				Material Description						ock Mass Defects
Drill Method	Water	RL ISO	Hole De (m)	pth	Soil Origin	Graphic Log	Class. Code	Description	Weathering	Estimated Strength STRENGTH STAN STAN	IS ₍₅₀₎ MPa	RQD %	Defect Spacing (mm)	Defect Description type, inclination,planarity, roughness, coating, thickness
NMLC Coring	<u> </u>	14.5	12.5 12.5 13.0	5		V V V V V V V V V V V V V V V V V V V	BAS	BASALT: As above but very low strength, with some highly fractured zones and crushed zones. BASALT: As above but low strength.	wx wx		0.29	18%		–J70° Un/Ro,St,O –J10° Stp/Ro,St,C –J40° Stp/Ro,St,O –CZ 50mm with Cly & VLS –CZ 70mm with Cly & VLS CZ throughout ranging between 10mm & 30mm
		13.0	14.0 14.0 14.2 14.3)		A V A V A V A V A V A V A V A V A V A V	BAS BAS BAS	BASALT: As above but low strength to medium strength and extremely to distinctly weathered. BASALT: As above but high strength and slightly weathered. BASALT: As above but very low strength and extremely weathered. BASALT: High strength and slightly weathered.	w Sw Xw-Dw		0.27	18%	₹	_J5° PI/Sm,Cn,O -CZ 30mm with Cly & VLS -J5° PI/Sm,Cn,O _J15° PI/Sm,Cn,O -J15° PI/Sm,Cn,O -HFZ 100mm -J30° PI/Sm,Cn,O
		11.5 11.0 10.5	15.0 15.5 16.0 16.5	5))				14.50m: BOREHOLE TERMINATED	(8)					
	vater v	9.5 9.0 nents:	el nown ow)	RS XW DW	thering Resid soil Extrei weath Distin weath Slight	mely nered ctly	Consistency Derection VS Very soft VL S Soft L F Firm MD St Stiff VSt Very stiff D H Hard VD	Loo Me der De		Roc ELS VLS LS MS HS	k Str Ext low Ver Lov Me Hig	ength cremely ry low w dium	Defects Refer to Defect Description Sheet

D Dry M Moist W Wet

FR Fresh



PROJECT: GEOTECHNICAL INVESTIGATION - TWEED VALLEY HOSPITAL **CLIENT: WOOD AND GRIEVE ENGINEERS PTY LTD**

LOCATION: CUDGEN ROAD, KINGSCLIFF

JOB NUMBER: GE18/144
BOREHOLE NUMBER: BH6
BOREHOLE DEPTH: 8.0m TO 14.5m



GEOTECHNIC

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Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH7

Page: 1 of 5

Job Number: GE18/144

Easting: 555540.70 Drilling Rig: Hydrapower Scout

Northing: 6873361.10 Driller: Redlands Drilling RL: Logged By: L. Bexley 25.40

Project: Geotechnical Invest - Tweed Valley Hospital

Client: Wood & Grieve Engineers

	Tot	tal Depth:	25.4				g: 02/08/2018	Locati	on: C	udgen	Road, I	Kingscliff		
	rilli	ing Info	rmation				Material Description					Tes	t San	nples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
T C Rit		25.0	0.7 –	Slopewash		СН	Sitty CLAY: Stiff, high plasticity, red brown, moist.		М	St		0.1	– BP	– 150kPa
			1.0	Residual		CH	Sitty CLAY: Very stiff, high plasticity, red brown, fine to medium sized gravel, some cobbles, moist. Sitty CLAY:		М	VSt H		1-		+
Wa shbore with Rock		24.0	1.5 –	<u>-</u>	v v	BAS	As above but hard, low plasticity and grey mottled orange brown. BASALT: Very low strength, extremely weathered,	xw		VLS		}	– SPT	- 6,10,12, N=22
Wa shb			2.0 1.9 -	Bedrock	V A	BAS	orange brown mottled grey. BASALT: As above but medium strength and distinctly weathered.	V DW		MS				
		23.0					2.00m: COMMENCE NMLC CORING							
		22.0	3.0											
		21.0	4.0											
		20.0	5.0											
Co	mme	ents:	6.0											

Comments.										Authorised by: Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
► Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
41147		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
── Water outflow	SW	Slightly					VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
		weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	D D	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

GEOTECHNIC

Easting:

Northing:

Total Depth:

555540.70

6873361.10

25.40

19.05

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Date: 02/08/2018

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH7

Page: 2 of 5

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

D	rillii	ng Info	rmation				Material Description							Rock Mass Defects
Drill Method	Water	RT (w) Soil Origin					Description	Weathering	S	timated trength	IS ₍₅₀₎ MPa	RQD %	Defe Spac (mn	ing n) type, inclination,planarity, roughness, coating, thickness
NMLC Coring		25.0 24.5 24.0 23.5 23.0 22.5 22.0 21.5 20.0 19.5	0.5 1.0 1.5 2.0 2.5 2.8 - 3.0 3.5 3.5 - 4.0 4.1 - 4.5 5.0	Bedrock	V A A A A A A A A A A A A A A A A A A A	BAS BAS	Commence NMLC Coring at 2.00m BASALT: Very high strength, slightly weathered to fresh, dark grey, moderately fractured. BASALT: As above but very low strength and extremely weathered. BASALT: As above but low strength to medium strength and extremely weathered to distinctly weathered. BASALT: As above but very high strength and slightly weathered. BASALT: As above but low strength to medium strength, extremely weathered to distinctly weathered, orange brown mottled grey, highly fractured, with some very high strength and slightly weathered zones.	XW-DW XW-DW XW-Fr			2.56	13%		J5° PI/Sm,Cn,O J10° PI/Sm,St,O S\$5° \$6\text{PM} S45° 20mm VLS S20° 15mm J15° PI/Sm,St,O -CZ 100mm cly & VLS -BZ 150mm -HFZ 450mm -HFZ 450mm -BZ 70mm -J25° Stp/Ro,Cn,O -J25° DI/Ro,Cn,O -J25° PI/Sm,Vr,O -J5° PI/Sm,Vr,O -J5° PI/Sm,Vr,O -J5° PI/Sm,Vr,O -J5° PI/Sm,Vr,O -J5° PI/Sm,Vr,O -J5° PI/Sm,St,O -J30° PI/Sm,St,O -J15° PI/Sm,St,O -J15° PI/Sm,St,O -BZ 340mm
Co	mm	nents:												
<u></u>	— or — w	ater leve date sho ater inflo ater outfl	own w	RS XW DW	Resid soil Extrei weath Distin weath Slight weath Fresh	mely nered ctly nered ly	Consistency Der VS Very soft VL S Soft L F Firm MD St Stiff VSt VSt Very stiff D H Hard VD Moisture D Dry M Moist W Wet	Loc Me der Der	dium		VLS LS MS HS VHS	low Ve Low Me Hig Ve	ry low w edium gh ry high tremely	Defects Refer to Defect Description Sheet

GEOTECHNIC

Easting:

Northing:

Total Depth:

RL:

555540.70

6873361.10

25.40

19.05

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Date: 02/08/2018

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH7

Page: 3 of 5

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

Location: Cudgen Road, Kingscliff

EHS Extremely

high

D	rillir	ng Info	ormation	3.00			Material Description						Rock Mass Defects
							p		Estimated			Defect	Defect Description
_					- CT			1	Strength		1	Spacing (mm)	type, inclination,planarity, roughness,
thoc				igin	c Log	Code		ring					coating, thickness
Drill Method	Water		Hole Depth	Soil Origin	Graphic Log	Class.		Weathering	ນ ດ	IS ₍₅₀₎	RQD %	_ 0000	
۵	Š	RL	(m)	တိ	อ็	ວັ	Description	š	ELS VLS MS HS VHS	MPa	S	300 300 300 300 300 300 300	
ing			H		VΥ	BAS	BASALT:	×					-
NMLC Coring		19.0	Ħ		V V		As above but low strength to medium strength, extremely weathered to distinctly	XW-DW		6.36			HFZ 3000mm
IMLO		- 13.0	6.5		ΔΊ		weathered, orange brown mottled grey,						
_			F		VΛ		highly fractured, with some very high strength and slightly weathered zones.						Ţ
		18.5	6.7 –		VΥ	BAS	BASALT:	Δ					
		-	7.0		Λ,		As above but medium strength and distinctly weathered.				%2		
			H		V A								
		18.0	A		VΥ								
		-	7.5		Α,	9							1
					V A								
		17.5	8.0		v'n]						<u> </u>	–BZ 70mm
		_	₽°.º		Λ							H	-CZ 70mm with Cly & VLS
			Ħ		٧Λ,							┎║	-J10° PI/Ro,St,O -BZ 100mm
		17.0	8.5		V V]							J50° PI/Ro,Cn,O
			H °.3		Λ							ا کے	-330 Fi/(to,cli,o
			Ħ		VΥ								D7 070
		16.5	9.08.9 -		Λ 7					0.50			-BZ 370mm
			H 9.00.0		VΛ	BAS	BASALT:	SW		9.58		IT L a ∥	-S10° 20mm
			Ħ		V V	1	As above but medium strength to high strength, distinctly weathered to slightly	DW-SW			16%	│ │ │ 	-S20° 20mm VLS
		16.0	9.5		Δ		weathered, with some very high strength and extremely weathered zones.				16	J	J60° PI/Sm,Vr,O
			H ""		VΥ		and extremely weathered zones.					الحا	–BZ 50mm
			R		V V							Π	-BZ 100mm -HFZ 100mm
		15.5 -	10.0		Δ							Щ	-BZ 100mm
			廿		VΥ								-CZ 70mm with cly & VLS
			H		V V					10.8		7	-BZ 140mm
		15.0	10.5		Λ							ጊ	–J20° PI/Ro,Ct,O –S20° 30mm VLS & cly
			Ħ		VΥ								HFZ 130mm
		44.5	10.8 –		ΛΙ							4	
		14.5	11.0		VΛ.	BAS	BASALT:	≷					-
	SWL		Ħ		V V	1	As above but low strength and extremely weathered.						1
	S	14.0	Ħ		Δ						%		
	_	- 14.0	11.5		VΥ						10%		-
			F		V V								1
		13.5	Ħ		Λ								
		- 10.0	12.0		VΛ								-
		ents:											
'	,,,,,,,,	ients:							Дп	thorised	þν.		
											-		
_									Da				
W	ater			Wea	athering Resid	-	Consistency Der VS Very soft VL	n sity Ve	ry loose			ength remely	Defects Refer to Defect
17		ater leve			soil		S Soft L	Loc	ose		low		Description Sheet
				XW	Extre weath		F Firm MD St Stiff	Me der	dium nse	VLS LS	Vei Lov	ry low v	
	— w	ater inflo	ow	DW	Distin	ctly	VSt Very stiff D	De	nse	MS	Me	dium	
1-	⋖ w	ater out	flow	SW	weath Slight		H Hard VD	Ve	ry dense	HS VHS	Hig Vei	h y high	
				٠.,	weath		Moisture					remely	

D Dry M Moist W Wet

weathered

Fresh

FR

GEOTECHNIC

Easting:

Northing:

RL:

555540.70

6873361.10

25.40

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH7

Page: 4 of 5

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

	To	tal Dept		5.40 9.05		LU	gged By: L. Bexley Date: 02/08/2018		Location	: Cudo	jen f	Road, Kin	gscliff
D	rillir	ng Inf	ormation				Material Description					R	lock Mass Defects
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description	Weathering	Estimated Strength STRENGTH STANGE ST	IS ₍₅₀₎ MPa	RQD %	Defect Spacing (mm)	Defect Description type, inclination,planarity, roughness, coating, thickness
NMLC Coring		13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5	12.5 13.0 13.5 13.6 - 14.0 14.5 15.0 16.0 16.5 17.0			BAS	BASALT: As above but very low strength, with some clay seams. BASALT: As above but very low strength, with some clay seams.	KX XW XW		8.29	100% 15% 10%		–J20° Stp/Ro,Cn,O –J5° Pl/Ro,Cn,O –J5° Un/Ro,Cn,O –J20° Pl/Sm,Cn,O
		ents:								te:			
<u></u>	— on — w	ater leve date sh ater inflo ater out	nown	RS	weath	mely nered ctly nered ly	Consistency Der VS Very soft VL S Soft L F Firm MD St Stiff VSt Very stiff D H Hard VD Moisture D Dry M Moist W Wet	Loc Me der De	dium ise	VLS LS MS HS VHS	low Ver Low Me Hig Ver	ry low v dium h y high remely	Defects Refer to Defect Description Sheet

GEOTECHNIC

Easting:

Northing:

RL:

555540.70

6873361.10

25.40

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH7

Page: 5 of 5

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

high

	То	tal Dept		9.05			Date: 02/08/2018			L	.oca	atior	ı: Cudg	jen	Roa	ıd, k	Kin	gscliff
	rilli	ng Info	ormation				Material Description											ock Mass Defects
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description		weatnering	S	stima trenç		IS ₍₅₀₎ MPa	RQD %	s	pacir (mm	ng)	Defect Description type, inclination,planarity, roughness, coating, thickness
NMLC Coring		7.0 - 6.5	18.5		A V A V A V A V A V	BAS	BASALT: As above but very high strength, fresh, dar grey vesicular, lenses of feldspar.		L				10.9	100%				–J30° Pl/Sm,Cn,O
		6.0 5.5	19.5		Δ		19.05m: BOREHOLE TERMINATED											
		5.0	20.5															
		4.0	21.5															
		3.0	22.5															
		2.0	23.0															
C	omn	nents:	24.0											•				<u>H</u>
N	or w	ater leven date shater infloater outf	own	Wea RS XW DW SW	weath Distin weath	mely hered ctly hered ly	VS Very soft V S Soft L F Firm I St Stiff VSt Very stiff L	. L 1 DM 0	Ver Loo Med den Den	dium se			VLS LS MS HS VHS	lov Ve Lo Me Hiç Ve	ry lo w ediun	ely w n		Defects Refer to Defect Description Sheet

D Dry M Moist W Wet

FR Fresh



PROJECT: GEOTECHNICAL INVESTIGATION - TWEED VALLEY HOSPITAL **CLIENT: WOOD AND GRIEVE ENGINEERS PTY LTD**

LOCATION: CUDGEN ROAD, KINGSCLIFF

JOB NUMBER: GE18/144

BOREHOLE NUMBER: BH7

BOREHOLE DEPTH: 2.0m TO 19.05m



Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH8

Page: 1 of 1

Job Number: GE18/144

Easting: 555637.00 Northing:

RL:

Total Depth:

6873523.00 20.20

3.00

Drilling Rig: Jeyhco Digga

Driller: Morrison Geotechnic

Logged By: C. Lam Date: 08.03.2018 Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

Drilling Information Material Description By By Date: 08.03.2018 Location: Cudgen Road, Kings Material Description									st San	nples						
Г	Ī	33.				<u>o</u>		2				_				F 2-
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	D	escription		Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
			0.1 -			CI	Sandy CLAY:				М	St		0.1 –		
vith TC Bit		20.0	1.0	Residual Slopewash		СН	Stiff, medium plasticity, grained sand, moist Silty CLAY:	red brown, fine to medium I brown mottled grey, some moist	/I		M	H		}	- BS	- Bulk Sample
100mm Solid Flight Auger with TC Bit		19.0 18.0	2.0	Rock	V A '	BAS	BASALT: Very low strength, extre grey, some low to medit	mely weathered, brown mo um strength fragments	ottled	xw		VLS		·		
		17.0	1 *		U 1		3.00m: BOREH	OLE TERMINA	TED							T I
		16.0	4.0													
			5.0													Ħ
	15.0															
Co	mm	ents:									.41					
										_		-				
Wa	= on _ Wa	ater level date showr ater inflow ater outflow	DW Disti weat SW Sligh	emely hered nctly hered tly hered	S S F F St S VSt V H H H	ery soft oft irm tiff ery stiff ard	Density VL Very loose L Loose MD Medium dense D Dense VD Very dense	Rock Strength ELS Extremely low VLS Very low LS Low MS Medium HS High VHS Very high EHS Extremely high	Tests U50 D SPT PP S DC	& Resi Undis Distur Stand 300m Hand Vane Dynar taper	turbed 5 bed san lard Pen m with a penetro shear va nic Con cone fitt	50mm dia nple. etration a 63.6kg meter es alue kPa e test, 9	am tube. Test, N = r hammer fa stimate of u .09kg hami	alling 762mn unconfined o mer, fall 508 er section.	lows to d n. compress Bmm, driv	rive 50mm sampler sive strength, kPa. ving 20mm, 30 deg jineering Purposes

Morrison Geotechnic Pty Ltd

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Engineering Log - Borehole

Borehole No.: BH9

Page: 1 of 1

Job Number: GE18/144

Easting: 555699.00 Northing: 6873542.00

17.70

1.30

RL:

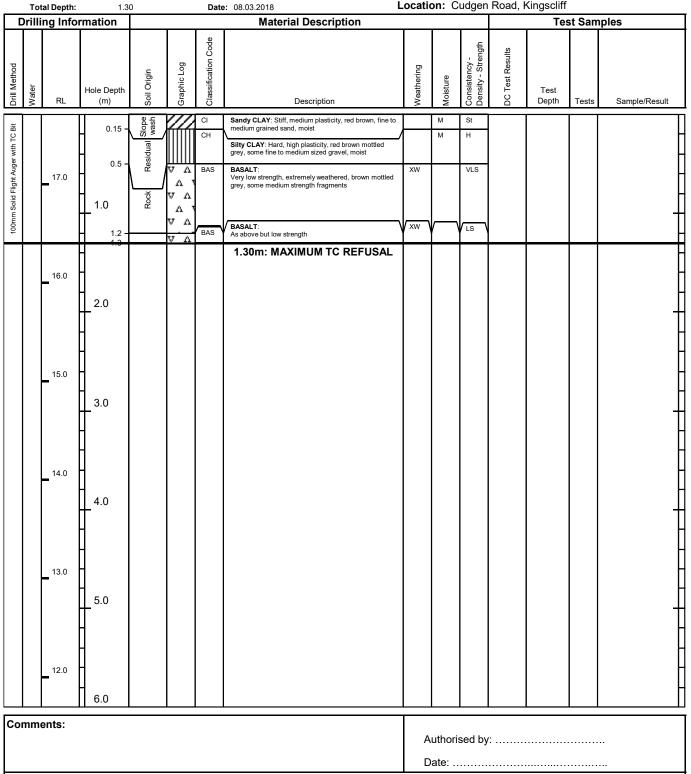
Drilling Rig: Jeyhco Digga

Driller: Morrison Geotechnic

Logged By: C. Lam

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital



Commonto.										Authorised by: Date:
Water	Wea	thering	Con	sistency	Der	nsity	Rock	Strength	Tests	s & Results
Water level on date shown Water inflow Water outflow	RS XW DW SW	Residual soil Extremely weathered Distinctly weathered Slightly	VS S F St VSt H	Very soft Soft Firm Stiff Very stiff Hard	VL L MD D VD	-	VLS LS MS HS VHS	Extremely low Very low Low Medium High	U50 D SPT PP S DC	Undisturbed 50mm diam tube. Disturbed sample. Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm. Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
-	FR	weathered Fresh	Mois D D	sture ry M Moist	w v	Vet	EHS	, ,	50	taper cone fitted to rods of smaller section. From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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Engineering Log - Borehole Borehole No.: BH10

Page: 1 of 1

Job Number: GE18/144

Easting: 555711.00 **Northing:** 6873497.70

Drilling Rig: Jeyhco Digga

D Dry M Moist W Wet

Client: Wood & Grieve Engineers

Northing: 68/3497.70 RL: 25.10

Driller: Morrison Geotechnic **Logged By:** C. Lam

Project: Geotechnical Invest - Tweed Valley Hospital

Total Depth: 3.00 Date: 08.03.2018 Location: Cudgen Road, Kingscliff

Total Depth: 3.00 Date: 08.03.2018 Location: Cudgen Road, Kingscliff Drilling Information Material Description Test Samples											-					
	Orilli	ing Infor	mation		1	1	Material	Description		1	ı	1		Tes	st San	nples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	0	Description		Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
		25.0	0.1 -	ls.	///	CI	Sandy CLAY:				М	St	10			
th TC Bit			1.0	Residual Slopewash	<u>/</u>	СН	grained sand, moist Sitty CLAY: Hard, high plasticity, refine to medium sized gr	red brown, fine to mediun d brown mottled grey, trac avel, moist			М	Н	8 5 4 4 5 9 11 8	1		
100mm Solid Flight Auger with TC Bit		24.0	2.0			СН	Sitty CLAY: As above but very stiff				М	VSt	12 11 10 11 15	}	- BS	- Bulk Sample
100mm		22.0	3.0													-
]				3.00m: BORE	HOLE TERMINA	TED							
		21.0	4.0													- - - - - - -
		20.0	5.0													- - - - - -
	<u> </u>	<u> </u>	0.0	l			<u> </u>				<u> </u>	L				<u> </u>
	mm	ents:	Weatherin	<u> </u>	Consis	tency	Dansity	Rock Strength	Toeto		ate:	-				
	Wa on Wa	ater level date shown ater inflow ater outflow	RS Resi soil XW Extre weat DW Disti weat SW Sligh	emely thered inctly thered ntly thered	VS S S S S S S S S S S S S S S S S S S	/ery soft Soft Firm Stiff /ery stiff Hard	L Loose MD Medium dense	ELS Extremely low VLS Very low LS Low MS Medium	U50 D SPT PP S DC	Undis Distur Stand 300m Hand Vane Dynar taper	sturbed strbed sand Per with a penetro shear v mic Concone fit	nple. netration a 63.6kg ometer e alue kPa le test, 9 ted to ro	hammer fa stimate of u a .09kg ham ds of small	alling 762mr unconfined o mer, fall 508 er section.	n. compress 3mm, dri	rive 50mm sampler sive strength, kPa. ving 20mm, 30 deg jineering Purposes

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Engineering Log - Borehole

Borehole No.: BH11

Page: 1 of 1

Job Number: GE18/144

Easting: 555681.90 26.70

weathered Slightly

weathered Fresh

FR

VD

Very dense

D Dry M Moist W Wet

Hard

Moisture

Water outflow

Northing: 6873421.00

RL:

Drilling Rig: Jeyhco Digga

Driller: Morrison Geotechnic

Logged By: C. Lam Date: 08.03.2018 Client: Wood & Grieve Engineers

Vane shear value kPa
Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg

taper cone fitted to rods of smaller section.
From AS1289-1993 Methods of Testing Soils for Engineering Purposes

S DC

HS High VHS Very high EHS Extremely

high

Project: Geotechnical Invest - Tweed Valley Hospital

		RL: tal Depth:	26.7		LO			Locati	on: C	udgen	Road, k	Kingscliff		
	Orill	ing Info	rmation				Material Description	1				Tes	st Sam	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
			0.1 -	ash I		CH	Sandy CLAY: Hard, high plasticity, red brown, fine to medium grained	<u> </u>	M M	H St	2			
			П	Slopewash		OI I	sand, moist	/	"	O.	8 15			П
TC Bit		26.0		Residual			Sitry CLAY: Stiff, high plasticity, red brown, moist							A
r with			0.8 - 1.0			СН	Silty CLAY: As above but brown, some fine to medium sized gravel		М	St				<u> </u>
100mm Solid Flight Auger with TC Bit														
lid Fi	25.0 25.0 BAS BASALT: Very low strength, extremely weathered, brown mottled grey, some medium strength fragments													
m So	Very low strength, extremely weathered, brown mottled grey, some medium strength fragments													
00m			H ^{2.0}		Vν									\dagger
_				<u> </u>	VΛ,		BASALT:							Ĭ
		77.11	2.5 -	Rock	VΛ	BAS	As above but low strength	XW		LS				
		24.0					2.60m: MAXIMUM TC REFUSAL							Ц
			3.0											\mathbb{H}
														H
														H
		23.0												
			4.0											4
														Н
			H											H
		22.0												H
			5.0											<u>I</u>
			Γ											I
			H											Ц
		21.0												H
			6.0											H
Co	mm	ents:	11 0.0					1	I	l				L
		ents.						Α	uthori	sed by	/:			
)ate:	<u></u> .				
I	ter	otor level		dual		ery soft	VL Very loose ELS Extremely U50		sturbed 5		am tube.			
		ater level date show	/*\ _/\\\	emely	F F	oft irm tiff	L Loose low D MD Medium VLS Very low SP1 dense LS Low	Stan		etration		number of bi		ive 50mm sampler
	_ Wa	ater inflow	DW Disti	nctly	VSt V	ery stiff ard	D Dense MS Medium PP VD Very dense HS High S	Hand		meter e	stimate of ι			ive strength, kPa.

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Engineering Log - Borehole Borehole No.: BH12

Page: 1 of 1

Job Number: GE18/144

Easting: 555644.00 Northing: 6873396.00

RL:

Total Depth:

26.50

1.50

Drilling Rig: Jeyhco Digga

Very soft Soft

Very stiff

D Dry M Moist W Wet

Firm Stiff

Hard

VSt

Moisture

RS

DW

SW

FR

Water level

Water inflow

Water outflow

on date shown

Residual

Extremely

Distinctly

weathered Slightly

weathered Fresh

soil

Very loose Loose

Very dense

MD Medium

dense

Dense

ELS Extremely

low

HS High VHS Very high EHS Extremely

high

Very low Low

Medium

VLS

LS MS

U50

SPT

PP

S DC

Undisturbed 50mm diam tube.

300mm with a 63.6kg hammer falling 762mm.

Standard Penetration Test, N = number of blows to drive 50mm sampler

Hand penetrometer estimate of unconfined compressive strength, kPa.

Vane shear value kPa
Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg

taper cone fitted to rods of smaller section.
From AS1289-1993 Methods of Testing Soils for Engineering Purposes

Disturbed sample.

VL

D

VD

Driller: Morrison Geotechnic Logged By: C. Lam

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

Location: Cudgen Road, Kingscliff Date: 08.03.2018

	tal Depth:	1.5 rmation	0		Date	e: 08.03.2018 L Material Description	Ocali	JII. C	uager	i Roau, i	Kingscliff	st San	nlos	7
I Dilli	T T	Illiation		T .		Material Description					168	St Saii	ipies	\dashv
Drill Method Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result	
100mm Solid Flight Auger with TC Bit	26.0	1.0	Roc Residual Slopewas	V A	CH CH	Sandy CLAY: Hard, high plasticity, red brown, fine to medium grained sand, moist Silty CLAY: Very stiff, high plasticity, red brown, trace fine to medium sized gravel, moist BASALT: Low strength, extremely weathered, grey, with medium strength fragments	XW	M	H VSt	2 3 3 2 3 3 3 3 3 5 5 7	0.5	– U50	– PP=350kPa –	
	24.0	2.0				1.50m: MAXIMUM TC REFUSAL							-	
Comm	nents:	6.0					Δ	uthoris	sed by	<i>r</i> .				
Water		Weatherin	g	Consist	tency	Density Rock Strength Test		ate:						4

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Engineering Log - Borehole

Borehole No.: BH13 Page: 1 of 1

Job Number: GE18/144

Easting: 555580.70 Northing: 6873319.60

RL:

Total Depth:

26.50

1.50

Drilling Rig: Jeyhco Digga

Driller: Morrison Geotechnic

Logged By: C. Lam Date: 08.03.2018 Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

		ing Info	rmation				Material Description						st Sam	ıples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
100mm Solid Flight Auger with TC Bit		26.0	0.1 -	Residual Slopewash		СН	Sandy CLAY: Hard, high plasticity, brown, fine to medium grained sand, with organics, moist Sitty CLAY: Hard, high plasticity, red brown, some fine to coarse sized gravel, moist		M	Н	11 6 10 4 5 6 5			-
100mm Solid Flight		25.0	1.0	Nock A		CH BAS	Silty CLAY: As above but stiff to very stiff BASALT: Low strength, extremely weathered, grey, with medium strength fragments	xw	М	St - Vst	4 3 8 15			
			2.0				1.50m: MAXIMUM TC REFUSAL							
		24.0	3.0											
		23.0	4.0											
		_ 22.0												
		21.0	5.0											<u> </u> - -
Co	mm	ents:	6.0											

Comments:										Authorised by: Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
Water level on date shown	RS XW	Residual soil Extremely	VS S F	Very soft Soft Firm	VL L MD	Very loose Loose Medium	VLS	low Very low	U50 D SPT	Undisturbed 50mm diam tube. Disturbed sample. Standard Penetration Test, N = number of blows to drive 50mm sampler
Water inflow Water outflow	DW SW	weathered Distinctly weathered	St VSt H	Stiff Very stiff Hard	D VD	dense Dense Very dense	LS MS HS VHS	Medium High	PP S DC	300mm with a 63.6kg hammer falling 762mm. Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
→	FR	Slightly weathered Fresh	Mois D Dr		wv	Vet		Very high Extremely high	DC	taper cone fitted to rods of smaller section. From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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Engineering Log - Borehole

Borehole No.: BH14

Page: 1 of 1

Job Number: GE18/144

Easting: 555523.40 Northing: 6873320.10 Drilling Rig: Jeyhco Digga Driller: Morrison Geotechnic Client: Wood & Grieve Engineers

24.80 RL: Total Depth: 0.90

Logged By: C. Lam

Project: Geotechnical Invest - Tweed Valley Hospital

Location: Cudgen Road, Kingscliff Date: 08.03.2018

[ng Info	rmation				Material Description					Tes	st Sam	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
er with TC			0.15 -	Slope		CH	Sandy CLAY: Stiff, high plasticity, red brown, fine to medium grained sand, with organics, moist		M M	St VSt	2 3 2			
J Flight Aug Bit			}	Residual			Silty CLAY: Very stiff, high plasticity, red brown, trace fine to medium sized gravel, moist BASALT: Very low strength, extremely weathered,				3 4 11			H
100mm Solid Flight Auger with TC Bit		24.0	0.6 -	Rock	V A	BAS	brown BASALT: As above but low strength	XW		VLS LS	15			Ī
			1.0 0.0		v n	BAS	0.90m: MAXIMUM T.C. REFUSAL	AVV		LS				Ħ
														Ĭ
		23.0												H
			2.0											1
														H
														Ħ
		22.0	30											H
			3.0											\forall
														H
		21.0												Н
			4.0											\mathbb{H}
														Н
														A
		20.0	5.0											Д
			T											Ţ
														H
		19.0												A
Co	mm	ents:	6.0											

Comments.										Authorised by:
Water	Wea	thering	Con	sistency	Den	sity	Rock	Strength	Tests	s & Results
	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
•		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
Water outflow	SW	Slightly				,	VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
		weathered					EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	Mois	sture				high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes
			D D	ry M Moist	W V	Vet		Ü		3 3 1

RL:

Total Depth:

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Engineering Log - Borehole Borehole No.: BH15

Page: 1 of 1

Job Number: GE18/144

Easting: 555453.90 Northing: 6873347.90

18.20

0.80

Drilling Rig: Jeyhco Digga

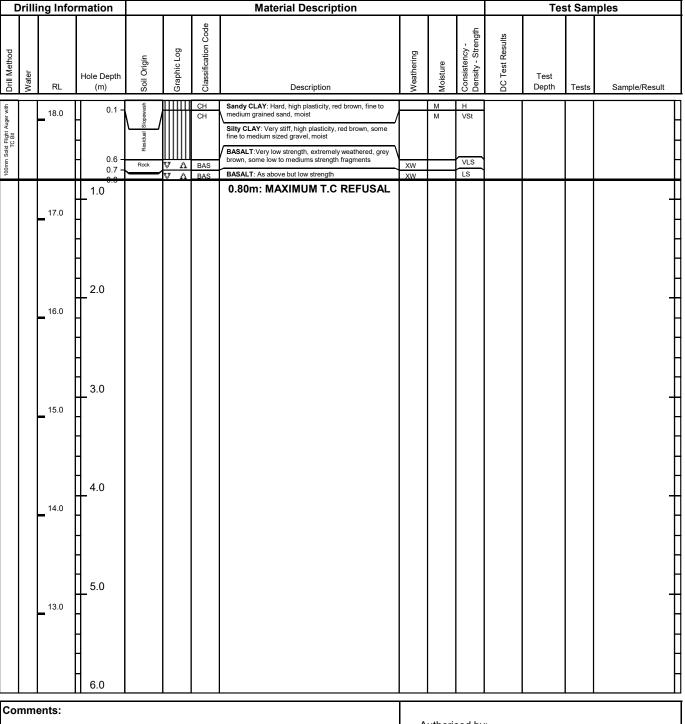
Driller: Morrison Geotechnic

Logged By: C. Lam

Date: 08.03.2018

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital



Comments:										Authorised by:
Water	Wea	thering	Con	sistency	Der	sity	Rock	Strength	Tests	s & Results
Water level on date shown	RS	Residual soil	VS S	Very soft Soft	VL L	Loose	ELS	low	U50 D	Undisturbed 50mm diam tube. Disturbed sample.
	XW	Extremely weathered	St	Firm Stiff	MD	Medium dense	VLS LS	Very low Low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly weathered	VSt H	Very stiff Hard	D VD	Dense Very dense	MS HS	Medium High	PP S	Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa
—◀ Water outflow	SW	Slightly weathered		. iai a		voly dolloo	VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg taper cone fitted to rods of smaller section.
	FR	Fresh	Mois D D		wv	Vet	LIIO	high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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Engineering Log - Borehole Borehole No.: BH16

Page: 1 of 1

Job Number: GE18/144

Easting: 555464.00 Northing:

RL:

Total Depth:

6873295.00 20.80

0.80

Drilling Rig: Jeyhco Digga

Date: 08.03.2018

Logged By: C. Lam

Driller: Morrison Geotechnic

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

[ng Info	rmation				Material Description					Tes	st Sam	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
r with			0.1 -	Slopewas		CH	Sandy CLAY: Hard, high plasticity, red brown, fine to medium grained sand, moist	\vdash	M M	H VSt				
ght Auge]]]]]]	Cii	Silty CLAY: Very stiff, high plasticity, red brown, some fine to coarse sized gravel, moist		l Wi	VOL				П
100mm Solid Flight Auger with TC Bit				Residua			BASALT : Very low strength, extremely weathered, grey brown, some low to medium strength fragments	V						П
100mm		20.0	0.6 - 0.7 -	Rock	VΛ	BAS BAS	BASALT: As above but low strength	xw xw		VLS LS				П
			1.0				0.80m: MAXIMUM T.C. REFUSAL							
														Ц
		19.0												Н
			2.0											#
														Н
														H
			Ц											H
		18.0												H
			3.0											\mathbb{H}
			_											Н
			_											Н
		47.0												Н
		17.0	4.0											H
			1 4.0											\mathbb{H}
														H
														H
		16.0												H
		_	5.0											Ħ
			T											#
														H
			1											П
		15.0												П
			6.0											
Со	mm	ents:							uthori	sed hv				

Comments.										Authorised by: Date:
Water	Wea	thering	Con	sistency	Den	sity	Rock	Strength	Tests	s & Results
Water level on date shown Water inflow Water outflow	RS XW DW SW	Residual soil Extremely weathered Distinctly weathered Slightly weathered Fresh	VS S F St VSt H	Very soft Soft Firm Stiff Very stiff Hard	VL L MD VD	Very loose Loose Medium dense Dense Very dense	VLS LS MS HS VHS EHS	low Very low Low Medium High	U50 D SPT PP S DC	Undisturbed 50mm diam tube. Disturbed sample. Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm. Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg taper cone fitted to rods of smaller section. From AS1289-1993 Methods of Testing Soils for Engineering Purposes
			D D	ry M Moist	W V	Vet				

GEOTECHNIC

Easting:

Morrison Geotechnic Pty Ltd

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Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Borehole

Borehole No.: BH17

Page: 1 of 1

Job Number: GE18/144

555407.00 Drilling Rig: Jeyhco Digga Client: Wood & Grieve Engineers

Northing: 6873296.10 Driller: Morrison Geotechnic Project: Geotechnical Invest - Tweed Valley Hospital

rotal Depth: 3.00 Date: 08.03.2018 Location: Cudgen Road, Kingscliff

		tal Depth:	3.0	0		Date		ocatio	on: C	udgen	Road, I	Kingscliff		
	Drill	ing Info	rmation				Material Description					Tes	st San	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
100mm Solid Flight Auger with TC Bit		14.0 13.0 12.0 11.0	1.0 2.0 3.0 4.0	Residual Slopewash		CH	Sandy CLAY: Hard, high plasticity, red brown, fine to medium grained sand, moist Sandy CLAY: Very stiff, high plasticity, red brown, fine to medium grained sand, some fine to medium sized gravel, moist 3.00m: BOREHOLE TERMINATED		M	H VSt		0.3 -	- BS	- Bulk Sample
	71111N	ents:							uthoris	sed by	:			

										Authorised by:
										Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
—	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
4		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
── Water outflow	SW	Slightly		_			VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
─ ■ Water outflow		weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	D D	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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Engineering Log - Borehole Borehole No.: BH18

Page: 1 of 1

Job Number: GE18/144

Easting: 555482.30 Northing: 6873253.70

23.40

RL:

Drilling Rig: Jeyhco Digga

Driller: Morrison Geotechnic

Logged By: C. Lam Date: 08.03.2018 Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

		tal Depth:	3.0						_ocati	on: C	udgen	Road, ł	Kingscliff		
L	Drill	ing Info	rmation		1			Material Description	1	1			Tes	st San	nples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin		Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
		23.0	0.5	Slopewash			СН	Silty CLAY: Hard, red brown, trace of fine to medium sized gravel, moist		М	Н	8 7 4 3	0.5		
100mm Solid Flight Auger with TC Bit		_ 22.0	1.0	Residual			СН	Silty CLAY: Stiff to very stiff, high plasticity, red brown, trace fine to medium sized gravel, moist.		М	St- VSt	3 3 15	0.5	– U50	- PP=310kPa
100mm		21.0	3.0				СН	Silty CLAY: As above but some fine to medium sized gravel		М	St- VSt				
		20.0	4.0					3.00m: BOREHOLE TERMINATED							- - - - -
		19.0	5.0												
		18.0	6.0												
Co	mm	ents:													

Comments:										Authorised by:
Water	Wea	thering	Con	sistency	Der	sity	Rock	Strength	Tests	s & Results
▼ Water level	RS	Residual	VS	Very soft	VL	. ,	ELS		U50	Undisturbed 50mm diam tube.
I V		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
▶ Water inflow	DW	Distinctly	VSt	Verv stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
-		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
_ Water outflow	SW	Slightly	•••			vo., ao	VHS		DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
_		weathered						Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	Mois	sture			2110	high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes
			D D	ry M Moist	W V	Vet		3		g

Total Depth:

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Engineering Log - Borehole

Borehole No.: BH19

Page: 1 of 1

Job Number: GE18/144

Easting: 555396.00

Drilling Rig: Jeyhco Digga

Client: Wood & Grieve Engineers

Northing: 6873218.00 RL:

17.10 3.00 Driller: Morrison Geotechnic

Project: Geotechnical Invest - Tweed Valley Hospital

Logged By: C. Lam Location: Cudgen Road, Kingscliff Date: 08.03.2018

		ing Info	rmation				Material	Description						Tes	st San	nples				
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Do	escription		Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result				
th TC Bit		17.0	0.1 -	Residual Slopewash		CH CH	sand, moist Silty CLAY:	I brown, fine to medium gi , red brown, trace of fine t oist	/		M M	H VSt	2 6 4 4 6 5 10 6 10	0.5 -}	– U50	– PP=350kPa				
100mm Solid Flight Auger with TC Bit		16.0 15.0	1.1 -			СН	Silty CLAY: As above but brown and gravel Silty CLAY: As above but brown mol	d some fine to medium siz	red		M	VSt VSt VLS								
		14.0	3.0	Rock	V A A V A V	BAS	BASALT: Very low strength, extret grey, some low to medit			xw		VLS								
		13.0	4.0																	
		12.0	5.0																	
Wa	Comments: Authorised by:																			
-	_ Wa	date snown	DW Disti wear	thered htly thered	St S VSt V H H		MD Medium dense D Dense VD Very dense	VLS Very low LS Low MS Medium HS High VHS Very high EHS Extremely high	SPT Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm. Hand penetrometer estimate of unconfined compressive strength, kPa. S Vane shear value kPa DC Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg taper cone fitted to rods of smaller section.											

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Engineering Log - Borehole Borehole No.: BH20

Page: 1 of 1

Job Number: GE18/144

Easting: 555434.90 Northing: 6873158.70

Drilling Rig: Jeyhco Digga

Driller: Morrison Geotechnic

Client: Wood & Grieve Engineers

RL: 21.10 Logged By: C. Lam Project: Geotechnical Invest - Tweed Valley Hospital

	To	RL: tal Depth:			LC		e: 08.03.2018	Loca	ion: (Cudger	n Road, I	Kingscliff		
	Drilli	ng Info	rmation				Material Description					Tes	st San	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
100mm Solid Flight Auger with TC Bit			0.1 - 0.5 - 1.0 1 - 1.3 - 2.0 2.5 - 2.6 3.0 4.0 4.0 - 6.0	Rock Residual Slopewas B	V A A A A A A A A A A A A A A A A A A A	CH CH CH SAS	Sandy CLAY: Hard, high plasticity, red brown, fine to medium grained sand, moist Sitty CLAY: Very stiff, high plasticity, red brown, trace of fine to medium sized gravel, moist Sitty CLAY: As above but with fine to coarse sized gravel and some cobbles Sitty CLAY: As above but brown BASALT: Very low strength, extremely weathered, brown mottled grey, some low to medium strength fragments BASALT: As above but low strength 2.60m: MAXIMUM T.C. REFUSAL	XW	M M M	VSt VSt LS	2 3 3 3 3 3 15			

										Authorised by: Date:
Water	Wea	thering	Con	sistency	Den	sity	Rock	Strength	Tests	s & Results
Water level on date shown Water inflow Water outflow	RS XW DW SW	Residual soil Extremely weathered Distinctly weathered Slightly weathered	VS S F St VSt H	Very soft Soft Firm Stiff Very stiff Hard	VL L MD D VD	Very loose Loose Medium dense Dense Very dense	VLS LS MS HS VHS EHS	, ,	U50 D SPT PP S DC	Undisturbed 50mm diam tube. Disturbed sample. Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm. Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg taper cone fitted to rods of smaller section.
	FR	Fresh	Mois D D	sture ry M Moist	wv	Vet	20	high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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Engineering Log - Borehole

Borehole No.: BH21

Page: 1 of 1

Job Number: GE18/144

Easting: 555387.00 **Northing:** 6873134.00

87.00 **Drilling Rig:** Jeyhco Digga

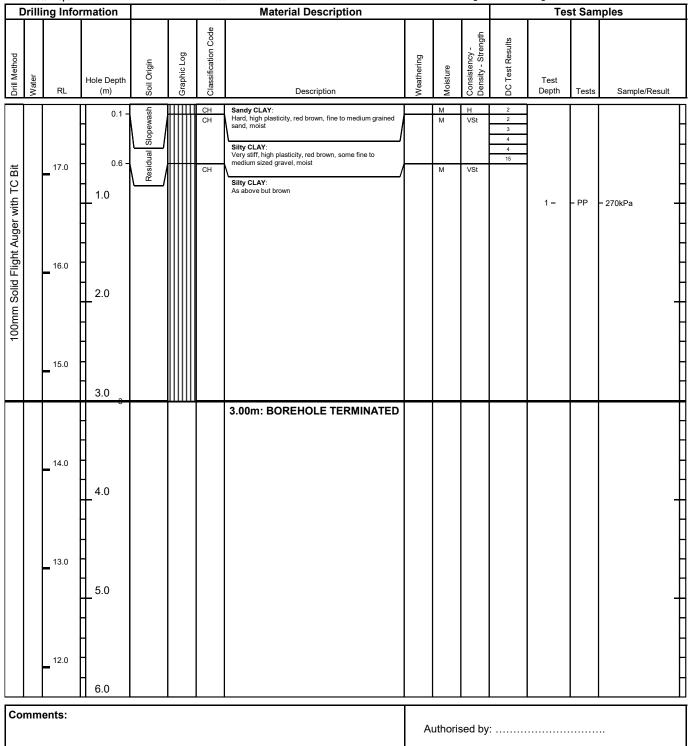
Driller: Morrison Geotechnic

Client: Wood & Grieve Engineers

RL: 17.70
Total Depth: 3.00

Logged By: C. Lam **Date:** 08.03.2018

Project: Geotechnical Invest - Tweed Valley Hospital



Comments:										Authorised by: Date:
Water	Weath	ering	Cons	istency	Den	sity	Rock	Strength	Tests	& Results
Water level on date shown	XW	Residual soil Extremely weathered	VS S F St	Very soft Soft Firm Stiff	VL L MD	Very loose Loose Medium dense	ELS VLS LS	Extremely low Very low Low	U50 D SPT	Undisturbed 50mm diam tube. Disturbed sample. Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
Water inflow Water outflow	DW SW	Distinctly weathered Slightly	VSt H	Very stiff Hard	D VD	Dense Very dense	MS HS VHS	Medium High Very high	PP S DC	Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
•		weathered Fresh	Mois D Dr		w v	Vet	EHS	Extremely high		taper cone fitted to rods of smaller section. From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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RL:

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6.30

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Logged By: C. Lam

Engineering Log - Borehole

Borehole No.: BH22

Page: 1 of 1

Job Number: GE18/144

Easting: 555738.00 Drilling Rig: Jeyhco Digga

Client: Wood & Grieve Engineers 6873607.00 Northing: Driller: Morrison Geotechnic Project: Geotechnical Invest - Tweed Valley Hospital

Location: Cudgen Road, Kingscliff Total Depth: 0.50 Date: 08.03.2018

	l Depth:	mation	0		Date	Material Description			uugen	rtoau, i	Tes	st Sam	nnles
Drill Method Water		Hole Depth	Soil Origin	Graphic Log	Classification Code		Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test		
۵ ۶	RL	(m)		ত		Description	>			ă	Depth	Tests	Sample/Result
00mm Solid Flight Auger with TC Bit	6.0	0.05 –	Residual wash		CH	Sandy CLAY: Stiff, high plasticity, red brown, fine to medium grained sand, trace of fine to medium sized gravel, moist Silty CLAY: Hard, high plasticity, red brown, moist		M	St H		0.3 –	– PP	– 450kPa
_	5.0 4.0	2.0	œ e			0.50m: BOREHOLE TERMINATED FOR PERMEABILITY TEST							
	1.0	5.0											
Commer	nts:												

										Authorised by:
										Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
	RS	Residual	VS	Very soft	VL	Very loose	ELS	Extremely	U50	Undisturbed 50mm diam tube.
Water level		soil	S	Soft	L	Loose		low	D	Disturbed sample.
on date shown	XW	Extremely	F	Firm	MD	Medium	VLS	Very low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler
		weathered	St	Stiff		dense	LS	Low		300mm with a 63.6kg hammer falling 762mm.
► Water inflow	DW	Distinctly	VSt	Very stiff	D	Dense	MS	Medium	PP	Hand penetrometer estimate of unconfined compressive strength, kPa.
.		weathered	Н	Hard	VD	Very dense	HS	High	S	Vane shear value kPa
── Water outflow	SW	Slightly					VHS	Very high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
		weathered	Mois				EHS	Extremely		taper cone fitted to rods of smaller section.
	FR	Fresh	D Di	ry M Moist	W V	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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Engineering Log - Borehole

Borehole No.: BH23 Page: 1 of 1

Job Number: GE18/144

Easting: 555796.00 Northing:

6873615.00

Drilling Rig: Jeyhco Digga

Driller: Morrison Geotechnic

Client: Wood & Grieve Engineers

7.20 RL: Total Depth: 0.50 Logged By: C. Lam Date: 08.03.2018

Project: Geotechnical Invest - Tweed Valley Hospital Location: Cudgen Road, Kingscliff

I		ing Info	rmation				Material Description						st San	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
100mm Solid Flight Auger with		7.0	0.05 -	Slo pew		CH CH	Silty CLAY: Stiff, high plasticity, red brown, trace of fine to medium sand, with organics, moist Silty CLAY: Hard, high plasticity, red brown, moist		M M	St H		0.2 –	- PP	- 450kPa
		6.0	1.0	-			0.50m: BOREHOLE TERMINATED FOR PERMEABILITY TEST							- - - - -
		5.0	2.0											
		4.0	3.0											- - - - -
		3.0	4.0											
		2.0	5.0											
			6.0											

Comments:										Authorised by:
Water	Weat	hering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
Water level on date shown Water inflow	RS XW DW	Residual soil Extremely weathered Distinctly weathered	VS S F St VSt H	Very soft Soft Firm Stiff Very stiff Hard	VL L MD D VD	Very loose Loose Medium dense Dense Very dense	VLS LS MS HS	Extremely low Very low Low Medium	U50 D SPT PP S	Undisturbed 50mm diam tube. Disturbed sample. Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm. Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa
—◀ Water outflow	SW FR	Slightly weathered Fresh	Mois D Dr	ture		,	VHS	High Very high Extremely high	DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg taper cone fitted to rods of smaller section. From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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Engineering Log - Borehole Borehole No.: BH24

Page: 1 of 1

Job Number: GE18/144

Easting: 555467.40 Northing: 6873402.50

RL:

18.30

Drilling Rig: Jeyhco Digga

Driller: Morrison Geotechnic

Logged By: C. Lam Date: 08.03.2018 Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

	To	otal Depth:					e: 08.03.2018 L	ocatio	on: C	udgen	Road, I	Kingscliff		
	Dril	ling Info	rmation				Material Description					Tes	st Sam	ples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
100mm Solid Flight Auger with TC Bit		18.0	0.1 - 0.4 - 0.5 -	sewadols Residual	V A	CH CH BAS	Sandty CLAY: Hard, high plasticity, red brown, fine to medium grained sand, moist Sitty CLAY: Very stiff, high plasticity, red brown, some fine to medium sized gravel, moist BASALT:Very low strength, extremely weathered, grey grown, some low to medium strength fragments	VLS	M	H VSt				
		17.0 16.0	1.0 2.0 3.0 4.0	Rock			0.50m: MAXIMUM T.C. REFUSAL	V2.3						
Co	mn	nents:							uthori					

Comments:										Authorised by: Date:
Water	Weat	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
Water level on date shown	RS XW	Residual soil Extremely	VS S F	Very soft Soft Firm	VL L MD	Very loose Loose Medium	ELS VLS	Extremely low Very low	U50 D SPT	Undisturbed 50mm diam tube. Disturbed sample. Standard Penetration Test, N = number of blows to drive 50mm sampler
Water inflow Water outflow	DW SW	weathered Distinctly weathered Slightly	St VSt H	Stiff Very stiff Hard	D VD	dense Dense Very dense	LS MS HS VHS	Low Medium High Very high	PP S DC	300mm with a 63.6kg hammer falling 762mm. Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg
_	FR	weathered Fresh	Mois D Dr		wv	Vet	EHS	Extremely high		taper cone fitted to rods of smaller section. From AS1289-1993 Methods of Testing Soils for Engineering Purposes

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Engineering Log - Borehole

Borehole No.: BH25

Page: 1 of 5

Job Number: GE18/144

Easting: 555600.30 Northing: 6873495.60

RL:

25.80

Drilling Rig: Hydrapower Scout Driller: Redlands Drilling

Client: Wood & Grieve Engineers Project: Geotechnical Invest - Tweed Valley Hospital

Logged By: L. Bexley Location: Cudgen Road, Kingscliff Date: 03/08/2018 1.55

	То	tal Depth:	1.5				: 03/08/2018 L	.ocatio	on: C	udgen	Road, I	Kingscliff		
	Drill	ing Info	rmation				Material Description					Tes	st San	nples
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Classification Code	Description	Weathering	Moisture	Consistency - Density - Strength	DC Test Results	Test Depth	Tests	Sample/Result
Washbore 100mm Auger with		_ 25.0	1.0	Bedrock	V A	CH BAS	Sitty CLAY: Stiff, high plasticity, red brown, with some fine to coarse sized gravel, cobbles throughout, moist. BASALT: Very low strength, extremely weathered, grey mottled orange brown, with some residual clay lenses. BASALT: As above but medium strength and distinctly weathered.	XW	М	St VLS MS		0.3 -	- PP - SPT	- 150-200kPa
		24.0	2.0				1.55m: COMMENCE NMLC CORING							
		23.0	3.0											
		22.0	4.0											
		21.0	5.0											
		20.0	6.0											

Comments:										Authorised by: Date:
Water	Wea	thering	Cons	sistency	Den	sity	Rock	Strength	Tests	& Results
Water level	RS	Residual soil	VS S	Very soft Soft	VL L	Very loose Loose	ELS	Extremely low	U50 D	Undisturbed 50mm diam tube. Disturbed sample.
on date shown	XW	Extremely weathered	F St	Firm Stiff	MD	Medium dense	VLS LS	Very low Low	SPT	Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
Water inflow	DW	Distinctly weathered	VSt H	Very stiff Hard	D VD	Dense Very dense	MS HS	Medium High	PP S	Hand penetrometer estimate of unconfined compressive strength, kPa. Vane shear value kPa
→ Water outflow	SW	Slightly weathered				,	VHS EHS		DC	Dynamic Cone test, 9.09kg hammer, fall 508mm, driving 20mm, 30 deg taper cone fitted to rods of smaller section.
	FR	Fresh	Mois D D		wv	Vet		high		From AS1289-1993 Methods of Testing Soils for Engineering Purposes

GEOTECHNIC

Easting:

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Phone: (07) 3279 0900 Fax: (07) 3279 0955

Engineering Log - Cored Borehole Borehole No.: BH25

Page: 2 of 5

Job Number: GE18/144

555600.30 Drilling Rig: Hydrapower Scout Client: Wood & Grieve Engineers

Northing: 6873495.60 Driller: Redlands Drilling
RL: 25.80 Logged By: L. Bexley

Project: Geotechnical Invest - Tweed Valley Hospital

Total Depth: 21.30 Date: 03/08/2018 Location: Cudgen Road, Kingscliff

D	rilli	ng Info	ormation	1.30			Material Description			. Oddg		R	lock Mass Defects
							·		Estimated Strength			Defect Spacing	Defect Description
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description	Weathering	Sureingui FR FR FR FR FR FR FR FR FR FR FR FR FR	IS ₍₅₀₎ MPa	RQD %	3000 3000 3000 3000 3000	type, inclination,planarity, roughness, coating, thickness
Ë			(,	0,			2000p	_			_		
NMLC Coring		25.5 25.0 24.5 24.0 23.5 23.0 22.5 22.0 21.5 20.0	0.5 1.0 1.5 2.0 2.18 - 2.5 _{2.47} - 3.0 3.5 4.3 ⁸⁵ - 4.5 5.0 5.1 - 5.5		A V A V A V A V A V A V A V A V A V A V	BAS BAS BAS	Commence NMLC Coring at 1.55m BASALT: Very high strength, slightly weathered to fresh, dark grey with some orange brown staining, moderately fractured. BASALT: As above but high strength and distinctly weathered to slightly weathered. BASALT: As above but very high strength and slightly weathered. BASALT: As above but low strength, extremely weathered, grey mottled orange brown. CORE LOSS BASALT: Very low strength, extremely weathered, grey mottled orange brown, numerous broken zones.	XW SW DW- SW-Fr		9.38	⁻ %09 %0 %0		S5° 50mm some VLS
14	ater			Mes	theri-		Consistency	olt.	Date				Defects
<u> </u>	W or	ater leven date sh date sh ater inflo	own	Wea RS XW DW SW FR	Resid soil Extrer weath Distin weath Slight weath Fresh	mely ered ctly ered ly ered	Consistency Den VS Very soft VL S Soft L F Firm MD St Stiff VSt VSt Very stiff D H Hard VD Moisture D Dry M Moist W Wet	Loc Me der De	dium	VLS LS MS HS VHS	Ext low Ver Low Me Hig	y low v dium h y high remely	Defects Refer to Defect Description Sheet

GEOTECHNIC

Easting:

Northing:

Total Depth:

555600.30

6873495.60

25.80

21.30

Morrison Geotechnic Pty Ltd

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Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Date: 03/08/2018

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH25

Page: 3 of 5

Job Number: GE18/144

Client: Wood & Grieve Engineers

Project: Geotechnical Invest - Tweed Valley Hospital

D	rillir	ng Info	ormation				Material Description						F	Rock Mass Defects
									Estimated				fect icing	Defect Description
_									Strength		1		ıcıng ım)	type, inclination,planarity, roughness,
thod				gi	P	ode		ing					·	coating, thickness
Drill Method	je.		Hole Depth	Soil Origin	Graphic Log	Class. Code		Weathering		ω IS ₍₅₀₎	RQD %		0.0	
Drill	Water	RL	(m)	Soil	Gra	Clas	Description	Wea	ELS VLS VLS HS VHS	MPa	RQI	30 100	868	
ng			Ц		VΛ	BAS	BASALT:	×						П
NMLC Coring		19.5	H		Λ		Very low strength, extremely weathered,	×						I H
∥ ΓC			6.5		ν.		grey mottled orange brown, numerous broken zones.							
Ž			<u> </u>		V V	1								1 1
		19.0	_		Λ									I H
		_	7.0		VΥ									Defects cannot be assessed due to
			+		Λ 7									XW rock
		18.5			V A A V									I H
		-	7.5		VΛ									
			 		Λ						%0			1 +
		18.0			VΛ						0			I
		-	8.0		A V									
			H		ΛV									+
		17.5	Ħ I		VΛ									
			8.5		Λ									l H
			H		VΛ									1 4
		17.0			Λ 7									
		- 17.0	$H_{\alpha\alpha}$		Λ Λ Λ									I H
			9.0		VΛ									1 4
			9.15 –		Δ									I H
		16.5					CORE LOSS							
			9.59.4 -		VΛ	BAS	BASALT:	≷						<u>H</u>
			F I		Λ		Very low strength, extremely weathered,	×						I
		16.0			VΥ		grey mottled orange brown, numerous broken zones.							
			10.0		V V		5151.511 201.661				<u>%</u>			I H
			Ī		ΛΥ						%0			T
		15.5			VΛ									
			10.5		Λ							Ш		I H
			10.6 -		VΥ		BASALT:	┖						1 1
		15.0	H		V A	BAS	As above but low strength and extremely	×						H
			11.0		V V]	Weathered BASALT:	١						
			+		Δ		As above but very high strength and slightly	1						
		14.5	11.15 –		VΛ	BAS	weathered to fresh. BASALT:	\ 			%			–S25° 30mm VLS –J10° PI/Sm,Ct,O
			1 ₁₁ 5 _{5 -}	L	Λ		As above but low strength and extremely	SW-Fr			25%	-		–J10° PI/Sm,Ct,O S15° 30mm VLS
			11.6 -		VΛ	BAS	weathered. BASALT:	√ < ≥						+
		14.0	H '''		VΛ	BAS	As above but very high strength and fresh.	芷						I A
		-	121 0 9 -		Λ 7	D	:BASALT As above but low strength, extremely weathered, numerous broken zones.	\ <u>``</u> \		15.6				
					VΛ	BAS	weautered, numerous proken zones.	I ×		<u> </u>	<u> </u>	Щ		
Co	mm	ents:												
									Aı	uthorised	by:			
									D	ate:				
w	ater			Wea	thering		Consistency De	nsity				ength		Defects
\	_	ater leve	el .	RS	Resid		VS Very soft VL	Vei	ry loose		Ext	remely		Refer to Defect
1-		date sh		xw	soil Extre	melv	S Soft L F Firm MD		ose dium	VI.S	low Vei	y low		Description Sheet
	\^/	ater inflo	NW/		weath	nered	St Stiff	der	nse	LS	Lov	v		
				DW	Distin weath		VSt Very stiff D H Hard VD		nse ry dense	MS HS	Me Hig	dium h		
1-	⋖ W	ater outf	low	sw	Slight	lly		v e1	., 401100	VHS	S Vei	y high		
				FR	weath Fresh		Moisture D Dry M Moist W Wet			EHS	Ext hig	remely	/	
Щ.				1 1	1 1621	'	•				nig			

GEOTECHNIC

Easting:

Northing:

555600.30

6873495.60

FR

Fresh

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH25

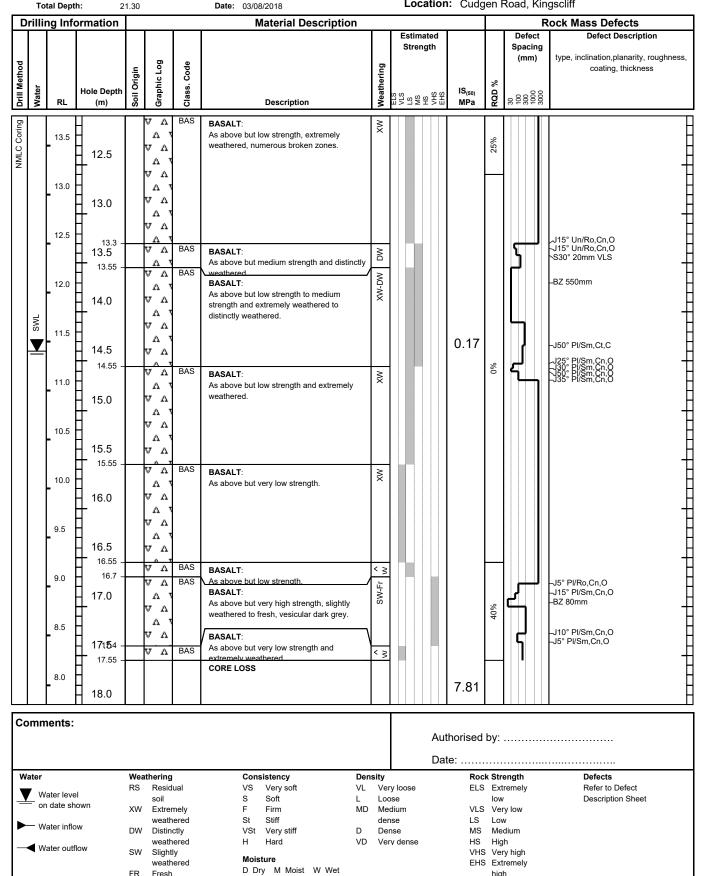
Page: 4 of 5

Job Number: GE18/144

Client: Wood & Grieve Engineers

high

Project: Geotechnical Invest - Tweed Valley Hospital



GEOTECHNIC

Easting:

Northing:

RL:

555600.30

6873495.60

25.80

Morrison Geotechnic Pty Ltd

A.B.N. 051 009 878 899 PO Box 3063, Darra, QLD 4076

Phone: (07) 3279 0900 Fax: (07) 3279 0955

Drilling Rig: Hydrapower Scout

Logged By: L. Bexley

Driller: Redlands Drilling

Engineering Log - Cored Borehole Borehole No.: BH25

Page: 5 of 5

Job Number: GE18/144

Client: Wood & Grieve Engineers

high

Project: Geotechnical Invest - Tweed Valley Hospital

	Total Depth: 21.30 Date: 03/08/2018 Location: Cudgen Road, Kingscliff						gscliff								
D	rilliı	ng Inf	ormation				Material Description					Rock Mass Defects			
Drill Method	Water	RL	Hole Depth (m)	Soil Origin	Graphic Log	Class. Code	Description	Weathering	Estimated Strength Strength SW SN	IS ₍₅₀₎ MPa	RQD %	Defect Spacing (mm) 000 000 000 000 000 000 000 000 000	Defect Description type, inclination,planarity, roughness, coating, thickness		
NMLC Coring		7.5 7.0 6.5 6.0 5.5 5.0 4.0 3.5 2.5	18.15 - 18.5 - 19.0 - 19.2 - 19.5 - 19.6 - 20.0 - 20.05 - 21.0 - 21.5 - 22.0 - 22.5 - 23.0 - 23.5 - 24.0 - 24.0		V A A A A A A A A A A A A A A A A A A A	BAS BAS BAS	CORE LOSS BASALT: Very high strength, slightly weathered, vesicular dark grey. CORE LOSS BASALT: Very high strength, slightly weathered to fresh, vesicular dark grey. BASALT: As above but low strength and extremely weathered. BASALT: As above but very high strength and slightly weathered. 21.30m: BOREHOLE TERMINATED	SW XW SW-Fr		7.87 6.42	32% 21%		-J10° PI/Ro,Cn,O -J15° PI/Ro,Cn,O -J15° PI/Sm,St,O -J5° Un/Ro,Cn,O -BZ -BZ -BZ -BZ -BZ -BZ -BZ -BZ		
		ents:								ıte:					
<u></u>	- or - w	ater leven date shater infloater out	nown	RS XW DW	weath	mely nered actly nered	Consistency	Loc Me der De	ry loose ose dium nse nse ry dense	VLS LS MS HS VHS	low Ve Low Me Hig Ve	ry low v dium	Defects Refer to Defect Description Sheet		

D Dry M Moist W Wet

FR Fresh

CLIENT: WOOD AND GRIEVE ENGINEERS PTY LTD

PROJECT: GEOTECHNICAL INVESTIGATION

- TWEED VALLEY HOSPITAL

LOCATION: CUDGEN ROAD, KINGSCLIFF

JOB NUMBER: GE18/144 BOREHOLE NUMBER: BH25

BOREHOLE DEPTH: 1.55m TO 21.3m





Discontinuity Description: Refer to AS1726-1993, Table A10.

Discon	unuity bescription. Refer to A
Aniso	tropic Fabric
BED	Bedding
FOL	Foliation
LIN	Mineral lineation
Defec	t Type
LM	Lamination Parting
BP	Bedding Parting
CLV	Cleavage / Foliation Parting
J, Js	Joint, Joints
SZ	Sheared Zone
CZ	Crushed Zone
BZ	Broken Zone
HFZ	Highly Fractured Zone
AZ	Alteration Zone
VN	Vein

Roughne	ss (e.	g. Planar, Sr	nooth is abbreviated PI / Sr	m)	Cla	SS	
			Rough or irregular (Ro)		ī		
Stepped	(Stp)		Smooth (Sm)		- II		
			Slickensided (SI)		II		
			Rough (Ro)		I۷	1	
Undulati	ng (Ur	ո)	Smooth (Sm)		V		
· · ·			Slickensided (SI)		VI		
			Rough (Ro)		VI	ı	
Planar (P	l)		Smooth (Sm)		VIII		
			Slickensided (SI)		IX		
Infilling			•	Ape	rture		
Clean	Cn	No visible	No visible coating or infill				
Stain	St	Surfaces d	Surfaces discoloured by mineral O				
Veneer	Vr	Visible min	Visible mineral or soil infill <1mm Fille				
Coating	Ct	Visible mir	/isible mineral or soil infill >1mm Tigl				

Other	
Cly	Clay
Fe	Iron
Co	Coal
Carb	Carbonaceous
Sinf	Soil Infill Zone
Qz	Quartz
CA	Calcite
Chl	Chlorite
Py	Pyrite
Int	Intersecting
Inc	Incipient
DI	Drilling Induced
Н	Horizontal
V	Vertical

Note: Describe 'Zones' and 'Coatings' in terms of composition and thickness (mm).

Discontinuity Spacing: On the geotechnical borehole log, a graphical representation of defect spacing Vs depth is shown. This representation takes into account all the natural rock defects occurring within a given depth interval, excluding breaks induced by the drilling / handling of core. Refer to AS1726-1993, BS5930-1999.

D	efect Spacing		Bedding Thickness (Sedimentary Rock Stratification)				
Spacing/Width (mm)	Descriptor	Symbol	Descriptor	Spacing/Width (mm)			
			Thinly Laminated	< 6			
<20	Extremely Close	EC	Thickly Laminated	6 – 20			
20 – 60	Very Close	VC	Very Thinly Bedded	20 – 60			
60 – 200	Close	С	Thinly Bedded	60 – 200			
200 – 600	Medium	М	Medium Bedded	200 – 600			
600 – 2000	Wide	W	Thickly Bedded	600 – 2000			
2000 - 6000	Very Wide	VW	Very Thickly Bedded	> 2000			
>6000	Extremely Wide	EW					

Defect Spacing in 3D								
Term	Description							
Blocky	Equidimensional							
Tabular	Thickness much less than length or width							
Columnar	Height much greater than cross section							

Defect Persistence
(areal extent)
trace length of defect given in metres

Symbols: The list below provides an explanation of terms and symbols used on the geotechnical borehole, test pit and penetrometer logs.

		Test Resul	lts		Test Symbols
PI	Plasticity Index	c'	Effective Cohesion	DCP	Dynamic Cone Penetrometer
LL	Liquid Limit	Cu	Undrained Cohesion	SPT	Standard Penetration Test
LI	Liquidity Index	C'R	Residual Cohesion	CPTu	Cone Penetrometer (Piezocone) Test
DD	Dry Density	φ′	Effective Angle of Internal Friction	PANDA	Variable Energy DCP
WD	Wet Density	фи	Undrained Angle of Internal Friction	PP	Pocket Penetrometer Test
LS	Linear Shrinkage	φ' _R	Residual Angle of Internal Friction	U50	Undisturbed Sample 50 mm diameter
MC	Moisture Content	Cv	Coefficient of Consolidation	U100	Undisturbed Sample 100mm diameter
ОС	Organic Content	m _v	Coefficient of Volume Compressibility	UCS	Uniaxial Compressive Strength
WPI	Weighted Plasticity Index	Caz	Coefficient of Secondary Compression	Pm	Pressuremeter
WLS	Weighted Linear Shrinkage	e	Voids Ratio	FSV	Field Shear Vane
DoS	Degree of Saturation	φ′~	Constant Volume Friction Angle	DST	Direct Shear Test
APD	Apparent Particle Density	qt/qc	Piezocone Resistance (Tip / Sleave)	PR	Penetration Rate
Su	Undrained Shear Strength	q _d	PANDA Cone Resistance	Α	Point Load Test (axial)
qu	Unconfined Compressive Strength	/ _{s(50)}	Point Load Strength Index	D	Point Load Test (diametral)
R	Total Core Recovery	RQD	Rock Quality Designation	L	Point Load Test (irregular lump)

Groundwater Symbols:

APPENDIX 'C'

LABORATORY TEST CERTIFICATES









Unit 1, 5 Brendan Drive (PO Box 2011), Nerang Q 4211... (07) 5596 1599 F (07) 5527 2027 ABN 51 009 878 899

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Quality of Materials Report

Client: **WOOD & GRIEVE ENGINEERS** Report Number: GE18-144.1/1

Address:

GEOTECHNICAL INVESTIGATION Project Name:

Project Number: GE18/144

Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF

Report Date: 15/08/2018

Order Number:

Test Method: AS1289.3.6.1

Page 1 of 1

Sample Number: 245179

Sampling Method:

Sampled By: LEIGH BEXLEY Date Sampled: 3/08/2018 Date Tested: 13/08/2018

Material Type : DISTURBED SAMPLE

Material Source : INSITU

Remarks ·

SAMPLE	LOCATION	

вн з 1.5 - 2.5

DISTURBED

SAMPLE

Test Number: Lot Number:

Specification Number:

Remarks :							Specificat	ion Number :				
AS Sieve Size(mm)	Percent Passing	Specification Limits										
100			100	FINE SAND	SAND MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL MEDUM GRAVEL	COARSE GRA	VEL	COBBLES	
75.0												
63.0			90					p/				
53.0			80									
37.5												
26.5	100		70								+	
19.0	96		3				+					
16.0			Percent Passing(%)									
13.2	88		Pass									
9.5	80		rcent									
6.7	75		[⊕] 40									
4.75	71		30									
2.36	66											
1.18	63		20									
0.600	60		10									
0.425	58		10									
0.300	56		0 =	Ę	E E E	90 mm	2 mm	0 0 mm 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	mm 0 0	Ę	76 mm	£ £
0.150	52		mm 870.0	0.160 mm	0.200 mm- 0.300 mm- 0.425 mm-	0.600 mm.	"	*	10.0 mm	8	Ž.	200 200
0.075	50						AS Sieve Size	e(mm)				
				Test Me	thod	Results						
Liquid Limit (9	%):			AS1289.	3.1.2	47	Shrinkage	e Comments :	crack	ing an	nd curlin	g
Plastic Limit (%):			AS1289.	3.2.1	33	Mould Ler	ngth (mm) :	250.4			
Plasticity Inde	x (%):			AS1289.	3.3.1	14	Sample H	istory				

8.5



Soil Description:

Linear Shrinkage (%):

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AS1289.3.4.1

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ABN 51 009 878 899

Specification Number:

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Quality of Materials Report

Client: WOOD & GRIEVE ENGINEERS Report Number: GE18-144.2/1

Address: Report Date: 15/08/2018

Project Name : GEOTECHNICAL INVESTIGATION Order Number :

Project Number: GE18/144 Test Method: AS1289.3.6.1
Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF Page 1 of 1

Sample Number: 245181 SAMPLE LOCATION

Sampling Method: - BH 7

 Sampled By :
 LEIGH BEXLEY
 0.1 - 0.5

 Date Sampled :
 3/08/2018
 DISTURBED

 Date Tested :
 13/08/2018
 SAMPLE

Material Type: DISTURBED Test Number:

Material Source: INSITU Lot Number:

Material Source : INSTIU

Remarks:

Kelliaiks .)	pecification	JII IN	ullibei	•					
AS Sieve Size(mm)	Percent Passing	Specification Limits																
100			100-	FINE SAND		SAND MEDIUM SAND		OARSE SAND		FINE GRAVEL		GRA\ MEDIUM G	EL RAVEL	COARSE	RAVEL		COBBLES	
75.0									+		7	Ĭ						
63.0			90)												Н		
53.0			80															
37.5			80															
26.5			70													Н		-
19.0																		
16.0			Percent Passing(%)															
13.2	100		Passi S													Ш		
9.5	99		cent															
6.7	99		₫ 40													Н		
4.75	99		30-													Ш		
2.36	98																	
1.18	97		20													H		
0.600	95		10															
0.425	94		10															
0.300	92		0		g g	g g	Ę	E	Ę	£ £	Ę	Ę			Ē	F F		E E
0.150	89		m 920 0		0.160 mm 0.200 mm	0.300 mm 0.425 mm	0.000 mm	1.18 mm	2 33	2 28 28 28 28 28 28 28 28 28 28 28 28 28	E e	E E 0	000		95 95 95 95 95 95 95 95 95 95 95 95 95 9	75 mm		200
0.075	88									AS Sieve Size	(mm)							
				Test	Metho	bd	R	esults										
Liquid Limit (%	6):			AS12	89.3.	1.2		42	S	hrinkage	Com	ment	s :	crac	king a	and	curlin	g
Plastic Limit (%):			AS12	89.3.	2.1		27	M	lould Len	gth (mm)		250.	1			
Plasticity Inde	x (%):			AS12	89.3.	3.1		15	S	ample His	story	,	•					
Linear Shrinka	ge (%) :			AS12	89.3.	4.1		10										
Soil Descriptio	n:																	



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ABN 51 009 878 899

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Quality of Materials Report

Client: WOOD & GRIEVE ENGINEERS Report Number: GE18-144.3/1

Address: Report Date: 15/08/2018

Project Name : GEOTECHNICAL INVESTIGATION Order Number :

Project Number: GE18/144 Test Method: AS1289.3.6.1
Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF Page 1 of 1

Sample Number: 245183 SAMPLE LOCATION
Sampling Method: - BH 10

 Sampled By :
 LEIGH BEXLEY

 Date Sampled :
 3/08/2018

 BULK

Date Tested : 13/08/2018 SAMPLE

Material Type: BULK SAMPLE Test Number:

Material Source: INSITU Lot Number:

Dama adva

Remarks :			Specification Number :
AS Sieve	Percent	Specification	
Size(mm)	Passing	Limits	

Size(mm)	Passing	Limits													
100			100	FINE SAND	SAND MEDIUM SAND	CI	DARSE SAND	FINE GRAVEL	М	GRAVEL DIUM GRAVEL	COARSE	GRAVEL		COBBLES	
75.0			100												
63.0			90			-		Ĭ							
53.0			1 [
37.5			80												
26.5			70										H		
19.0															
16.0			% 60 60												
13.2	100		Passi 05										Н		
9.5	99		Percent Passing(%)												
6.7	97		₫ 40												
4.75	96		30												
2.36	94														
1.18	93		20												\vdash
0.600	92		10												
0.425	91		10												
0.300	90		0 =	E	£ £	E	ш ш	E E	E	E	E	Ę Ę	E E		u.
0.150	88		0.075 mm	0.160 mm	00000	0.600 mm	1.18 mm. 2 mm.	2.30 mm 4.75 mm	.mm 6	E E E		97.5 mm	90 % E E E		160 mm
0.075	87							AS Sieve Size(n	nm)						

0.075	87			7.00 0.010 0.000()	
		Test Method	Results		
Liquid Limit (%	%) :	AS1289.3.1.2	46	Shrinkage Comments :	cracking and curling
Plastic Limit (%):	AS1289.3.2.1	29	Mould Length (mm) :	250.1
Plasticity Inde	x (%):	AS1289.3.3.1	17	Sample History	
Linear Shrinka	ıge (%) :	AS1289.3.4.1	12		

Soil Description :

NATA
WORLD RECOGNISED
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ABN 51 009 878 899

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Quality of Materials Report

Client : WOOD & GRIEVE ENGINEERS Report Number:

Address :

Project Name:

GEOTECHNICAL INVESTIGATION

Project Number: GE18/144

Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD , KINGSCLIFF

Report Number: **GE18-144.4/1**Report Date : **15/08/2018**

Order Number:

Test Method: AS1289.3.6.1

Page 1 of 1

Sample Number: 245185

Sampling Method :

Sampled By:

Date Sampled: 3/08/2018

Date Tested: 13/08/2018

Material Type: BULK SAMPLE

Material Source: INSITU

SAMPLE LOCATION

BH 17 0.3 - 1.0

BULK SAMPLE

Test Number :

Lot Number :

Material Source	e:	INSITU				Lot Number	·:			
Remarks :						Specificatio	n Number :			
AS Sieve Size(mm)	Percent Passing	Specification Limits								
100			100 FINE	SAND MEDIUM SAND	COARSE SAND	FINE GRAVEL	GRAVEL MEDIUM GRAVEL	COARSE GRAVEL	COI	DBBLES
75.0										
63.0			90							
53.0			80							
37.5										
26.5			70							
19.0										
16.0			Percent Passing(%)							
13.2	100		Lass 50							
9.5	99		rcent							
6.7	99		₫ 40							
4.75	97		30							
2.36	87									
1.18	77		20							
0.600	65		10							
0.425	59		10							
0.300	52		0	WW WW WW 959	E E	2 mm 38 mm 75 mm	mm mm mm	Ę	8 % EE EE EE	Ę Ę
0.150	41		0.076 mm	0.160 mm - 0.300 mm - 0.426 mm	0.600 mm	2.30 mm- 4.76 mm-		97.6 mm	8 %	180
0.075	36					AS Sieve Size(m	m)			
			Te	est Method	Results					
Liquid Limit (%	b):		AS	1289.3.1.2	40	Shrinkage (Comments :	cracking	and cu	rling
Plastic Limit (%	%):		AS	1289.3.2.1	32	Mould Leng	th (mm) :	250.4		
Plasticity Index	· (%):		AS	1289.3.3.1	8	Sample Hist	ory			
Linear Shrinka	ge (%) :		AS	1289.3.4.1	5.5					
Soil Description	n :									



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ABN 51 009 878 899

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15/08/2018

Shrink Swell Index Report

Client: WOOD & GRIEVE ENGINEERS Report Number: GE18-144.5/1

Address: Report Date:
Project Name: GEOTECHNICAL INVESTIGATION Order Number:

Project Number: GE18/144 Test Method: AS1289.7.1.1

Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD , KINGSCLIFF Page 1 of 1

Sample Number :	245178	245180	245184	245186
Test Number :				
Sampling Method :	-	-	-	-
Sampled By :	LEIGH BEXLEY	LEIGH BEXLEY	LEIGH BEXLEY	LEIGH BEXLEY
Date Sampled :	3/08/2018	3/08/2018	3/08/2018	3/08/2018
Date Tested :	7/08/2018	7/08/2018	7/08/2018	7/08/2018
Material Type :	UNDISTURBED SAMPLE	UNDISTURBED SAMPLE	UNDISTURBED SAMPLE	UNDISTURBED SAMPLE
Material Source :	INSITU	INSITU	INSITU	INSITU
Sample Location :	BH 2	BH 4	BH 12	BH 18
	0.15 - 0.24	0.1 - 0.29	0.5 - 0.76	0.5 - 0.7
	U50	U50	U50	U50
Inert Material Estimate (%) :	0	0	0	0
PP before (kPa) :				
PP after (kPa) :				
Shrinkage Moisture Content (%) :	28.6	28	33.6	37
Shrinkage (%) :	2.3	2.5	2.2	6.3
Swell Moisture Content Before (%) :	29.3	27.2	34.9	32.4
Swell Moisture Content After (%) :	31.4	30.6	37.1	37.7
Swell (%):	0	0	0	0
Unit Weight (t/m³) :	1.69	1.62	1.83	1.76
Shrink Swell Index Iss (%):	1.3	1.4	1.2	3.5
Visual Classification :	Silty Clay - Brown			
Cracking:	Y	Υ	Υ	Υ
Crumbling:	Y	Y	Υ	Y
Remarks :		1	<u>l</u>	I.

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ABN 51 009 878 899

Order Number:

BH 8

0.1 - 1.1 BULK

SAMPLE

Lot Number :

Test Number:

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California Bearing Ratio Report (1 Point)

Client: WOOD & GRIEVE ENGINEERS Report Number: GE18-144.6/1

Address:

Project Number: GE18/144

Project Name : GEOTECHNICAL INVESTIGATION

Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD , KINGSCLIFF

Report Namber. GE16-144.0/1

Report Date : 15/08/2018

Test Method : AS1289.6.1.1 Page 1 of 1

SAMPLE LOCATION

Sample Number: 245182

Date Sampled: 3/08/2018

Date Tested: 10/08/2018

Sampled By: LEIGH BEXLEY

Sampling Method : -

Material Source : INSITU

Material Type: BULK SAMPLE

Remarks:

Moisture Method :	AS 1289.2.1.1	CSR 1 Part Graph Forus in Particulation
Maximum Dry Density (t/m³) :	1.579	3/0
Optimum Moisture Content (%):	25.5	2300
Compactive Effort :	Standard	2700
Nominated Percentage of MDD :	100	290
Nominated Percentage of OMC :	100	238
Achieved Percentage of MDD :	99	2,100
Achieved Percentage of OMC :	100.0	190
Dry Density Before Soak (t/m³) :	1.571	
Dry Density After Soak (t/m³) :	1.568	0 1500 0 1.100
Moisture Content Before Soak (%) :	25.6	
Moisture Content After Soak (%) :	29.0	100
Density Ratio After Soak (%):	99	
Field Moisture Content (%):	28.0	
Top Moisture Content - After Penetration (%):	29.9	50
Total Moisture Content - After Penetration (%):	27.0	46 A
Soak Condition :	Soaked	200
Soak Period (days) :	4	85 1 15 2 25 3 35 4 45 5 55 6 85 7 75 10 125 Restriction (mi)
Swell (%):	0.0	-
CBR Surcharge (kg) :	4.5	CBR 2.5mm (%): 12
Oversize (%):		CBR 5.0mm (%): 10
Oversize Material Replaced (%):		CBR Value (%): 12
	•	
Site Selection :		



Soil Description:

Accredited for compliance with ISO/IEC 17025 - Testing.

APPROVED SIGNATORY

IAN MASMAN - MANAGER NATA Accreditation Number : 1169

Document Code RFO39-12



Unit 1, 5 Brendan Drive (PO Box 2011), Nerang Q 4211 P (07) 5596 1599 F (07) 5527 2027

ABN 51 009 878 899

Report Date:

1.0 - 1.5 BULK

SAMPLE

Lot Number :

Test Number:

www.morrisongeo.com.au

15/08/2018

California Bearing Ratio Report (1 Point)

Client: WOOD & GRIEVE ENGINEERS Report Number: GE18-144.7/1

Address:

Project Number: GE18/144

Project Name : GEOTECHNICAL INVESTIGATION

Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD , KINGSCLIFF

Order Number :
Test Method : AS1289.6.1.1

Page 1 of 1

Sample Number: 245183 SAMPLE LOCATION

Date Sampled: 3/08/2018 BH 10

Date Sampled: 3/08/2018

Date Tested: 10/08/2018

Sampled By: LEIGH BEXLEY

Sampling Method : -

Material Source : INSITU

Material Type: BULK SAMPLE

Remarks:

Moisture Method :	AS 1289.2.1.1	CSR 1-Part Graph Force is Pertilation
Maximum Dry Density (t/m³) :	1.358	1380
Optimum Moisture Content (%):	36.7	178
Compactive Effort :	Standard	1500
Nominated Percentage of MDD :	100	150
Nominated Percentage of OMC :	100	138
Achieved Percentage of MDD :	100	128
Achieved Percentage of OMC :	100.0	198
Dry Density Before Soak (t/m³) :	1.358	(2 so
Dry Density After Soak (t/m³) :	1.359	20 00
Moisture Content Before Soak (%):	36.7	80 80 80 80 80 80 80 80 80 80 80 80 80 8
Moisture Content After Soak (%) :	38.0	
Density Ratio After Soak (%):	100	55
Field Moisture Content (%):	38.2	
Top Moisture Content - After Penetration (%):	38.5	250
Total Moisture Content - After Penetration (%):	36.6	
Soak Condition :	Soaked	59
Soak Period (days) :	4	65 1 15 2 25 3 35 4 45 5 55 6 65 7 75 10 125 Pediatri from
Swell (%):	0.0	
CBR Surcharge (kg) :	4.5	CBR 2.5mm (%) : 6
Oversize (%):		CBR 5.0mm (%) : 6
Oversize Material Replaced (%):		CBR Value (%): 6



Site Selection :
Soil Description :

Accredited for compliance with ISO/IEC 17025 - Testing.

APPROVED SIGNATORY

IAN MASMAN - MANAGER NATA Accreditation Number : 1169

Document Code RFO39-12



Unit 1, 5 Brendan Drive (PO Box 2011), Nerang Q 4211, P (07) 5596 1599 F (07) 5527 2027 ABN 51 009 878 899

BH 17

0.3 - 1.0 BULK

SAMPLE

Lot Number:

Test Number:

www.morrisongeo.com.au

California Bearing Ratio Report (1 Point)

WOOD & GRIEVE ENGINEERS Client : Report Number: GE18-144.8/1

Address:

Project Number: GE18/144

Project Name: **GEOTECHNICAL INVESTIGATION**

Location: TWEED VALLEY HOSPITAL, CUDGEN ROAD, KINGSCLIFF

Report Date: 15/08/2018

Order Number: Test Method: AS1289.6.1.1

SAMPLE LOCATION

Page 1 of 1

Sample Number : 245185

Date Sampled: 3/08/2018 Date Tested: 10/08/2018 Sampled By: LEIGH BEXLEY

Sampling Method:

Material Source: INSITU

Material Type: **BULK SAMPLE**

Remarks:

Moisture Method :	AS 1289.2.1.1
Maximum Dry Density (t/m³) :	1.401
Optimum Moisture Content (%) :	34.8
Compactive Effort :	Standard
Nominated Percentage of MDD :	100
Nominated Percentage of OMC :	100
Achieved Percentage of MDD :	99
Achieved Percentage of OMC :	100.0
Dry Density Before Soak (t/m³) :	1.393
Dry Density After Soak (t/m³) :	1.395
Moisture Content Before Soak (%):	34.7
Moisture Content After Soak (%):	34.0
Density Ratio After Soak (%):	100
Field Moisture Content (%):	33.5
Top Moisture Content - After Penetration (%): Total Moisture Content - After	37.5
Total Moisture Content - After Penetration (%):	32.7
Soak Condition :	Soaked
Soak Period (days) :	4
Swell (%):	0.0
CBR Surcharge (kg) :	4.5
Oversize (%):	
Oversize Material Replaced (%):	



Soil Description:

Accredited for compliance with ISO/IEC 17025 - Testing.

APPROVED SIGNATORY

IAN MASMAN - MANAGER NATA Accreditation Number:

1169 Document Code RFO39-12



	_	POINT	LOAD	ILS	i Ni		<u> </u>		
Client:		Wood & Griev	ve Engineers			Report No:	GE18/1	44.1	
Client Address:	Leve	I 2, 232 St Pauls Terrace	, Fortitude Valle	y QLD 4006		Report Date:	08.07.18		
lob No:		GE18	3/144			Sample Date:	03.08	.18	
Project:	Geotec	hnical Investigation - Pr	oposed Tweed V	alley Hospi	tal	Order No:			
ocation:		Lot 102 on DP870722, C	udgen Road, Kin	gscliff		Test Method:	AS4133	3 4.1	
								Page 1 of 1	
Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Terr	
634	08.07.2018	Borehole BH1	2.00	Core	7.95	7.84	Diametral	VH	
635	08.07.2018	Borehole BH1	3.40	Core	0.98	0.98	Diametral	M - H	
636	08.07.2018	Borehole BH1	5.30	Core	6.17	6.01	Diametral	[#] ∨H	
637	08.07.2018	Borehole BH1	6.20	Core	11.30	10.78	Diametral	EH	
638	08.07.2018	Borehole BH1	7.20	Core	9.75	9.40	Diametral	VH	
639	08.07.2018	Borehole BH1	10.00	Core	0.63	0.63	Diametral	М	
640	08.07.2018	Borehole BH1	14.60	Core	8.18	8.03	Diametral	VH	
641	08.07.2018	Borehole BH1	16.30	Core	10.10	10.00	Diametral	VH - EH	
642	08.07.2018	Borehole BH1	17.20	Core	8.96	8.63	Diametral	VH	

Remarks:

Samples are Basalt which are slightly weathered to fresh (SW-Fr).

*EL: Extremely Low, VL: Very Low, L: Low, M: Medium, H: High, VH: Very High, EH: Extremely High





Accredited for compliance with ISO/IEC 17025.

Approved Signatory

Form Number

Liam McDowall - Laboratory Manager
(Brisbane)

NATA Accreditation Number

1162 / 1169

Form Number

Form Number

[#] Denotes sample failed along defect plane



Client:		Wood & Griev	ve Engineers			Report No:	GE18/1	44.2
Client Address:	Level	2, 232 St Pauls Terrace	, Fortitude Valle	y QLD 4006		Report Date:	08.08.	18
Job No:		GE18	3/144			Sample Date:	01.08.	08
Project:	Geotech	nnical Investigation - Pr	oposed Tweed V	alley Hospi	tal	Order No:		
Location:	ı	ot 102 on DP870722, C	udgen Road, Kin	gscliff		Test Method:	AS4133	3 4.1
								Page 1 of 1
Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
643	07.08.2018	Borehole BH2	3.73	Core	9.31	9.14	Diametral	VH
644	07.08.2018	Borehole BH2	4.80	Core	10.43	10.24	Diametral	VH - EH
645	07.08.2018	Borehole BH2	5.55	Core	12.99	12.51	Diametral	EH
646	07.08.2018	Borehole BH2	6.55	Core	11.88	11.55	Diametral	EH
647	07.08.2018	Borehole BH2	8.30	Core	7.59	7.45	Diametral	VH
648	07.08.2018	Borehole BH2	9.25	Core	11.15	10.85	Diametral	EH

Remarks:

Samples are Basalt which are slightly weathered to fresh (SW-Fr).

*EL: Extremely Low, VL: Very Low, L: Low, M: Medium, H: High, VH: Very High, EH: Extremely High





Accredited for compliance with ISO/IEC 17025.

Approved Signatory Form Number Sian A MOODE Liam McDowall - Laboratory Manager (Brisbane) NATA Accreditation Number ER0033 1162 / 1169

[#] Denotes sample failed along defect plane



lient:		Wood & Griev	e Engineers	Report No:	GE18/144.3			
lient Address:	Level	I 2, 232 St Pauls Terrace	, Fortitude Valle	Report Date: Sample Date: Order No: Test Method:	08.08.18 31.07.08			
ob No:		GE18	/144					
roject:	Geotecl	nnical Investigation - Pr	oposed Tweed V					
ocation:	ı	Lot 102 on DP870722, C	udgen Road, Kin		AS4133 4.1			
								Page 1 of 1
Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
649	07.08.2018	Borehole BH4	1.20	Core	8.22	8.22	Diametral	VH
650	07.08.2018	Borehole BH4	3.40	Core	8.53	8.14	Diametral	VH
651	07.08.2018	Borehole BH4	4.95	Core	10.30	10.11	Diametral	VH - EH
652	07.08.2018	Borehole BH4	6.45	Core	12.13	11.80	Diametral	EH
653	07.08.2018	Borehole BH4	6.95	Core	11.97	11.97	Diametral	EH
654	07.08.2018	Borehole BH4	7.90	Core	11.71	11.71	Diametral	EH
655	07.08.2018	Borehole BH4	8.50	Core	14.17	14.04	Diametral	EH
656	07.08.2018	Borehole BH4	9.80	Core	10.39	10.21	Diametral	VH - EH

Remarks:

Samples are Basalt which are slightly weathered to fresh (SW-Fr).

*EL: Extremely Low, VL: Very Low, L: Low, M: Medium, H: High, VH: Very High, EH: Extremely High





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Approved Signatory

Sieu A

Liam McDowall - Laboratory Manager
(Brisbane)

NATA Accreditation Number

1162 / 1169

Form Number

Form Number

[#] Denotes sample failed along defect plane



Client:		Wood & Griev	/e Engineers	Report No:	GE18/144.4			
Client Address:	Leve	l 2, 232 St Pauls Terrace	, Fortitude Valle	Report Date: Sample Date: Order No:	08.08.18 30.07.08			
lob No:		GE18	144					
Project:	Geotec	hnical Investigation - Pr	oposed Tweed V					
ocation:	Lot 102 on DP870722, Cudgen Road, Kingscliff					Test Method:	AS4133 4.1	
								Page 1 of 1
Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
657	06.08.2018	Borehole BH5	1.35	Core	8.26	8.11	Diametral	VH
658	06.08.2018	Borehole BH5	3.35	Core	12.73	12.49	Diametral	EH
659	06.08.2018	Borehole BH5	4.95	Core	5.30	5.30	Axial	VH
660	06.08.2018	Borehole BH5	6.40	Core	9.64	9.46	Diametral	VH

Remarks:

Samples are Basalt which are slightly weathered to fresh (SW-Fr).

*EL: Extremely Low, VL: Very Low, L: Low, M: Medium, H: High, VH: Very High, EH: Extremely High





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Form Number

Liam McDowall - Laboratory Manager
(Brisbane)

NATA Accreditation Number

1162 / 1169

[#] Denotes sample failed along defect plane



lient:		Wood & Griev	ve Engineers	Report No:	GE18/144.5			
lient Address:	Leve	I 2, 232 St Pauls Terrace	e, Fortitude Valle	Report Date: Sample Date: Order No: Test Method:	08.08.18			
ob No:		GE18	3/144		30.07.08			
roject:	Geotecl	hnical Investigation - Pr	oposed Tweed V					
ocation:	ı	Lot 102 on DP870722, C	udgen Road, Kin		AS4133 4.1			
								Page 1 of 1
Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
661	06.08.2018	Borehole BH6	8.40	Core	7.34	7.21	Diametral	VH
662	06.08.2018	Borehole BH6	9.37	Core	11.23	10.92	Diametral	EH
663	06.08.2018	Borehole BH6	12.70	Core	0.29	0.29	Diametral	[#] L-M
664	06.08.2018	Borehole BH6	14.00	Core	0.27	0.27	Diametral	[#] L-M
665	06.08.2018	Borehole BH6	14.45	Core	0.39	0.39	Diametral	*M

Remarks:

Samples are Basalt which are distrinctly weathered to fresh (DW-Fr).

*EL: Extremely Low, VL: Very Low, L: Low, M: Medium, H: High, VH: Very High, EH: Extremely High





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(Brisbane)

NATA Accreditation Number

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Client:		Wood & Griev	e Engineers	Report No:	GE18/144.6			
Client Address:	Leve	I 2, 232 St Pauls Terrace	, Fortitude Valle	Report Date:	08.08.18			
lob No:		GE18	/144	Sample Date:	30.07.08			
Project:	Geotec	hnical Investigation - Pro	oposed Tweed V	Order No:				
ocation:	1	Lot 102 on DP870722, Co	udgen Road, Kir	Test Method: AS4133 4.1		3 4.1		
	-							Page 1 of 1
Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
666	06.08.2018	Borehole BH7	2.20	Core	6.51	6.51	Diametral	VH
667	06.08.2018	Borehole BH7	3.75	Core	2.56	2.56	Diametral	Н
668	06.08.2018	Borehole BH7	6.25	Core	6.48	6.36	Diametral	VH
669	06.08.2018	Borehole BH7	8.95	Core	9.85	9.58	Diametral	VH
670	06.08.2018	Borehole BH7	10.30	Core	10.93	10.83	Diametral	EH
671	06.08.2018	Borehole BH7	13.15	Core	0.15	0.16	Diametral	#L
672	06.08.2018	Borehole BH7	17.65	Core	8.21	8.29	Diametral	VH
673	06.08.2018	Borehole BH7	18.50	Core	10.81	10.91	Diametral	EH
674	06.08.2018	Borehole BH7	18.85	Core	4.95	4.90	Diametral	VH

Remarks:

Samples are Basalt which are distinctly weathered to fresh (DW-Fr).

*EL: Extremely Low, VL: Very Low, L: Low, M: Medium, H: High, VH: Very High, EH: Extremely High





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Approved Signatory

Sieu A

Liam McDowall - Laboratory Manager
(Brisbane)

NATA Accreditation Number

1162 / 1169

Form Number

Form Number

[#] Denotes sample failed along defect plane



Brisbane | Gold Coast | Brendale | Maroochy dore
Unit 1, 35 Limestone Street (PO Box 3063), Darra Q 4076 P (07) 3279 0900 F (07) 3279 0955
ABN 51 009 878 899
www.morrisongeo.com.au

		POINT	LOAD	TES	T RI	EPOR ¹	Γ	
Client:	Wood & Grieve Engineers					Report No:	GE18/1	44.7
Client Address:	Lev	rel 2, 232 St Pauls Terrace, l	Fortitude Valle	y QLD 4006		Report Date:	08.08	18
Job No:		GE18/1	44			Sample Date:	03.08	18
Project:	Geote	chnical Investigation - Prop	osed Tweed V	alley Hospi	tal	Order No:		
Location:		Lot 102 on DP870722, Cuc	lgen Road, Kir	gscliff		Test Method:	AS4133	3 4.1
								Page 1 of 1
Sample Number	Date of Test	Location	Depth (m)	Sample Type	Is (MPa)	Is (50) (MPa)	Loading Direction	Descriptive Term
675	06.08.2018	Borehole BH25	1.60	Core	8.82	8.66	Diametral	VH
676	06.08.2018	Borehole BH25	2.90	Core	9.74	9.38	Diametral	VH
677	06.08.2018	Borehole BH25	3.70	Core	10.17	9.80	Diametral	VH
678	06.08.2018	Borehole BH25	11.80	Core	16.36	15.60	Diametral	EH
679	06.08.2018	Borehole BH25	14.35	Core	0.17	0.17	Diametral	L
680	06.08.2018	Borehole BH25	17.80	Core	7.95	7.81	Diametral	VH
681	06.08.2018	Borehole BH25	18.65	Core	1.38	1.37	Diametral	Н
682	06.08.2018	Borehole BH25	19.70	Core	7.95	7.87	Diametral	VH
683	06.08.2018	Borehole BH25	21.20	Core	6.58	6.42	Diametral	VH

Remarks:

Samples are Basalt which are slighlty weathered to fresh (SW-Fr).

*EL: Extremely Low, VL: Very Low, L: Low, M: Medium, H: High, VH: Very High, EH: Extremely High





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Approved Signatory

Sieu A

Liam McDowall - Laboratory Manager
(Brisbane)

NATA Accreditation Number

1162 / 1169

Form Number

Form Number

[#] Denotes sample failed along defect plane

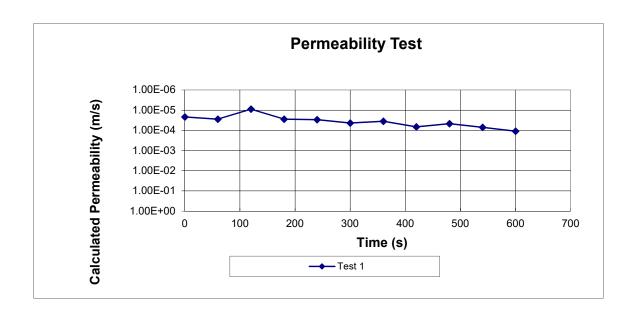
PERMEABILITY - Percolation Test

Project	Tweed Valley Hospital				
Project Number			Date		
Test Location	BH23		Tester	BE	
Depth of Hole		500 mm			
Diameter of Hole		100 mm			
Length of Test Section	on	400 mm			

Date	Time		Depth of water from	Δt	Δd	Permeability
		of test (t) (s)	Reference level (d) (mm)			(P) (m/s)
7/9/17	11:45:00	0	510	0	0	
	11:46:00	60	483	60	27	2.16E-05
	11:47:00	120	450	60	33	2.80E-05
	11:48:00	180	440	60	10	8.87E-06
	11:49:00	240	410	60	30	2.78E-05
	11:50:00	300	380	60	30	2.98E-05
	11:51:00	360	340	60	40	4.33E-05
	11:52:00	420	310	60	30	3.57E-05
	11:53:00	480	260	60	50	6.74E-05
	11:54:00	540	230	60	30	4.63E-05
	11:55:00	600	190	60	40	7.11E-05
	11:56:00	660	140	60	50	1.10E-04
	11:57:00	720	80	60	60	1.88E-04

Time for 25mm	drop	

Permeability (m/s)	5.7E-05
mm/hr	203.5



PERMEABILITY - Percolation Test

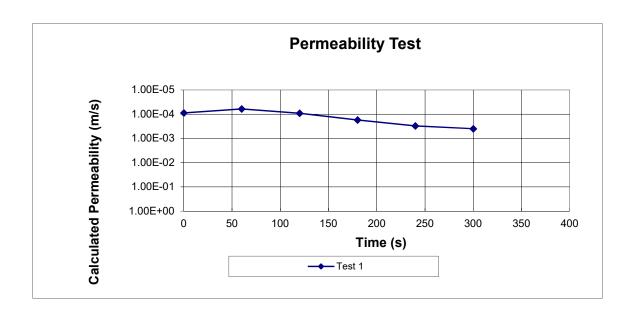
Project	Tweed Valley Hospital				
Project Number			Date		
Test Location	BH24		Tester	BE	
Depth of Hole		500 mm			
Diameter of Hole		100 mm			
Length of Test Section	on	400 mm			

Date	Time	Time since start	Depth of water from	Δt	∆d	Permeability
		of test (t) (s)	Reference level (d) (mm)			(P) (m/s)
7/9/17	12:00:00	0		0	0	, , , ,
	12:01:00	60	270	60	70	8.87E-05
	12:02:00	120	230	60	40	6.07E-05
	12:03:00	180	180	60	50	9.09E-05
	12:04:00	240	110	60	70	1.74E-04
	12:05:00	300	40	60	70	3.05E-04
	12:06:00	360	0	60	40	3.98E-04
	ĺ					

Time for	r 25mm	drop	

 Permeability (m/s)
 1.9E-04

 mm/hr
 670.3



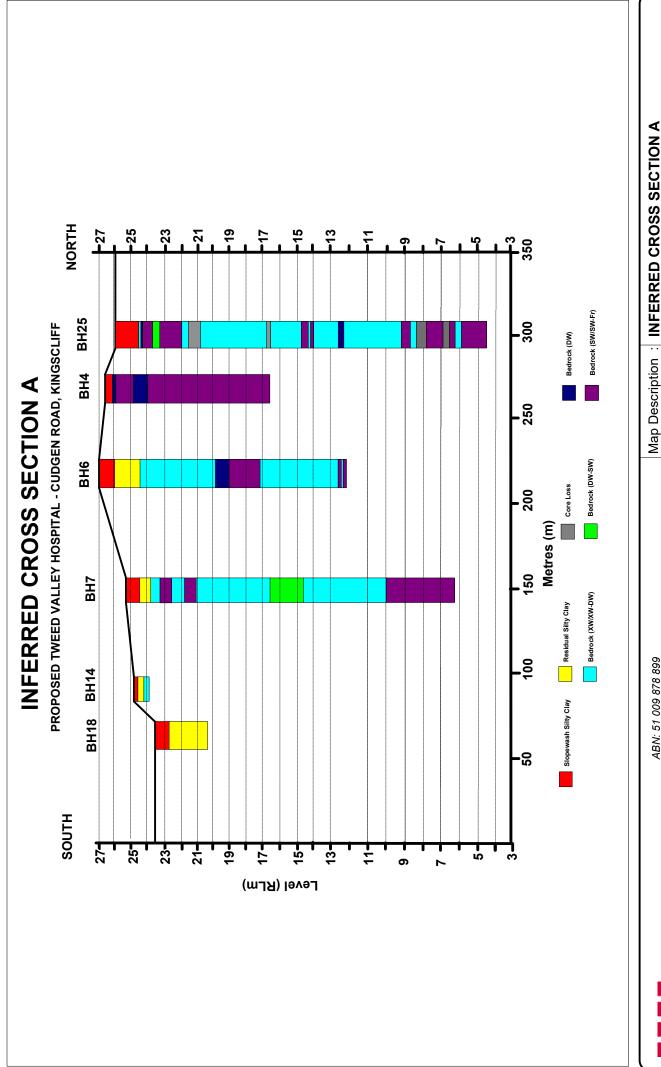
APPENDIX 'D'

CROSS SECTIONS OF BOREHOLES – SECTIONS A, B AND C









Date: 15/08/18 | Scale: Not to Scale TWEED VALLEY HOSPITAL, KINGSCLIFF Client : WOOD & GRIEVE ENGINEERS GE18/144 Project : Project No :

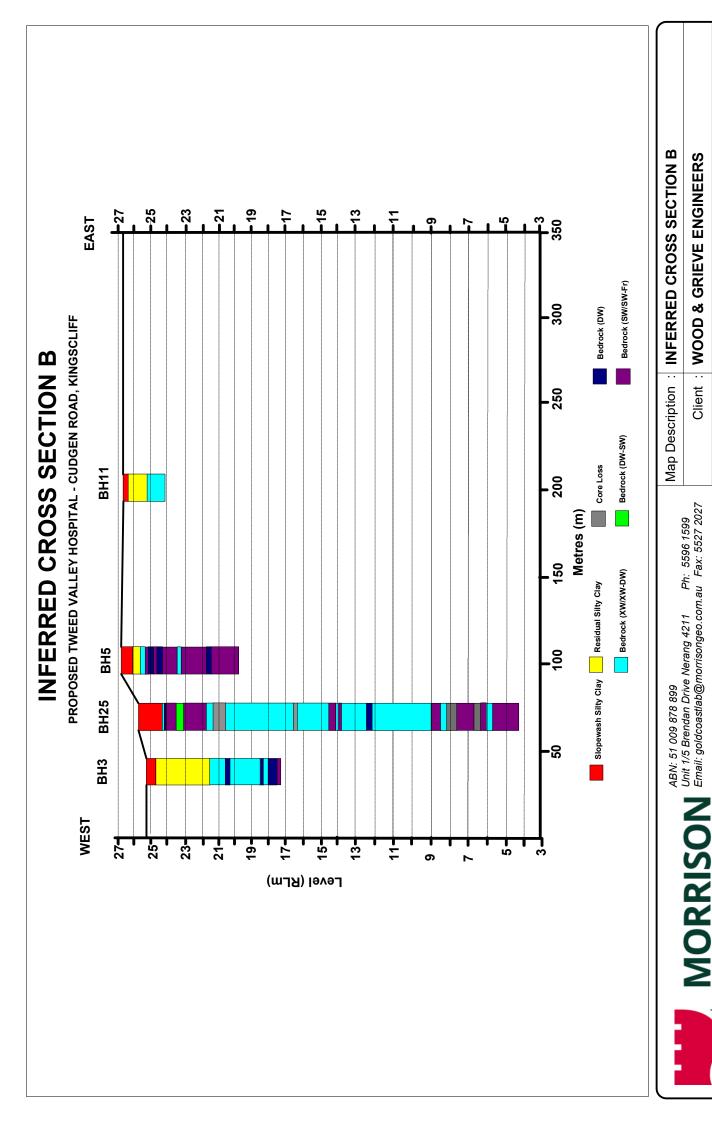


ABN: 51 009 878 899 Unit 1/5 Brendan Drive Nerang 4211 Ph: 5596 1599 Email: goldcoastlab@morrisongeo.com.au Fax: 5527 2027



Engineers: D.Riley, J.Daly, S.Wynne, D.Dragun, B.Taylor D.Vanderhor & B.Elsmore Geologists: L.Bexley & R.Howchin





Date: 15/08/18 | Scale: Not to Scale

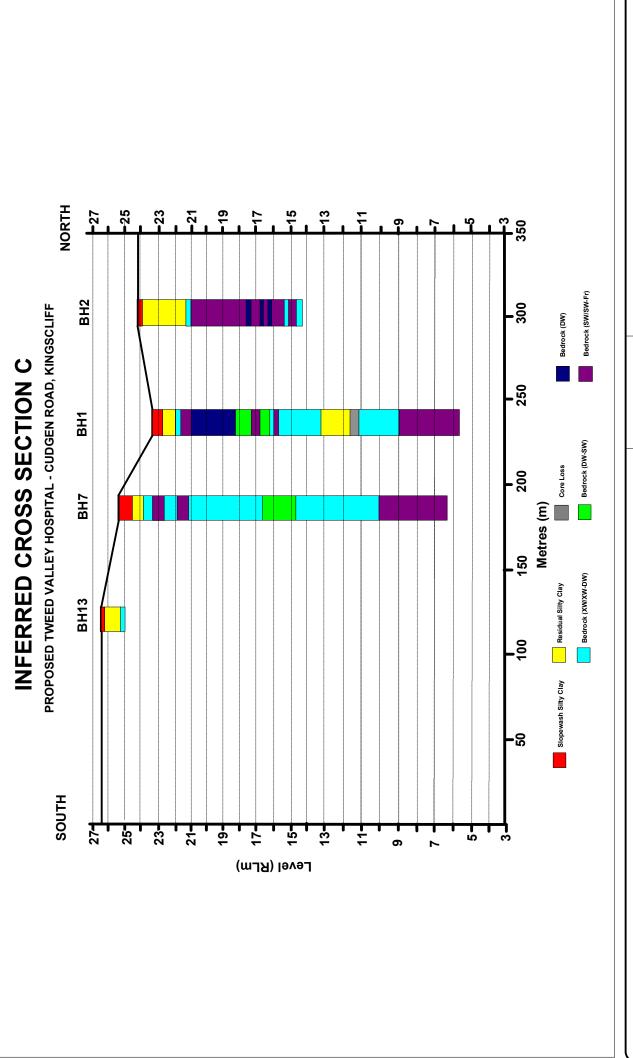
GE18/144

Project No :

Engineers: D.Riley, J.Daly, S.Wynne, D.Dragun, B.Taylor
D.Vanderhor & B.Elsmore

Geologists: L.Bexley & R.Howchin

Project : TWEED VALLEY HOSPITAL, KINGSCLIFF



Map Description : INFERRED CROSS SECTION C

Client : WOOD & GRIEVE ENGINEERS

Project : TWEED VALLEY HOSPITAL, KINGSCLIFF

Project No : GE18/144 | Date: 15/08/18 | Scale : Not to Scale

ABN: 51 009 878 899 Unit 1/5 Brendan Drive Nerang 4211 Ph: 5596 1599 Email: goldcoastlab@morrisongeo.com.au Fax: 5527 2027

Engineers: D.Riley, J.Daly, S.Wynne, D.Dragun, B.Taylor
D.Vanderhor & B.Elsmore

Geologists: L.Bexley & R.Howchin



APPENDIX 'E'

GUIDELINES FOR HILLSIDE CONSTRUCTION







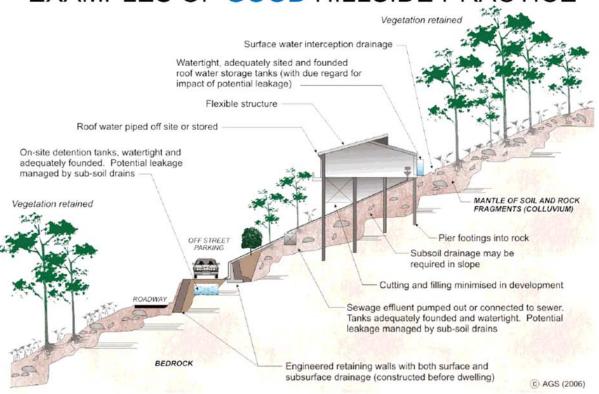
SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

GOOD ENGINEERING PRACTICE

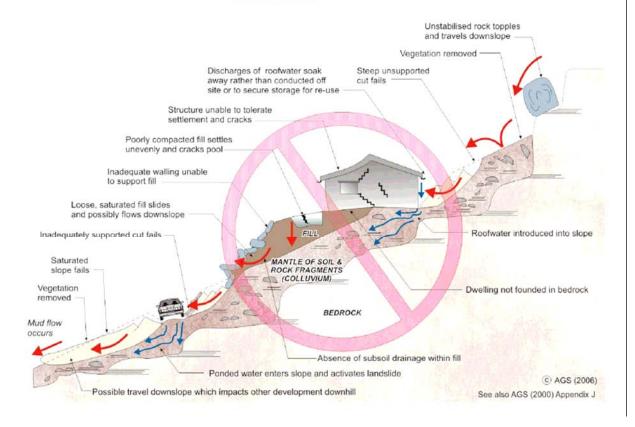
POOR ENGINEERING PRACTICE

	GOOD ENGINEERING PRACTICE	POOR ENGINEERING PRACTICE
ADVICE		
GEOTECHNICAL	Obtain advice from a qualified, experienced geotechnical practitioner at early	Prepare detailed plan and start site works before
ASSESSMENT	stage of planning and before site works.	geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk	Plan development without regard for the Risk.
	arising from the identified hazards and consequences in mind.	
DESIGN AND CON	STRUCTION	
	Use flexible structures which incorporate properly designed brickwork, timber	Floor plans which require extensive cutting and
HOUSE DESIGN	or steel frames, timber or panel cladding.	filling.
HOUSE DESIGN	Consider use of split levels.	Movement intolerant structures.
	Use decks for recreational areas where appropriate.	
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS &	Satisfy requirements below for cuts, fills, retaining walls and drainage.	Excavate and fill for site access before
DRIVEWAYS	Council specifications for grades may need to be modified.	geotechnical advice.
FARTHWORKS	Driveways and parking areas may need to be fully supported on piers.	To the charles are to the control of a
EARTHWORKS	Retain natural contours wherever possible. Minimise depth.	Indiscriminatory bulk earthworks. Large scale cuts and benching.
Cuts	Support with engineered retaining walls or batter to appropriate slope.	Unsupported cuts.
CUIS	Provide drainage measures and erosion control.	Ignore drainage requirements
	Minimise height.	Loose or poorly compacted fill, which if it fails,
	Strip vegetation and topsoil and key into natural slopes prior to filling.	may flow a considerable distance including
	Use clean fill materials and compact to engineering standards.	onto property below.
FILLS	Batter to appropriate slope or support with engineered retaining wall.	Block natural drainage lines.
	Provide surface drainage and appropriate subsurface drainage.	Fill over existing vegetation and topsoil.
		Include stumps, trees, vegetation, topsoil,
		boulders, building rubble etc in fill.
ROCK OUTCROPS	Remove or stabilise boulders which may have unacceptable risk.	Disturb or undercut detached blocks or
& BOULDERS	Support rock faces where necessary.	boulders.
	Engineer design to resist applied soil and water forces. Found on rock where practicable.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced
RETAINING	Provide subsurface drainage within wall backfill and surface drainage on slope	blockwork.
WALLS	above.	Lack of subsurface drains and weepholes.
	Construct wall as soon as possible after cut/fill operation.	Eack of subsurface drains and weepholes.
	Found within rock where practicable.	Found on topsoil, loose fill, detached boulders
FOOTINGS	Use rows of piers or strip footings oriented up and down slope.	or undercut cliffs.
FOOTINGS	Design for lateral creep pressures if necessary.	
	Backfill footing excavations to exclude ingress of surface water.	
	Engineer designed.	
	Support on piers to rock where practicable.	
SWIMMING POOLS	Provide with under-drainage and gravity drain outlet where practicable.	
	Design for high soil pressures which may develop on uphill side whilst there	
DRAINAGE	may be little or no lateral support on downhill side.	
DRAINAGE	Provide at tops of cut and fill slopes.	Discharge at top of fills and cuts.
	Discharge to street drainage or natural water courses.	Allow water to pond on bench areas.
SURFACE	Provide general falls to prevent blockage by siltation and incorporate silt traps.	
	Line to minimise infiltration and make flexible where possible.	
	Special structures to dissipate energy at changes of slope and/or direction.	
	Provide filter around subsurface drain.	Discharge roof runoff into absorption trenches.
SUBSURFACE	Provide drain behind retaining walls.	
Бевбенгиев	Use flexible pipelines with access for maintenance.	
	Prevent inflow of surface water.	District the state of the state
SEPTIC &	Usually requires pump-out or mains sewer systems; absorption trenches may	Discharge sullage directly onto and into slopes.
SULLAGE	be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Use absorption trenches without consideration of landslide risk.
EROSION	Control erosion as this may lead to instability.	Failure to observe earthworks and drainage
CONTROL &	Revegetate cleared area.	recommendations when landscaping.
LANDSCAPING		indications when landscaping.
	ITE VISITS DURING CONSTRUCTION	
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
	MAINTENANCE BY OWNER	
OWNER'S	Clean drainage systems; repair broken joints in drains and leaks in supply	
RESPONSIBILITY	pipes.	
	Where structural distress is evident see advice.	
	If seepage observed, determine causes or seek advice on consequences.	

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE



Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- · not prepared for your project,
- · not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

 the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize* that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geotechnical mental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures*. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else*.

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the express purpose of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveved in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.



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